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Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances (PFAS)

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Acronyms List

°C	Degrees Celsius
µg/L	Micrograms per Liter
%	Percent
%R	Percent Recovery
>	Greater Than
<	Less Than
≤	Less Than or Equal To
AFFF	Aqueous Film Forming Foams
CFR	Code of Federal Regulation
COC	Chain-of-Custody
DoD	Department of Defense
DQI	Data Quality Indicators
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EDF	Electronic Data Format
GPS	Global Positioning System
HDPE	High Density Polyethylene
HNO_3	Nitric Acid
IDW	Investigation Derived Waste
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
mL	Milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ng/g	Nanograms per Gram
ng/L	Nanograms per Liter
oz	Ounce

PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppt	Parts per Trillion
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QC	Quality Control
QSM	Quality Systems Manual
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SM	Standard Methods
SOP	Standard Operating Procedure
TDS	Total Dissolved Solids
USEPA	United State Environmental Protection Agency

1. Introduction

This Sampling and Analysis Plan (SAP) presents the methods and procedures used for this sampling program. The SAP will provide:

- A description of the equipment and method by which representative soil and water samples will be collected to avoid cross-contamination,
- A description of the sampling equipment decontamination procedures to be used (if necessary),
- Sample handling and analytical techniques to be used,
- Name of the laboratory that analyze the samples, qualifications, analyte list, and detection limits,

Table 1 – PFAS Analyte List and Reporting Limits

PFAS Analytes Subject to Analysis	Required RL (Influent) (ng/L)	Required RL (Effluent) (ng/L)	Required RL (Groundwater) (ng/L)	Required RL (Stormwater) (ng/L)	Required RL (Soil) (ng/g)
Perfluorobutanoic acid (PFBA)	80	80	8	8	1
Perfluoropentanoic acid (PFPeA)	50	50	5	5	1
Perfluorohexanoic acid (PFHxA)	50	50	5	5	1
Perfluoroheptanoic acid (PFHpA)	50	50	5	5	1
Perfluorooctanoic acid (PFOA)	50	50	5	5	1
Perfluorononanoic acid (PFNA)	50	50	5	5	1
Perfluorodecanoic acid (PFDA)	50	50	5	5	1
Perfluoroundecanoic acid (PFUnDA)	50	50	5	5	1
Perfluorododecanoic acid (PFDoA)	50	50	5	5	1
Perfluorotridecanoic acid (PFTrDA)	50	50	5	5	1
Perfluorotetradecanoic acid (PFTA)	80	80	8	8	2
Perfluorobutane sulfonic acid (PFBS)	50	50	5	5	1
Perfluoropentane sulfonic acid (PFPeS)	50	50	5	5	1
Perfluorohexane sulfonic acid (PFHxS)	50	50	5	5	1
Perfluoroheptane sulfonic acid (PFHpS)	50	50	5	5	1
Perfluorooctane sulfonic acid (PFOS)	50	50	5	5	1
Perfluorodecane sulfonic acid (PFDS)	50	50	5	5	1
Perfluorooctanesulfonamide (PFOSAm)	80	80	8	8	1
N-Ethyl perfluorooctane sulfonamido ethanol (EtFOSE)	80	80	8	8	2
N-Methyl perfluorooctane sulfonamido ethanol (MeFOSE)	80	80	8	8	2
N-Ethyl perfluorooctane sulfonamide (EtFOSAm)	80	80	8	8	2
N-Methyl perfluorooctane sulfonamide (MeFOSA, MeFOSAm)	80	80	8	8	2
N-Methyl perfluorooctane sulfonamidoacetic acid (NMeFOSA	80	80	8	8	2
N-Ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	80	80	8	8	2
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	80	80	8	8	2
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	80	80	8	8	2
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	80	80	8	8	2
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	80	80	8	8	5
4,8-Dioxa-3Hperfluorononanoic acid (ADONA)	80	80	8	8	5
9-Chlorohexadecafluoro-3- oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	80	80	8	8	5
11-Chloroeicosafluoro-3- oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	80	80	8	8	5

ng/g – Nanograms per gram

ng/L – Nanograms per Liter
RL – Reporting Limits

- A detailed description of data validation procedures for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS), and
- Establish guidelines for data quality objectives and assessment needed to address the project goals.

1.1 Responsible Agency

The sampling activities described in this SAP will be managed by AECOM. Results will be submitted by the client to the applicable Regional Water Board.

1.2 Impact on Human Health and/or the Environment

AECOM has updated the Health and Safety Plan (HASP) to establish protocols that will be followed to minimize hazards to personnel performing field activities and to the environment. The HASP describes the Site and includes a description of the scope of work, site control practices, potential chemical and physical hazards, personal protective equipment, emergency response procedures, communications, and decontamination procedures. Although this work is not considered hazardous waste operations, the HASP will meet the requirements of 29 Code of Federal Regulations (CFR) 1910.120.

2. Project and Data Quality Objectives

2.1 Measurement Quality Objectives

Identifying data quality indicators (DQIs) and establishing quality control (QC) samples and performance criteria to assess the DQIs are key components of project planning and development. These components demonstrate an understanding of the data to support project decisions and help to establish there is a well-defined system in place to assess the DQOs. Data collected will be used to make informed decisions regarding the nature and extent of contamination, remedy selection, and the effectiveness of the selected remedy. These uses require high quality data that is qualitatively and quantitatively precise, accurate, representative, comparable, adequately sensitive, and legally defensible. The PARCCs parameters (precision, accuracy, representativeness, completeness, comparability, and sensitivity) outlined below are used to interpret and assess specific data quality needs for each sample matrix and analytical operation.

Precision: Precision is a measure of mutual agreement between duplicate samples, or co-located sample measurements of the same analyte. The closer the numerical values of the measurements are to each other, the more precise the measurement. Precision for a single analyte will be expressed as a relative percentage difference (RPD) between results of field duplicate samples, laboratory duplicate samples, or matrix spike duplicate (MSD) in cases where both results are greater than five times the reporting limit (RL). RPD is defined as follows:

$$\text{RPD (percent, \%)} = 100 \times \frac{|S-D|}{(S+D)/2}$$

Where: S = concentration of an analyte in a sample
D = concentration of an analyte in a duplicate sample

See **Table 2.3** for accuracy limits.

Accuracy: Accuracy is a measure of bias in a measurement system. The closer the value of the measurement agrees with the true value, the more accurate the measurement. This will be expressed as the percent recovery (%R) of a surrogate, laboratory control sample (LCS), or matrix spike (MS) analyte or of a standard reference sample, and is defined as follows:

$$\%R = \frac{A-B}{C} \times 100$$

Where: A = measured concentration of analyte in a spiked sample
B = concentration of analyte in an unspiked sample
C = known concentration of spike added

See **Table 2.3** for accuracy limits.

Representativeness: Representativeness is a qualitative parameter, which expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The design of and rationale for the sampling program (in terms of the purpose for sampling, selecting the sampling locations, the number of samples to be collected, the ambient conditions for sample collection, the frequencies and timing for sampling, and the sampling techniques) ensures that the environmental condition has been sufficiently represented.

Completeness: Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. The closer the numbers are, the more complete the measurement process. Completeness will be expressed as the percentage of valid to planned measurements and will be calculated as follows:

$$\text{Completeness (\%)} = \frac{V}{P} \times 100$$

Where: V = number of valid measurements
P = number of planned measurements

The objective is to establish the quantity of data needed to support the investigation. This will be achieved by obtaining samples for the types of analyses required at each individual location, a sufficient volume of sample material to complete the analyses, samples that represent possible contaminant situations under investigation, and samples at critical data locations. Completeness will take into consideration environmental conditions and the potential for change with respect to time and location. The overall completeness goal is 90% for each sampling event. The effect of any rejected data on project objectives will be evaluated in order to assess the need for recollection or reanalysis of these samples.

Comparability: Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data sets will be considered comparable only when precision and accuracy are considered acceptable during data validation. Sample data will be collected and reported in order to be comparable with other measurement data for similar samples and sample conditions. This goal will be achieved through using the applicable laboratory, field, and/or contractor standard operating procedures (SOPs) to collect and then analyze representative samples and through reporting analytical results in appropriate and consistent units. Each analytical procedure selected from among the acceptable options will be used throughout the work assignment, unless rationale is provided for any alteration. In essence, comparability will be maintained by consistency in sampling conditions, selection of sampling procedures, sample preservation methods, analytical methods, and data reporting units.

Sensitivity: To evaluate the utility of the data for comparison to numeric standards or screening levels (e.g., risk based or federally mandated criteria such as maximum contaminant levels, etc.).

The DQI's will be evaluated through QC samples performed by and submitted to the laboratories and meet the criteria provided in **Table 2.3**. The associated QC frequencies are provided in **Section 9**.

Table 2.3 – Quality Assurance Objectives

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Use to Assess Measurement Performance
Precision – Laboratory	See laboratory limits	MS/MSDs and/or LCS/LCSD
	For Laboratory Duplicates the following criteria will be used: • If the parent sample and duplicate values are >5xRL, then <20% RPD for water samples (<35% soil and other matrices). • If the parent sample or duplicate sample value is <5xRL, then absolute difference is <1xRL for water samples (<2xRL) for soil and other matrices).	Laboratory Duplicates

	See analytical method and/or DoD QSM 5.3	Calibration – Initial and Continuing
Precision – Field	For Field Duplicates the following criteria will be used: • If the parent sample and duplicate values are >5xRL, then <30% RPD for water samples (<50% soil and other matrices). • If the parent sample or duplicate sample value is <5xRL, then absolute difference is <2xRL for water samples (<3xRL for soil and other matrices).	Field Duplicates
Accuracy/Bias - Laboratory	See DoD QSM 5.3	LCS, MS/MSD, and Surrogate recoveries
	See analytical method and/or DoD QSM 5.3	Calibration – Initial and Continuing
Accuracy/Bias Contamination	No Target Analyte Detected >1/2 MDL	Method Blanks
Sensitivity	Results reported to the MDL; RLs must meet screening criteria	Quarterly verification: RLs meet the criteria outlined in Order WQ 2021-0006-DWQ
Completeness	90%	Data Completeness Check

> – Greater Than
< – Less Than
% – Percent
DoD – Department of Defense
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
QSM – Quality Systems Manual
RL – Reporting Limit

2.2 Data Review and Validation

2.2.1 Data Review, Verification, and Validation

Decision and recommendations will be based on verified or validated data. The process through which data will be accepted or rejected will be based on specific data verification and validation criteria. AECOM personnel experienced with sampling and analytical protocols and procedures will perform the data validation in accordance with the established criteria and the intended use of the data.

Stage 2B data validation will be performed on laboratory data packages. This will include review of chain of custody forms, laboratory receipt checklist, sample related QC data and QC acceptance criteria linked to field samples, requested spike analytes as appropriate (LCS, matrix spikes), QC sample frequency, initial calibration summaries, initial and continuing calibration verification summaries, instrument performance check summaries, and preparation logs. Data validation qualifiers will be applied as necessary in accordance with Table B-15 of DoD QSM version 5.3, or the associated applicable criteria.

Qualified chemists not involved with the actual generation of the data will conduct the analytical data validation for definitive data. The data will be validated using guidance from the following documents (or most current versions) as pertinent to the analytical methods and QA acceptance criteria:

- EPA National Functional Guidelines for Organic Superfund Methods Data Review (EPA-540-R-2017-002) (USEPA, 2017a)
- EPA National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA-540-R-2017-001) (USEPA, 2017b)
- EPA National Functional Guidelines for High Resolution Superfund Methods Data Review (EPA-542-B-16-001) (USEPA, 2016)
- Department of Defense Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances by QSM Table B-15 (DoD, 2020)

2.2.2 Verification and Validation Methods

Although data verification and validation are commonly used terms, they are defined and applied differently. According to EPA Guidance on Environmental Data Verification and Data Validation (EPA/240/R-02/004) (USEPA,

2002), data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. Data validation is an analyte and sample specific process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set.

Analytical data validation will be performed routinely to determine if the laboratory data is meeting the DQI's for the project. Discrepancies noted during the verification process may require the data validation team to alert the end user to limitations of the data. In addition, data validation may be requested for data used in court cases.

EPA National Functional Guidelines and Department of Defense Quality Systems Manual Version 5.3 (DoD, 2019) (or most current version) will be used as a source of performance criteria for review of the data. The guidelines are designed to assist an experienced reviewer in the technical review of laboratory data. A Level 2B validation will be performed. Specific areas of data review covered include chain of custody forms, laboratory receipt checklist, sample related QC data and QC acceptance criteria linked to field samples, requested spike analytes as appropriate (LCS, matrix spikes), QC sample frequency, initial calibration summaries, initial and continuing calibration verification summaries, instrument performance check summaries, and preparation logs. Further details on the level of validation are included in DoD Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substance by QSM Table B-15. By using these guidelines in addition to the criteria in the analytical methods, an experienced reviewer can qualify, accept, or reject laboratory data.

All data will be verified to ensure they are representative of samples analyzed and locations where measurements were made, and that sample data and the associated QC data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for verifying the data each task generates or handles. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of custody forms. The data management task deals primarily with electronic data.

Validation and verification of data will be performed by staff using self-assessment and peer review, followed by technical review by the AECOM project manager or designate. The assigned project QA Officer will be responsible for validating that the verified data are usable. The QA Officer will evaluate the data for anomalies and address any suspected errors or anomalous data before data validation can be completed.

2.2.3 Reconciliation With User Requirements

Assessment of the data quality will determine if project objectives have been met. Data validation will document any data that do not meet the quality criteria and the associated effects on usability. This assessment will include deviations to the SAP, effectiveness of the data collection and generation processes, QC issues related to the laboratory analysis or sampling activities, and identify limitations to the data, including data determined to be unusable. Data that do not satisfy the DQOs will be evaluated to determine the impacts on usability and if corrective actions are warranted. Corrective measure may include resampling to ensure data are legally defensible and meet the DQOs.

2.3 Data Management

The project data management scheme begins in the field with initial collection of the data. All field data shall be recorded by field personnel in bound logbooks for each site or on sample collection log sheets for each sample collected at each site sample location. Pages of the logbook will be consecutively numbered. Data initially collected (i.e., depth to groundwater, temperature, electric conductivity, pH, and turbidity) shall be converted to standard reporting units and recorded in standard formats. Mistakes are lined out, initialed and correctly re-entered.

Data shall be reviewed by the site project manager for clarity, completion, translation, or transcription errors. Other notes for a given project, including records of communication and meetings, are kept filed by the contractor project manager. Notes which are kept confidential are filed separately but within project files and kept in a secured location.

Once the samples have been collected in the field, they will be subjected to the sample handling and custody requirements detailed in **Section 8**.

Laboratory analytical reports will include QC results and any other necessary analytical information to enable reviewers to determine the data quality. The criteria for validation and verification is outlined in **Section 2.4.1**.

2.4 Analytical Laboratory

Collected environmental samples will be analyzed by laboratories that have well-developed QA programs; the laboratory used to implement this SAP will be approved to perform the analyses specified in **Section 4.1**. The analytical data will be generated by Eurofins Lancaster of Lancaster, Pennsylvania. Eurofins Lancaster is certified for the analyses specified in **Section 4.1** and holds DoD ELAP accreditation.

AECOM acknowledges that it understands and agrees to the measurement quality objectives defined by Eurofins Lancaster which will be used for the project. Laboratory QC measures for standards, blanks, calibration, analyte identification, and quantitation will be performed as specified by the analytical method, DoD QSM version 5.3 (DoD, 2019), this SAP, and Eurofins Lancaster's Quality Assurance Manual.

Soil and water reporting limits will be less than or equal to those reported in **Table 1**.

3. Field Methods and Procedures

Consistency in data collection will be maintained throughout field activities via strict adherence to project SOPs by an experienced team of field personnel. AECOM's SOPs that are to be used during sampling include, but are not limited to:

- 3-01 Utility Clearance
- 3-04 Sample Handling Storage and Shipping
- 3-05 IDW Management
- 3-06 Equipment Decontamination
- 3-07 Land Surveying
- 3-12 Monitoring Well Installation
- 3-14 Monitoring Well Sampling
- 3-16 Soil and Rock Classification
- 3-20 Operation and Calibration PID
- 3-21 Surface and Subsurface Soil Sampling
- 3-24 Water Quality Parameter Testing

These SOPs are included in **Appendix B**.

3.1 Field Equipment

Field equipment may include, but not be limited to, the following:

- Handheld global positioning system (GPS) to locate and mark sample locations
- PID to field-screen soils
- Subcontractor-provided drill rig and associated equipment
- Hand auger and trowel for collecting surficial soil samples
- Laboratory-prepared sample containers, sample coolers, water, ice, blanks
- Sample labels, chain-of-custodies (COCs), zip-lock bags
- Personal protective equipment (PPE), at a minimum steel-toe boots and nitrile gloves
- Field logbook, field forms, pens
- Camera
- Alconox® detergent, PFAS-free deionized water, buckets, tarps, scrub brush
- 55-galon drums to containerize investigative-derived waste
- Tape measure
- Trash bags, paper towels

. Care will be taken with equipment, field clothing, PPE, food packaging, and person hygiene/personal care products to decrease the possibility of cross-contamination.

3.2 Soil Sampling

Soil samples will be collected as described in **Section 3.1** and field activities will be conducted in accordance with the field SOPs provided in **Appendix B**. Subsurface soils may require a drill rig to reach the desired depth. Decontamination procedures using PFAS-free water will be in used for sampling and drilling equipment as applicable.

See **Section 4.1** for bottle and preservation requirements.

3.3 Water Sampling

Groundwater, stormwater, and wastewater samples will be collected as described in **Sections 3.2, 3.3, and 3.4** and field activities will be conducted in accordance with the field SOPs provided in **Appendix B**. Samples will be analyzed for PFAS, general chemistry, and metals as required. Decontamination procedures using PFAS-free water will be in used for sampling as applicable.

See **Section 4.1** for bottle and preservation requirements.

3.4 Decontamination Procedures

Non-disposable sampling equipment will be decontaminated using a three-stage method: a tap water rinse, an Alconox® and water solution rinse, and then triple rinsed with distilled water. Equipment decontamination will be performed over a bucket and/or tarp to prevent decontamination water from flowing onto the ground surface. Decontamination water will be handled as described in **Section 7**.

4. Sampling Containers, Preservation, Packaging, and Shipping

4.1 Soil Samples

PFAS - Soil samples will be analyzed for PFAS and collected in 4-ounce jars. The samples will be chilled to <6°C immediately upon collection.

The container and preservative requirements are outlined in **Section 4.1** and sample documentation will be followed as outlined in **Section 8**.

4.2 Water Samples

PFAS – Water samples will be analyzed for PFAS and collected in 2x250-millilter HDPE bottles. The samples will be chilled to <6°C immediately upon collection.

General Chemistry – Water samples will be analyzed for the alkalinity, anions, and total dissolved solids (TDS) in unpreserved containers. The samples will be chilled to <6°C immediately upon collection.

Metals – Water samples will be analyzed for metals and collected in 500 mL HDPE bottles preserved with nitric acid. The samples are not required to be chilled, however, they may be placed in coolers with ice along with the samples collected for other analyses.

The container and preservative requirements are outlined in **Section 4.1** and sample documentation will be followed as outlined in **Section 8**.

4.3 Packaging and Shipping

Upon collection and labeling, samples shall be packed for delivery to the assigned laboratory.

Until shipment, sample integrity will be maintained in the field by AECOM field personnel using appropriate sample handling procedures. Specifically, appropriate sample preservation techniques (e.g., chemical preservations, stored in coolers with ice) will be applied to collected samples, samples will be packaged to prevent breakage or cross-contamination, and samples will remain under the control (e.g., within sight, locked storage) of the Field Sampling Team until custody is relinquished to the overnight delivery service. If samples are held overnight, sufficient ice (if necessary) will be added to the cooler to maintain the required preservation temperature of ≤6°C, and the coolers will be kept in a locked, secure location.

When transporting samples by vehicle, the following steps should be completed:

- Select a sturdy cooler in good condition. Secure and tape the drain plug with duct tape both inside and outside.
- Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly.
- Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Double bag all soil samples. Bottles may be wrapped in bubble wrap. It is preferable to place glass sample bottles and jars into the cooler vertically.
- Place ice and sample containers in a large garbage bag(s) and properly seal with tape. Double bag with garbage bags and properly seal with tape.
- Place the completed chain-of-custody form into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.

Upon laboratory receipt, laboratory personnel will open the shipping container and sign the chain-of-custody form to document transfer of samples.

5. Disposal of Residual Materials

In the process of collecting environmental samples, the sampling team will generate different types of potentially contaminated investigation-derived waste (IDW) that includes the following:

- Used PPE
- Disposable sampling equipment
- Decontamination fluids
- Soil cuttings from soil borings

Soil cuttings generated during the subsurface sampling will be disposed of in an appropriate manner.

Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

Wash water from sampling equipment decontamination will be containerized in 55-gallon drums, and one sample from each drum will be analyzed for waste characterization purposes. Based on the results, the waste will be disposed of properly. AECOM assumes that the waste will be classified as non-hazardous.

6. Sample Documentation

6.1 Field Notes

As applicable, field documentation will include, but not be limited to, the following

- Field notebook detailing dates and times of field work, personnel on-site (including subcontractors, client representatives, etc.), equipment used, and a summary of the activities performed
- Photographs, with approval from the site
- Sample COCs
- Health and safety forms (daily tailgate safety meeting, job hazard analysis, etc.)

6.2 Sample Labeling

A sample label will be affixed to each sample container. The label will be completed with the following information written in indelible ink:

- Sample identification
- Analysis requested
- Preservative
- Sample collection date
- Sample collection time
- Identification of the sampler

After labeling, each sample will then be prepared for storage and shipment in accordance with the storage and preservation requirements listed for that method (see **Section 4.1**) and as further discussed in **Section 6.3.**

6.3 Sample Chain-of-Custody Forms and Custody Seals

AECOM will use standard sample chain-of-custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis. A sample will be considered to be in custody if one of the following statements applies:

- It is in a person's physical possession or view
- It is in a secure area with restricted access
- It is placed in a container and secured with an official seal in such a way that the sample cannot be reached without breaking the seal

The custody of a sample must be traceable from the time of sample collection to the reporting of results. Chain of custody procedures provide a mechanism for documenting information related to sample collection and handling. Completion of a chain of custody form must occur after sample collection and prior to sample shipment or release. Cross-checking the chain of custody form, sample labels, and field documentation is necessary to verify sample identification, date and time the sample was collected, the required containers and preservatives, and sample volume are in accordance with the project requirements.

The chain-of-custody form will be used to document all samples collected and the analyses requested as part of this Project. Information that the field personnel will record on the chain-of-custody form includes the following:

- Project name and number
- Sampling location
- Name and signature of sampler
- Destination of sample (laboratory name)
- Sample ID
- Date and time of collection
- Number and type of containers filled
- Analyses requested (note if dissolved)
- Preservatives used (if applicable)
- Filtering for analysis of dissolved constituents (as applicable)
- Signatures of individuals involved in custody transfer, including the date and time of transfer
- Air bill number (if applicable) or courier information
- Project contact and phone number

Unused lines on the chain-of-custody form will be crossed out, initialed, and dated. If samples are shipped, field personnel will sign chain-of-custody forms, and the air bill number will be recorded. The chain-of-custody will be placed in a waterproof plastic bag and taped to the inside of the shipping container used to transport the samples

(see **Section 6.3**). Copies of the chain-of-custody form, and the air bill will be retained and filed by field personnel before the containers are shipped. The cooler lid will be tabbed closed in two places with strapping table which completely encircles the sample cooler and dated custody seals affixed to each taped closure location.

The laboratory sample custodian (Eurofins Lancaster) will receive all incoming samples, sign the accompanying chain-of-custody forms, and retain copies of the forms as permanent records. The laboratory sample custodian will record all pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (e.g., sealed, unsealed, or broken container; temperature; or other relevant remarks), the sample IDs, and any unique laboratory identification numbers for the samples. When the sample transfer process is complete, the custodian is responsible for maintaining internal logbooks, tracking reports, and other records necessary to maintain custody throughout sample preparation and analysis.

The laboratory will provide a secure storage area for all samples. Access to this area will be restricted to authorized personnel. The custodian will ensure that samples requiring special handling (e.g., samples that are heat- or light-sensitive, radioactive, or have other unusual physical characteristics) are properly stored and maintained pending analyses.

7. Quality Control

7.1 Field Quality Control Samples

Evaluation of field sampling procedures requires the collection and evaluation of field QC samples. To provide a means of assessing data quality resulting from the field sampling program, collection and submittal to the analytical laboratory includes field blanks, equipment blanks, and field duplicates.

Field Blanks

A field blank is a clean, analyte-free sample which is carried to the sampling site and then exposed to sampling conditions. The field blank is intended to provide information about contaminants that may be introduced during the sample collection, storage, and transportation of field samples. Field blanks will be collected at a rate of one per 20 field samples for the full analytical suite. The sample container is assigned a unique identification number in the field.

Equipment Blanks

An equipment blank, sometimes referred to as a rinsate blank, is a sample of analyte-free water poured over or through decontaminated field sampling equipment prior to the collection of environmental samples. It is used to assess the adequacy of the decontamination process in terms of contamination from the total sampling process when decontaminated sampling equipment is used to collect samples. Equipment blanks will be collected, at a rate of one per 20 field samples collected for the full analytical suite. The sample container is assigned a unique identification in the field.

Matrix Spike/Matrix Spike Duplicates (as applicable)

A MS/MSD sample is an aliquot of sample spiked with a known mass and concentration of specific analytes. The spiking occurs prior to sample preparation and analysis at the laboratory. To allow the analytical laboratory to run MS/MSD analyses, additional sample volumes will be collected in the field to provide sufficient sample material for the laboratory to perform the additional analyses. MS/MSDs will be collected at a rate of one per 20 field samples for the full analytical suite, as applicable to the analytical method. If possible, MS/MSD samples should be collected from a location expected to be relatively free from contamination as these will be used for laboratory quality control purposes.

Field Duplicates

Field duplicates will be collected at selected locations to provide estimates of the total sampling and analytical precision. Field duplicates will be collected at a rate of one per 10 field samples for the full analytical suite to provide estimates of the analytical precision. The field duplicates will be handled and analyzed in the same manner as the environmental samples; however, the chain-of-custody forms will not indicate which samples are duplicates. The field duplicates will be collocated duplicates that are collected simultaneously or immediately after the parent sample. If possible, field duplicates should be collected from a location with contamination as these results will be used to evaluate precision.

A summary of the quality control samples is provided below:

Table 9.1 – Summary of Quality Control Samples

Sample Type	Purpose	Collection Frequency
Field Blank	To evaluate contamination introduced during sample collection, preservation, and shipment.	One per 20 samples (5%) per matrix. If less than 20, then one per week per matrix.
Equipment Blank or Rinsate Blank	To evaluate field decontamination procedures on any reusable equipment.	One per 20 samples (5%) taken. If less than 20, one blank per week.
Field Duplicate	To evaluate sampling and laboratory precision.	One per 10 samples (10%) per matrix. If less than 10, then one per week per matrix.
Matrix Spike (MS) and Duplicate (MSD) (As applicable to the analytical method)	To evaluate accuracy and precision as it relates to the sample matrix.	One per 20 samples (5%) per matrix. If less than 20, then one per week per matrix.

% – Percent
MS/MSD – Matrix Spike/Matrix Spike Duplicate

7.2 Background Samples

No background sampling is required.

7.3 Field Screening, Confirmation Samples, and Split Samples

No field screening, confirmation, or spilt samples will be required for this sampling.

7.4 Laboratory Quality Control Samples

Laboratory QC procedures are part of an integrated program with quality assurance (QA) reviews to generate data of known and documented quality. Information from QC procedures is used to demonstrate acceptable levels of performance by the laboratory and to determine the need for corrective action procedures.

The approved methods, typically EPA-approved methods, outline the associated method QC samples. It may include QC procedures for instrument calibration and verification, internal standard responses, calibration and method blanks, method duplicate, as well as control samples required to evaluate accuracy and precision as it relates to the antapical method.

8. Field Variances

As conditions in the field may vary, it may become necessary to implement minor modification to this SAP. The AECOM field manager will notify the AECOM project manager when field variances are necessary. As appropriate, cleint will be notified, and an approval will be obtained before implementing the changes. Variances to this SAP will be documented in the field notebook.

9. Health and Safety Procedures

Prior to starting field activities, AECOM will review the Site conditions and task objectives to identify potential hazards, particularly those that may increase the risk of an incident affecting people or property (i.e., underground utilities, aboveground utilities, terrain, contamination). The identified risks and associated abatement measures will be included in the site-specific HASP that clearly defines task-specific control or prevention procedures, along with the roles and responsibilities for members of the project team.

10. References

29 Code of Federal Regulations (CFR) Part 1910. Occupational Safety and Health Standards. Available on-line at:

https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.120

Department Of Defense (DoD). 2019. Quality System Manual (QSM) for Environmental Laboratories. Version 5.3. July.

United States Environmental Protect Agency (USEPA). 2002. Guidance on Environmental Data Verification and Data Validation. EPA QA-G8. November.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, EPA/240/B-06/001. February.

_____. 2016. National Functional Guidelines for High Resolution Superfund Methods Data Review, EPA-542-B-16-001. April.

_____. 2017a. National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002. January.

_____. 2017b. National Functional Guidelines for Inorganic Superfund Methods Data Review, EPA-540-R-2017-001. January.

Attachment A

Environmental Quality Policy Manual

eurofins	Always check on-line for validity. **Environmental Quality Policy Manual**	Level: **Quality Manual**
Document number: **QA-QM11872**		
Old Reference: **1-P-QM-GDL-9015377; DOD - EQPM**		
Version: **18**		Organisation level: **5-Sub-BU**
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Title Page

Environmental Quality Policy Manual

Eurofins Lancaster Laboratories Environmental, LLC (ELLE)

2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300
Fax: 717-656-2681

Reviewed and Approved by:
President
Technical Director
Quality Assurance Director
(as recorded in the electronic document control system)

Revision Log

	Revision: 18	**Effective Date**: This Version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Section 1.2 & 2.4-2.6	Revised Quality Statement	Inserted text from the revised 2020 Eurofins Quality Policy Statement; added wording to address impartiality and risk evaluation
Section 1.5, 11.4 & 11.5	New process	Added allowance for remote assessments.

	Revision: 18	**Effective Date**: This Version
Section 2.12 & 11.3	Deactivated GLP	Removed references to GLP as this is not currently offered
Section 3	Campus changes	Added new buildings to the facilities description
Throughout document	Process changes related to new LIMS	Changes made in how sample and data handling, qualification, report generation, approvals, signatures occur to reflect change to new LIMS
Appendices	Current information	Updated with current content

	Revision: 17	**Effective Date**: 7/17/2019
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Section 2.2	Correction	Changed timeline for deputies and notification to agencies
Section 2.5	Correction	Notification timelines are dictated by regulatory authority.
Section 6.3.4	Clarification	Calibration/verification is at least annual

1.0 INTRODUCTION

This *Quality Policy Manual* is based upon Eurofins Lancaster Laboratories Environmental LLC's (herein referred to as the laboratory) overall business and management philosophies, mission, and goals. This manual is written to present the policies employed by the laboratory as well as the support departments that serve the environmental laboratories and to comply with the requirements of the National Environmental Laboratory Accreditation Program (also referred to as NELAP or TNI), ISO 17025, the Department of Defense (DoD), Quebec Accreditation Program for Analytical Laboratories (PALA) as well as individual state agency requirements. These policies define the "what" we do with emphasis on management's responsibilities and commitment to quality.

Governing SOPs are in place within the organization, to ensure the proper execution of this policy document (refer to Appendix A). This manual is required reading for laboratory personnel. The most recent and up-to-date *Quality Policy Manual* and all referenced documents are available to all laboratory personnel who work in or support the laboratory. As described within this document, the laboratory actively strives for continuous improvement of its quality systems to better serve our clients.

1.1 Mission Statement

The laboratory offers analytical and consulting services in the chemical and biological sciences with comprehensive expertise in environmental laboratory applications. The company mission statement describes the corporate philosophy:

At Eurofins Lancaster Laboratories Environmental LLC we are people working together to serve the health and environmental needs of society through science and technology. We strive to be the recognized leader in all that we do.

Our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. As a corporate community, we:

- Deliver quality by fully understanding and always meeting the requirements of those we serve.
- Live our values by relating to our clients, coworkers, shareholders, suppliers, and community in a fair and ethical manner.
- Manage our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders, and maintain our meaningful and enriching workplace.

1.2 Quality Policy

The Executive Management Group recognizes quality as a key element of the laboratory's standard of service. The group supports the laboratory's commitment to quality as defined by NELAP, ISO 17025, DoD, PALA and other regulatory agencies (i.e. states) through the strict adherence to the Quality Policy Statement. The policy cannot be revised without their approval of Eurofins US QA Directors.

The Quality Policy Statement gives employees clear requirements for the production of analytical data. Employees are trained on the components of the Quality Policy Statement during their first day of orientation. Each employee signs the statement upon hire as agreement to implement the policy in all aspects of their work. Employee agreement to any subsequent revisions of the statement is obtained by documented reading and understanding of an agreement to follow the Quality Manual, which contains the current version of the statement. The statement is as follows:

As an organization, all personnel are committed to high quality professional practice, testing and data, and service to our clients.

We strive to provide the highest quality data achievable by:

- Reading and understanding all of the quality documents applicable to each position and implementing the process in our work.
- Following all recordkeeping requirements; describing clearly and accurately all activities performed; recording "real time" as the task is carried out; understanding that it is never acceptable to "back date" entries and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Ensuring data integrity through the completeness, consistency, impartiality and accuracy of the data generated. Data is attributable, legible, contemporaneously recorded, original or a true copy, and accurate (ALCOA). This applies to manual paper documentation and electronic records.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/qualification/validation, analysis, and reporting; establishing an audit trail (the who, what, when, and why) that identifies date, time, analyst,

instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.

- Emphasizing a total quality management process which provides impartiality, accuracy, and strict compliance with agency regulations and client requirements, giving the highest degree of confidence; understanding that meeting the requirements of the next employee in the work flow process is just as important as meeting the needs of the external client.

- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications, but is still of use to the client; understanding this occurs only after discussion with the client on the data limitations and acceptability of this approach.

- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems, with investigation and applicable corrective action; documenting these activities completely, including the reasons for the decisions made.

- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expression of concern on quality issues to management. Eurofins recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.

- Continually improve systems and manage risk to support quality improvement efforts in laboratory, administrative and managerial activities.

We each take personal responsibility to provide this quality product while meeting the company's high standards of integrity and ethics, understanding that improprieties, such as failure to conduct the required test, manipulation of test procedures or data, or inaccurate documentation will not be tolerated. Intentional misrepresentation of the activities performed is considered fraud and is grounds for termination.

I understand the expectations and commit to implementation of all applicable policies and procedures and to providing quality data.

1.3 Statement of Values

Eurofins Lancaster Laboratories Environmental is a team of people who work together to serve the health and environmental needs of society through science and technology.

At Eurofins Lancaster Laboratories Environmental, our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. We fulfill our mission by incorporating our values into our work every day.

As a corporate community, we embrace our heritage of integrity and strive to live by the following principles:

- Fairness and honesty in all our relationships

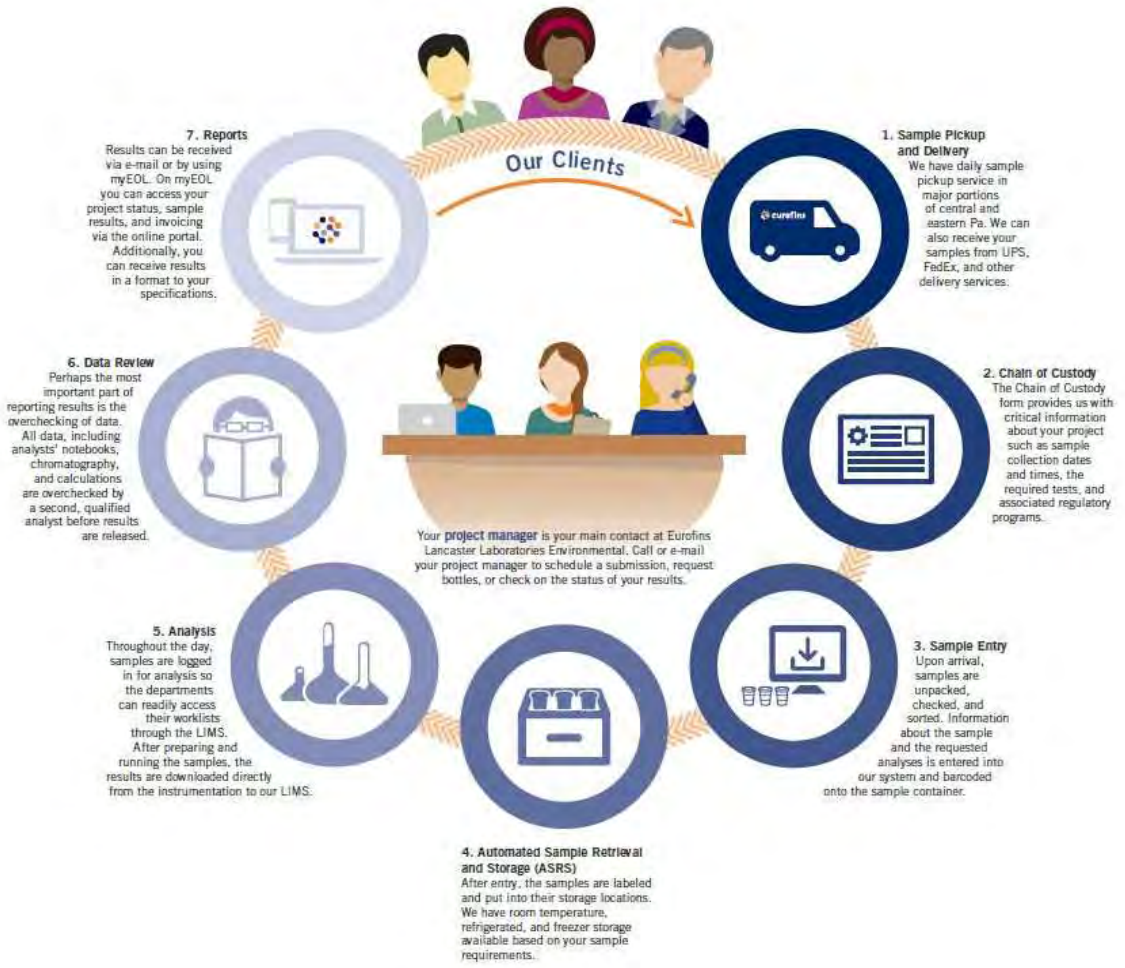
- Mutual trust
- A respect for ourselves and others
- A sense of caring that leads us to act responsibly toward each other and society, now and in the future
- Loyalty to our clients and one another
- A spirit of open-mindedness as we deal with all
- Dedication to service
- Good stewardship of our resources
- A commitment to flexibility and continuous improvement

We are committed to:

- Delivering quality by fully understanding and always meeting the requirements of those we serve.
- Living our values by relating to our clients, coworkers, shareholders, suppliers and community in a fair and ethical manner.
- Managing our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders and maintain our meaningful and enriching workplace.

At Eurofins Lancaster Laboratories Environmental, we each take personal responsibility to live these values in all of our dealings, knowing full well that our pledge may involve difficult choices, hard work and courage.

1.4 Sample Flow-Through Diagram



1.5 Certifications, Accreditations, and Registrations

Accreditation/Certification is the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications and/or standards. It is the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional, quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in those areas relevant to our technical expertise. We strive to ensure that the facilities, equipment, procedures, records, and methods used by the laboratory in the testing of environmental samples are in compliance with the requirements of these standards.

Although organizations offering accreditation differ somewhat in the details of their programs, they generally evaluate laboratories in four basic areas: personnel (adequate staffing, education, training, and experience), physical facilities, instrumentation/equipment, and quality assurance program. This evaluation is performed by one or more of the following procedures: periodic on-site and/or remote inspections of the laboratory by assessors experienced in technical operations, quality systems, and management; periodic analysis of proficiency test samples; and periodic updating of the laboratory's file to reflect changes in personnel, equipment, or services offered. Some agencies offer reciprocity with other agency programs.

Appendix B lists accreditations and registrations held by the laboratory in support of environmental work. Current copies of all scopes of accreditation are available on the laboratory website https://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/certifications-and-accreditations-eurofins-lancaster-laboratories-environmental/ and are kept on file in the Quality Assurance Department.

2.0 ORGANIZATION AND PERSONNEL

2.1 Company Overview and History

The laboratory was founded in 1961 by Dr. Earl Hess in response to a need for high quality technical services by the agricultural and industrial communities in southeastern Pennsylvania. Nourished in a culture of quality and caring about all those associated with the business, the corporation became an industry leader known for innovative business practices and people-friendly policies. The company was independently owned until the retirement of Dr. Hess in 1995. At that time, the laboratory was acquired by a publicly held company, Thermo TerraTech, Inc., a Thermo Electron company. Ownership changed in September 2000, when the laboratory was acquired by Goldner, Hawn, Johnson, and Morrison, Inc. (GHJ&M), a private equity investment firm. In August 2005, the laboratory was acquired by Fisher Scientific under their BioPharma Division. On November 9, 2006, Thermo Electron and Fisher Scientific merged to form Thermo Fisher Scientific. In April 2011, Thermo Fisher Scientific sold the laboratory to Eurofins Scientific. Effective July 1, 2013, the Pharmaceutical and Environmental Divisions were split into separate business entities and the company name became Eurofins Lancaster Laboratories Environmental, LLC. The laboratory continues to operate as an independent laboratory and is incorporated by the State of Delaware.

The laboratory provides a wide array of laboratory services to clients working in environmental industries. We strive to offer high quality technical services in the chemical and biological sciences with personal attention to client needs. These services include chemical analyses and analytical method development. We are, therefore, a technical service company and do not manufacture or distribute goods. Our "product" is accurate and timely technical information and our continued existence depends on the quality of the services we offer and efficiency with which we deliver them.

2.1.1 Business Continuity and Contigency Plans

Various policies and practices are in place to address continuity of business and contingency plans to ensure continued operations or minimal disruption in operations should unplanned events (natural disasters, unexpected management changes, etc.) occur.

Section 2.2 of this document explains the identification of deputies for key management positions. Section 3.3 discusses the disaster recovery plan. Section 6.4 addresses the security and backup of our computer systems. Section 10.8 addresses handling of client records should the company have a change in ownership or go out of business.

2.2 Organizational Structure

The laboratory President, in conjunction with the Director of Operations and senior management staff, is responsible for the daily operations of the laboratory. Duane Luckenbill is designated as the laboratory's Technical Director relative to accreditations.

The Executive Management Group is defined as the President and laboratory directors.

The management staff includes directors, managers and group leaders. Organizational charts of the management staff are presented in Appendix C. Individual departmental staff lists are maintained in the company's internal intranet. The Technical Director and Quality Assurance (QA) Director have identified deputies for all key management personnel. Deputies would temporarily fill a role if the primary is absent for more than 15 consecutive calendar days. The deputies must meet the same qualifications as the primary person should they be required to take on the responsibilities. Notification to agencies is performed as noted in section 2.5.

2.2.1 Technical Director

The Technical Director ensures that the laboratory's policies and objectives for quality of testing services are documented in this quality manual. The Technical Director must assure that the manual is communicated to, understood, and implemented by all personnel concerned.

2.2.2 Quality Assurance Director

The Quality Assurance Director ensures that the quality system is followed at all times. The QA Director reports directly to the President thus ensuring corrective actions to quality issues are taken promptly and are separate from business decisions. The QA Director has no direct supervisory responsibility for the generation of technical data to avoid any conflict of interest in administrating the QA program. The QA Director has the final authority to stop work that compromises our integrity or data quality. The situation must be investigated and appropriate corrective action must be put in place before the QA Director will authorize the resumption of work. The specific duties of the QA Director are communicated in the position qualification description (PQD).

2.3 Management Responsibilities

Laboratory management duties are outlined for supervisory personnel using a job plan format, which details each individual's responsibilities along with expected results. Typically, management duties include, but are not limited to:

- Personnel hiring and training
- Supervision of personnel
- Providing resources to ensure a work environment free from commercial, financial, and other undue pressures that may adversely affect the quality of their work
- Providing resources to ensure a safe work environment
- Directing daily work operations, including scheduling of work

- Ensuring compliance with the TNI Standards, ISO 17025, Department of Defense Quality Systems Manual, regulatory programs, analytical methods, and client requirements.

- Assessing laboratory capacity and workload

- Resource allocation

- Ensuring quality of data produced

- Contributing to the continuous improvement of the laboratory operation

- Ensuring that corrective actions are carried out in an appropriate and agreed upon time-frame.

- Communicating problems, risks, and concerns to Senior and Executive Management to enlist a higher level of support for corrections and continuous improvements.

- Maintaining awareness of technical developments and regulatory requirements

2.4 Overview of the Quality Assurance Program

Quality Assurance (QA) is responsible for developing planned activities whose purpose is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of NELAP, ISO 17025, DoD, PALA, and any other regulatory agencies (i.e. states) in which we hold accreditation. Although the laboratory is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and Quality Systems operations described in this manual are specific to the Lancaster site and associated service centers.

The administration of the QA program is the responsibility of the QA Director in cooperation with all levels of management.

The QA program, as directed by executive management, was established to:

- Ensure accountability, accuracy, traceability, and impartiality for all analytical data generated.

- Ensure that current regulatory, agency, and client requirements are being met.

- Ensure that operating procedures are in place to minimize risk, the possible loss, damage, and tampering with data, in addition to ensuring that raw data is stored in a secured area and is maintained by designated archivists and/or system administrators.

- Ensure that curriculum vitae (CVs) and training records are maintained to document that staff members have the necessary education, training, and experience to perform their job responsibilities and functions.

- Ensure that regulatory training is provided to applicable employees on a routine and ongoing basis.

- Ensure that all procedures are available, controlled, and current.

- Ensure that documentation demonstrates that procedures are carried out in a compliant and effective manner.

- Ensure that all equipment and instrumentation is qualified, maintained, and calibrated, as appropriate, in accordance with written standard operating procedures.

- Ensure that all significant laboratory problems are investigated, evaluated for root cause and corrective action is put in place as documented

- Ensure that an internal audit program is in place to provide on-going monitoring, evaluate areas of risk, and confirm that laboratory personnel are adhering to standard operating procedures and applicable regulations.

- Ensure that quality issues are brought to the attention of management in a timely manner.

2.5 Quality Assurance Responsibilities

The QA Director assigns tasks with input from the company President. The primary responsibilities of QA include, but are not limited to the following:

- Oversee the laboratories' internal audit program which consists of various audit types and applies to all laboratory activities (technical and administrative).

- Review and approve standard operating procedures and analytical methods.

- Review and approve validation documentation.

- Review non-conforming quality control data

- Perform tracking and trending of quality measurements and report the status, effectiveness, and potential risk areas of the quality system to management.

- Review and approve investigation and corrective action reports (ICARs) and audit responses to ensure that they are completed in a timely manner, evaluated for root cause, that corrective actions are implemented as needed and to monitor corrective action for effectiveness.

- Host client and regulatory agencies during facility audits and follow-up to any cited deficiencies.

- Provide regulatory guidance to the laboratory and support areas.

- Communicate quality issues to management in a timely manner

- Provide and/or coordinate on-going regulatory training (e.g., Ethics).

- Participate in the vendor and supplier approval process, including subcontractors.

- Review analytical data for compliance with our procedures.
- Prepare and review QA project plans (QAPPs) as required by EPA and client projects.
- Maintain and update this *Quality Policy Manual*.
- Maintenance of the Laboratory's accreditations, including but not limited to, administration of the proficiency test sample programs.
- Communication to the relevant regulatory authorities is required when there are management or facility changes that impact the laboratory. Changes in the technical director must be communicated within a period of time and in the manner dictated by each regulatory authority.

2.6 Communication of Quality Issues to Management

The QA Department is responsible for preparing reports to Management to keep them apprised of outstanding quality issues. Reports to management foster communication, review, and refinement of QA activities to ensure that the QA program is adequate to meet regulatory and the laboratory's quality objectives. The following reports are used to communicate quality issues, potential risk, and include, but are not limited to:

- Internal, client, and agency audit reports and corrective action plans
- Proficiency test reports
- Investigation and corrective action reports
- Monthly management system status reports
- Quarterly quality metrics submitted to Eurofins global QA team
- Plans for corrective action

Upon review of quality issues, management and/or QA may issue a stop work notice if an issue indicates the risk for a problem on a broader scale with an analysis. The investigation would need to be completed and the issue resolved before work could continue. The information is tracked through our Investigation and Corrective Action Report (ICAR) process.

2.7 Personnel Qualifications and Responsibilities

The position qualification descriptions (PQDs) for senior staff (Technical Director, QA Director, Laboratory Operations Director, Science Officer, Technical Manager and Support Manager) are provided in Appendix D.

PQDs for all positions are maintained in the laboratory's document control system. Resumes (curricula vitae or CVs) are maintained on file for all staff in the training record system. Responsibilities are outlined in the PQD at the position level. Individual responsibilities and expectations are documented in each employee's job plan. The job plan is evaluated and discussed with each employee on an annual basis. The job plan is a confidential personnel record.

2.8 Relationship of Functional Groups and Quality Assurance Program

In addition to this *Quality Policy Manual*, aspects of the QA program are documented in a series of standard operating procedures that support the proper execution of this document. Technical operation procedures with required quality components are also in place. A list of the titles of relevant SOPs is provided in Appendix E. There are a variety of mechanisms used to communicate requirements and verify compliance with the QA program, including:

- Management requires that all employees read and be trained in the policies and SOPs that are pertinent to their jobs.

- Employee job plans define individual responsibilities. All job plans include data quality aspects, and performance is reviewed annually.

- Laboratory audit findings are communicated to management and require a response and follow-up to items needing corrective action.

- Cross-functional meetings, including representatives from QA, Client Services, Business Development, management, and technical operations are held as needed to review specific projects and quality issues.

2.9 Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the laboratory Operations Director, in conjunction with the President, and management team. Input from business development, sample registration, and client services management is also evaluated. These responsibilities are documented in the individual job plans for these positions.

The laboratory facilities and staff size are very large compared to other laboratories serving the environmental industry. Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in case of malfunctions. This minimizes the need to evaluate small and medium size projects against capacity available to complete them. Large projects are reviewed against capacity estimates before bids are submitted to ensure that the client's analysis schedule is met.

Regularly scheduled meetings are held with upper management, laboratory middle management, Client Services and QA personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Laboratory capacity and backlog is tracked on a continuous basis using information from the Laboratory Sample Information System (LIMS) including turnaround time, and work in progress.

2.10 Identification of Approved Signatories

All data is reviewed and verified by a second level reviewer at the department level prior to release to the client. The signature of the assigned project manager (PM) is applied to the Analysis Report. The PM performs a basic content check of the report. The authorization of the data is stipulated by the technical reviews performed and documented in the LIMS (1st and 2nd level reviews).

Based on complexity or regulatory needs, some projects are designated for additional QA review of the Analysis Reports and/or data deliverables. Designated QA staff are the "approved signatories" for these secondary reviews. Completion of the QA review is documented in the LIMS job tasks.

Note: "signatures" are attached through the LIMS interface and employee login.

2.11 Personnel Training

The experience and training received by personnel is of great importance to our company, our clients and regulatory agencies. Curricula Vitae (CVs) and on-going training documentation are available to demonstrate how personnel have been prepared for the tasks they routinely perform. To ensure the highest quality of services at the laboratory, training programs and plans are developed to match skills with job functions. Accurate training documentation is the responsibility of both the employee and their supervisor. On a routine basis, the supervisor reviews and approves training documentation to verify that it is complete and current.

Training requirements can be met through education, prior job experience, internal and external training classes, on-the-job training, training modules, procedure reading, or any combination thereof, to enable the person to perform assigned job functions and meet regulatory compliance.

Each analyst training to perform a new analysis is required to perform an initial demonstration of capability and meet the requirements for accuracy and precision before working independently on the test method. Typically, this is accomplished by the successful analysis of four known samples (i.e. a quad study). However, there are certain tests performed that are not required by the mandated test method or regulation to perform the above procedure since they are not conducive to spiking . In this case, the analyst's documentation of proficiency is achieved by documentation of having read, understood, and agreed to follow the SOP as written, on-the-job training and observation by a senior analyst.

Management personnel are responsible for planning ongoing professional growth and development activities for an employee through on-the–job training and/or internal and external training courses so an employee can maintain a current skill set to match job responsibilities.

An annual performance review based on job responsibilities, accountabilities, objective measures, and pre-defined standards is completed by management personnel for each employee. This assessment is documented and maintained. Input is obtained from other managerial personnel as needed. Performance reviews are maintained in the employee's personnel file and are confidential.

2.11.1 New Hire Training

New employees are oriented as part of a year-long process that is designed to make the employee feel welcome and comfortable by defining our culture, traditions, philosophies, and work practices. During the orientation process an employee learns about personnel and safety policies and business strategies in addition to quality, ethics, and customer satisfaction expectations through a formal process administered by collaboration of our Human Resources staff, QA, and the management of the employee's assigned department.

New employees are required to attend "core" technical orientation, as applicable, which can entail the participation in training module exercises, short session attendance, and/or other skill training specific to their assigned department or

job function. Additional job-specific training required for an employee is based upon their assigned duties and is identified by their supervisor. Technical orientation occurs during the first few weeks of employment.

Note: Seasonal and temporary employees have reduced “core” training requirements based on the assigned tasks and as defined by QA, Safety, and the assigned department management.

The orientation process is designed to enable employees to initiate and take responsibility for their personal and professional career growth at the laboratory. The orientation process is conducted without regard to employee race, color, creed, national origin, sex, age, or disability in accordance with the laboratory’s Employee Equal Opportunity (EEO) policy.

2.11.2 Ongoing Training

Refresher and ongoing training occurs through various means, which include but are not limited to, training in or independent review of new/updated standard operating procedures and work instructions; on-going regulatory training; in-house or off-site classes or seminars. The goal of this training is to ensure that employees remain current with changes to laboratory systems and practices, as applicable to their job function. Retraining and re-qualification activities occur as directed by procedures or regulations. Employees are retrained if an issue or investigation warrants that retraining is a necessary corrective action. Management directs when employee re-training is required, and the extent of the re-training.

2.12 Regulatory Training

The QA Department is responsible for coordinating and conducting initial and ongoing regulatory training (e.g., Ethics) for all applicable laboratory and support personnel. It is the responsibility of management within each department to ensure that personnel attend the required training sessions.

The choice of training format and topics covered for ongoing regulatory training is left to the discretion of QA and the trainer. All training sessions reinforce the concepts in the regulations as they are relevant to the laboratory.

Whenever possible, after training is completed, a demonstration of proficiency of the training topic is given. The demonstration of proficiency is generally in the form of a quiz although other demonstrations of proficiency are acceptable depending on the scope and content of the training. If necessary, training is presented and/or repeated one -on-one with individuals who do not demonstrate proficiency in the training topic. This is performed by QA in conjunction with applicable laboratory management personnel.

2.13 Employee Safety

The laboratory, being mindful of its responsibilities as an employer and active corporate citizen, has established the following objectives of its safety program:

- Provide a safe environment for its employees, visitors, and the community surrounding its place of business.
- Provide ongoing safety training for employees.
- Provide all necessary facilities and equipment to ensure the safety of its employees and to minimize all chemical exposure during the normal performance of their required tasks, and to take all necessary precautions to safeguard the surrounding environment.

- Provide periodic health physicals for employees.

- Foster and encourage safe operations and a proper safety attitude on the part of our employees through general operations and systems, training, and the *Chemical Hygiene Plan* (CHP).

The CHP addresses various aspects of our safety program in greater detail.

A Safety Committee works to enhance our overall safety program. The committee meets on a routine and ongoing basis and its specific responsibilities are detailed below:

- Review accident and incident reports. Make recommendations for methods of prevention to eliminate further accidents.

- Promote safety awareness and distribute safety information by various means (e.g., posters, videotapes, pamphlets, and books). Use internal communication channels to promote safety awareness.

- Enhance and recommend safety-training programs for all employees, as necessary.

- Maintain up-to-date information on employee concerns that are safety related. Offer input and information to the Chemical Hygiene Officer and/or Safety Officer, as needed.

2.14 Client Services/Project Management Responsibilities

Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager (a.k.a. “CSR” or "PM") who serves as their primary contact at the laboratory. It is the project manager’s responsibility to act as the client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements. While most communication occurs and is stored via email, all client verbal communications are documented by the project manager in a controlled notebook. In addition to information management, Project Management responsibilities include:

- Coordinating and preparing proposals in conjunction with technical staff.

- Confirming certification status.

- Assisting QA with hosting client visits and audits.

- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.

- Answering common technical questions, facilitating problem resolution.

- Providing clients with sample status report or results (partial reports) prior to receipt of the final Analysis Reports.

- Scheduling sample submissions, sample containers orders, and sample pick-up via the laboratory courier service.

- Informing the client of deviation from their contract.

- Documenting client concerns in the LIMS; directing priority or high risk concerns to QA when formal investigation is needed.

2.15 Confidentiality

Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are willingly provided.

All employees are required to protect company data, including client names and test results from disclosure to any third party. This policy, as described in the *Eurofins Lancaster Laboratories Employee Handbook*, is provided and presented to employees during their orientation period and whenever revisions are made.

Intellectual property associated with the testing that we perform under contract for a client is the property of the client.

In an attempt to ensure the confidentiality of our systems and procedures within our laboratory, it is our policy to restrict the distribution of our internal procedures to clients. Requests for copies of SOPs to be provided to clients must be approved through QA. Audit and investigation reports are considered company confidential. Audit or investigation summaries will be generated as needed for a client. Personnel files are strictly confidential and facility floor plans may only be viewed on site.

2.16 Business Conduct

Our business conduct policy applies to all operations of the company. All employees must avoid involvement in any activities that would diminish confidence in their competence, impartiality, judgment, or operational integrity. All employees must further avoid any relationship with other individuals or organizations that might impair, or even appear to impair, the proper performance of their company-related responsibilities. Employees must avoid any situation that might affect their independence of judgment with respect to any business dealings between the company and any other organization or individual. Any employee who believes that they have such a conflict, whether actual or potential, or who is aware of any conflict involving any other employee must report all pertinent details to the President, QA Director, and/or Operations Director of the company. The company's management vigorously enforces this policy and takes prompt and appropriate action, including termination, against any employee found to be in violation.

2.17 Operational Integrity

All employees review and sign the Employee Ethics Statement on their first day of employment and annually thereafter. All employees are instructed in regard to how ethics and data integrity are relevant to every position in the company. Employees responsible for generating, handling, or reviewing laboratory data understand that the laboratory mission is to perform all sample processing and testing with the highest level of integrity. Under no circumstances are shortcuts or generating results to suit a client's purpose rather than good scientific practice considered acceptable. Any violation of the laboratory ethics policy results in a detailed investigation that could lead to termination.

All levels of management consider the following activities unacceptable:

- Knowingly recording inaccurate data.

- Fabrication of data without performing the work needed to generate the information. This includes creating any type of fictitious data or documentation.

- Time travel or adjusting clocks on computerized systems to make it appear that data was acquired at some time other than the actual time.

- Manipulation of data for the express purpose of passing system suitability or quality control criteria.

- Selective use of data generated, or not using data that was legitimately generated and has an impact on the outcome of the test.

- Executing significant deviations from approved test methods and procedures without prior approval from the laboratory management, QA, and/or the client.

If an issue does arise which could compromise data integrity, personnel are instructed to perform the following activities:

- Clearly document the situation and maintain all data generated. There is a big difference between poor judgment and fraud. Fraud usually involves intent to conceal an action taken. Therefore, the more documentation that is maintained, the less likely an action is considered fraudulent if further scrutinized.

- When out-of-specification results or quality type issues are detected, all supporting data and relative background information must be documented and presented for management review. Problem resolution and client contact, as applicable, must also be documented.

- Review any questionable situations and decisions with a supervisor.

- Bring a questionable or uncomfortable issue directly to the QA Director or a member of the QA Department as part of our QA open door policy.

- Utilize the company's anonymous Ethics hotline service. See Section 12.4 of this manual.

3.0 BUILDING AND FACILITIES

3.1 Facility

The laboratory is located at 2425 New Holland Pike, Lancaster PA. The facility consists of two campuses with multiple buildings located on the North and South sides of Route 23. The two campuses are connected by a pedestrian bridge that spans Route 23.

Building A resides on a commercial plot measuring 13.6 acres on the north side of Route 23. Building A is a three-story building of concrete and steel construction which houses both laboratory space and administrative offices. It is approximately 108,000 square feet and consists of approximately 47,000

square feet of laboratory space; 29,000 square feet of office space; and 32,000 square feet of storage, mechanical, and common areas. On this parcel, adjacent to Building A, sit two chemical storage buildings (Buildings I and L) with a total space of 2500 square feet. In addition, a 10,500 square foot storage building houses stability chambers (Building J). The bottles packing area, which includes preservation of bottles being sent to clients for sampling, is located in a separate 3100 square foot building (Building K). In addition, there are two other buildings (Buildings G and H) with a total square footage of 20,000 square feet that host recycling, storage, workshop and facilities maintenance areas.

The remaining buildings reside on a commercial plot measuring 35.7 acres on the south side of Route 23. These building are connected to the north campus buildings via a pedestrian walkway over the highway.

Building B is a three-story building of steel and concrete construction. It is approximately 56,000 square feet and consists of approximately 17,000 square feet of laboratory space; 14,000 square feet of office space; and 25,000 square feet of storage, mechanical, and common areas.

Building C resides between buildings B and D and consists of a three-story building of steel and concrete construction. It is approximately 47,000 square feet and consists of approximately 25,000 square feet of laboratory space; 6,900 square feet of office space; and 15,100 square feet of storage, mechanical, and common areas. The first floor houses the main lobby and visitor's entrance.

Building D is connected to building C. It is a 78,000 square foot, four-story building of steel and concrete construction and provides approximately 35,000 square feet of laboratory space, 19,000 square feet of office space, and 24,000 square feet of storage, mechanical, common area.

Building M is a four-story laboratory and office building constructed of steel and concrete located over a ground-level parking garage. The building is approximately 163,700 square feet, 46,000 square feet of office space, 34, 000 square feet of office space, and 65,000 square feet of support area including conference rooms, restrooms, hallways, cafeteria, dining, shipping dock, and mechanical spaces.

Building R is a single-story 920 square-foot masonry building adjacent to building "M" that housed chilled water pumps and cooling towers.

Buildings "V,W,X" are storage buildings adjacent to building "M" that support new chemical storage and waste storage operations. Total space is approximately 1850 square feet.

Building N is a two-story, masonry, 18,800 square-foot building that houses administrative services for Eurofins US operations. This building is located in a nearby condominium complex. Services provided include accounting, purchasing and human resource operations.

Building S is a two-story stone, masonry, and wood-frame barn consisting of approximately 13,700 square feet. This building is used for storage of facility materials and equipment.

Building T, located on an adjacent parcel, consists of a single-story, 21,000 square-foot, pre-engineered metal building hosting storage, pharmaceutical medical device testing, and training facilities.

Two small support buildings (Buildings E and F) with a combined space of approximately 800 square feet are used for chemical and waste storage on the south campus.

Building U is a 18,000 square foot stability storage building.

There is an automatic fire alarm and security system hooked up at the facility. This system is monitored offsite by Choice Security. The entire campus and all exterior doors are monitored by video surveillance.

All facilities are serviced by public sewer. Drinking water and the facility sprinkler system is fed by the public water supply. Laboratory process water is supplied via on-site wells. The closest surface water is the Conestoga River.

3.2 Security

The laboratory is considered a secure facility. All outside doors except the main lobby entrance are locked during normal business hours to prevent unauthorized entry. An attendant monitors this entrance at all times.

During evenings, weekends, and holidays, all doors are locked and Security personnel are on site to prevent unauthorized entry into the building. Video cameras are utilized by Security personnel to monitor the facility grounds.

Every employee is issued a photo ID badge which also serves as a building access card. This badge must be worn at all times while on laboratory property so that employees are easily identified. Access to secured/designated areas within the building is limited to only applicable employees through the building security system. This system is administered by Security staff.

All visitors must register with the lobby attendant and are issued a visitor badge. A staff person must accompany visitors while in the facility. Additional visitor rules are outlined in the *Visitor Security and Safety Rules* pamphlet which is provided to all guests.

Building access cards are issued on a temporary basis to contractors or service technicians (e.g., electricians and plumbers) who need access to the building to work on a project. These cards provide the contractor with limited access during the normal workday and must be returned when the work is complete.

3.3 Disaster Recovery

A disaster recovery plan is in place to provide direction for situations where normal operations of the laboratory are not possible. In the event that the building or information technology (IT) systems would be severely challenged, a designated disaster recovery team, which includes Physical Services, Maintenance, Safety, Corporate Management, Public Relations, IT, QA and other applicable personnel depending on the scope of the disaster, would assemble at a designated area to assess the situation and formulate a plan.

The plan addresses, in general terms, how to approach the following issues: electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, and stability chamber failures.

3.4 Environmental Monitoring

The air handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors to ensure that samples are not contaminated. The Physical Services/Maintenance Group is responsible for maintaining the HVAC and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive pressure system is maintained.

Most refrigerators, freezers, incubators, and ovens used for analysis are monitored by a computerized system equipped with stationary thermometer temperature probes linked to a master panel that is accessed through a computer. If a unit is outside of a predefined temperature range for a specified period of time, the system alarms. Units not on the computerized system must be monitored manually by recording thermometer temperature readings twice daily.

The laboratory is set up so that there is effective separation between neighboring areas in which there is potential for contamination. Laboratory storage blanks are also used to evaluate conditions under which samples for volatile analysis are stored to monitor for cross-contamination potential. QA provides oversight of the environmental monitoring system.

QA and technical management, in consultation with facilities management as needed, evaluate any issues with environmental conditions that could have adverse effects on data to determine if alternative operational plans (moving testing to alternate laboratories, temporary shutdowns, etc.) need to be employed.

3.5 Water Systems

Well water and the public sewer system service the facility. The water system is monitored to meet the permit requirements of the Pennsylvania Department of Environmental Protection.

Reagent water is available to analysts for sample preparation (including dilution) and glassware cleaning. Two reverse-osmosis deionized water systems deliver highly purified water to a sealed fiberglass storage tank. From the storage tank the water is delivered to an ion-exchange-carbon filter system for further polishing. The water is also exposed to an in-line ultraviolet sterilization lamp before being circulated to taps throughout the laboratory.

Daily monitoring and preventive maintenance for the system is the responsibility of the Physical Services Department. Monthly and annual testing is performed as required by regulatory guidance. QA provides oversight of the water system monitoring. In addition, method blanks are tested with each batch (=20) of samples.

3.6 Housekeeping/Cleaning

The laboratory is dedicated to providing a clean workplace. A third party professional cleaning service provides routine cleaning of "common areas" that include lavatories, drinking fountains, floors, and windows. Technical staff are responsible for the cleaning (or the contract of cleaning) of specific laboratory work areas.

Detergents used for cleaning contain no to very low levels of metals, pesticides/herbicides/ fungicides, or volatile solvents.

3.7 Insect & Rodent Control

Steps are taken to prevent, monitor, and control insect and rodent infestation. The coordination of this program is the responsibility of the Physical Services Department under the direction of QA. An outside service firm is contracted to perform routine and ongoing monitoring of the facility to ensure that preventive measures which are in place are effective and are working as intended.

No insect or rodent control chemical agents in a liquid or vapor form are applied or sprayed in any laboratory building, unless there is no other option, in which case department management must be contacted for approval.

3.8 Emergency Power Supply

The laboratory is located at the junction of two power grids that supply electrical service to the facility. If one of the power grids fails, we have the ability to work with the power company to have service switched to the other grid. Various types of diesel and natural gas generators are also available on a standby basis to supply power to selected areas of the laboratory in case of a power outage.

To reduce spikes and spurious line voltage changes to laboratory instruments that can affect results or damage electronic equipment, "conditional power" is fed to these sensitive instruments. All essential computer systems are on uninterrupted power supply (UPS) which is a battery system that provides continuous conditional power for a limited time period in the event of a short power outage.

3.9 Facility Changes

Procedures are in place to manage change, ensure communication, and to minimize negative consequences through active participation of personnel involved in a facility change. The goal is to ensure that physical and environmental condition changes are adequately evaluated for impact and reduction of risk to quality, safety, health, employee, environment, property, analytical services, and business operations before and after the change is implemented.

4.0 DOCUMENT CONTROL

The administration of the document control system including tracking, filing, updating, and archiving of inactive copies is managed by the laboratory and QA staff using an electronic record keeping system. All documents are maintained and accessed through the electronic system. If an employee or department uses hardcopy versions of the documents, they are responsible to ensure that they are using the active version of the document.

It is our policy to restrict the distribution of our internal procedures to clients and we discourage the distribution of company confidential documents outside of the facility. Clients are permitted to review our procedures while on-site as part of an audit or visit. Any documents that are distributed are only sent with the approval of QA and are considered "Uncontrolled".

The goals of the document control process are:

- Format documents according to consistent and defined standards
- Review and approve new documents
- Schedule review of existing documents
- Control of document versions and effective dates
- Review and approval of document changes
- Communicate and track employee training on SOPs
- Control document distribution and removal of obsolete documents
- Archive obsolete documents

4.1 Hierarchy of Internal Operating Procedures

The hierarchy of controlled procedures at the laboratory is defined. The levels (e.g. Policy, SOPs, work instructions, forms) are identified for each document in the document control system. These procedures and documentation are made available to promote consistency throughout the organization and to meet regulatory requirements. A list of relevant methods and procedures is located in Appendix E. The development of new procedures and the review and updating of current procedures is ongoing based on laboratory changes, new method development and regular review cycles.

4.1.1 Level 1 - Quality Policy Manual and Company Policies

The intent of these documents is to define "what" we do with emphasis on Executive and Management's responsibility for quality.

The purpose of the Quality Policy Manual is to provide a framework to outline the quality systems at the laboratory. Information on key quality system processes is described within the manual. Organizational

charts, list of SOPs, a list of equipment, instrumentation, and PQDs for senior personnel are included as attachments to this manual.

- Executive Management is responsible for ensuring that adequate personnel, resources, and support are available to carry out the requirements of this Quality Policy Manual.

- Management is responsible for ensuring that SOPs, Work Instructions, or other appropriate documents are written and available to personnel to define the practices and systems which support these policies.

- All employees are responsible for conducting business in a manner which is compliant with quality and company policies and associated SOPs, Work Instructions, or other appropriate documents. Review of these policies and procedures must be documented.

Additional company policies are written to support and expand upon this Quality Policy Manual. These policies contain more detailed information about a subject with approval signatures executed at the Executive and/or Management level.

4.1.2 Level 2 - Standard Operating Procedures

The intent of these standard operating procedures is to define "who, what, where, and when." These procedures provide specific information for a process or topic so that the requirements outlined in this *Quality Policy Manual* and company policies can be achieved. The review and approval of these SOPs is performed at the director/manager/group leader level, including QA review and signoff, and the responsibility of these SOPs lies with the area or person directing the operation.

SOPs can apply to site-wide operations, the entire company, across multiple departments, or a specific operating area.

4.1.3 Level 3 - Work Instructions (at a department level)

The intent of these procedures or documents is to define in greater detail the specific "how to". The level of detail in these documents must be sufficient so any appropriately trained person can perform the task accurately. Examples include, but are not limited to departmental standard operating procedures (SOPs); maintenance and calibration procedures; and the laboratory analytical methods. Departmental level procedures/documents are reviewed and approved at the manager or group leader level including QA review and signoff.

4.1.4 Level 4 - Quality Records

The intent of these documents is to provide documented evidence to support our quality systems and operations. Examples include but are not limited to, data notebooks/logbooks, and preformatted data recording forms.

4.2 Document Approval, Issue, Control, and Maintenance

The document control process ensures that documents are approved and adequate for use. It ensures that documents are readily available to personnel and at locations where essential operations are performed.

Procedures are available to all employees in electronic form through our document management system. The laboratory management and QA staff is responsible for ensuring the documents in this system are in a current and accurate state. These procedures can be printed from this system for reference by employees as the corresponding task is being performed. Prior to using a printed document, the employee **must** ensure that it is the current version.

Each procedure is uniquely identified and includes effective date, version identification, designated user groups and the "approved by" employee. Document editors and reviewers are recorded in the electronic system for each version of a document. All documents are searchable and uniquely identified in the document management system.

Controlled policies, procedures, and work instructions are reviewed and approved by appropriate individuals and are formally issued and administered through the electronic document management system. The editor, reviewer and approval personnel are recorded within the document as through the document control interface. The recording of these steps is through the employee's secure network log -in and password. Designated personnel are assigned the editor, reviewer, and approval roles. Administration of the role assignments is managed by QA.

Procedures undergo scheduled annual review to ensure that they are accurate, current, and compliant. QA is the final approver and publisher on procedures which gives QA the authority to implement the procedure. Forms may be approved and published by department management. Upon the effective date of new or updated documents, all copies of obsolete documents are removed from service.

Interim amendments to procedures are not allowed. Any needed changes require a revision to the document. The document management system has a feedback function which enables information to be given to the assigned document editors. If minor edits (e.g. typos) are identified that can wait until the next review cycle, these can be communicated through the feedback function.

Forms are frequently used in logbooks. The logbooks are created by the Office Services group. The appropriate form is provided to Office Services to be made into a logbook. The logbook is given a unique identification number and is tracked by Office Services in regard to issuance to the associated department and through to subsequent archival.

4.3 Client-Supplied Methods and Documentation

Client documentation to support environmental testing at the laboratory is maintained in a centralized area. This information is organized by client/project in the Client Services/Project Management Group. Client documentation includes the following information depending on project size and scope:

- Client supplied analyte lists

- Client supplied project plans
- Client contract quality manuals with specified limits, QC criteria, etc.
- Communication/correspondence records which relate to testing requirements, interpretation of results, or reporting formats

4.4 Laboratory Notebooks, Logbooks, and Forms

Procedures are in place to ensure that all data is traceable, authentic, complete, and retrievable. Most documentation and records are maintained within the LIMS. For data that requires a physical log, the following general requirements outline our system for the issuing, control, and archival of laboratory notebook and logbooks.

- The administration of notebooks and logbooks is controlled by the Office Services Group. They maintain a master index to uniquely number and identify each book distributed.
- Notebooks and logbooks can contain blank or preformatted pages.
- Notebooks and logbooks are bound, uniquely identified and have sequentially pre-numbered pages.
- If notebooks or logbooks contain preprinted laboratory form pages:
    - A unique identification number is assigned to each form
    - Forms are approved through the electronic document management system by appropriate management personnel before they are put into use
    - Forms are reviewed on a routine basis to ensure they are still accurate and current
- Completed notebooks are returned to an archivist. Incomplete books are returned to the Office Services group:
    - Two years from the issue date
    - For employee specific notebooks – when the employee leaves the company
    - For project specific notebooks – when the project for which it was used is complete
- In specific situations, records may be bound to create books at the time of archival (e.g., temperature charts).

- At the time of archival any page(s) in the notebook or logbook that does not contain data documentation is crossed-out or a statement is written on the last page used to note that the book is complete to prevent data from being entered at a later date.

- Notebooks and logbooks identified as requiring permanent archival are assigned a designated qualifier.

4.5 Control of External Documents

Hard copy versions of external documents are controlled using an inventory form in the document management system. Any external document that is maintained in the laboratory are inventoried and listed on a department specific controlled form.

External documents such as copies of the 40 CFR and ASTM methods are stored exclusively in the QA Department. QA also keeps applicable agency documents on file, these include, but are not limited to, the TNI (The NELAC Institute) and ISO 17025 Standards.

Environmental methods from the EPA or Standard Methods are available in the QA Department, but the technical areas also have copies that pertain to the tests that they perform. Some methods are available on-line and are accessed through the Internet.

It is the laboratory's understanding that the need to control external documents is to ensure that the most current version of a method is referenced or appropriate manual is being used. Regulatory methods are used as references by the laboratory and testing is performed as per written SOPs that fall under our existing document control system and have scheduled reviews. The scheduled review of SOPs is used to ensure that the proper version of a method is referenced. While using the most current version of an analytical method is our typical practice, there are specific client needs and accreditation rules that require previous versions of a method to be used.

The technical areas are responsible for ensuring that all manufacturers' manuals are current and available to analysts. The vendor provides instrument manuals when new equipment is purchased or existing instruments are updated. These manuals are kept with the instruments to which they are associated.

5.0 SAMPLE HANDLING

5.1 Sample Collection

It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples of the system from which they are drawn. The laboratory assumes that all multiple sample containers with the same designator/description and bottle type contain a homogeneous, representative sample. We also assume that it is acceptable to deplete one container and move to the next, without implications unless otherwise indicated by the client.

The laboratory provides the appropriate sample containers, required preservative, chain-of-custody (COC) forms, shipping containers, labels, and custody seals. The laboratory also provides trip blanks

and analyte-free water for field blanks. Preparation of methanol containers for field preservation of volatile soil samples is available.

Sample containers are purchased pre-cleaned by the supplier. For pre-preserved bottles, each lot of preservative is checked for contaminants before use. This also serves as a check on the associated containers. An annual bottle lot check is performed to evaluate the cleanliness of any containers not already covered by the preservative checks. The evaluation is to assess cleanliness to the laboratories' detection limits. These checks are processed through the LIMS as samples. Results are documented through the LIMS Analysis Report.

The laboratory provides instructions with all bottle orders that define how to sample, preserve, store, and ship the samples prior to their delivery at the laboratory. These instructions inform the client of the importance of proper sampling and advise them that non-compliant samples are rejected or reported with a qualifier.

As samples are analyzed at the laboratory, there are times when additional sample volume is necessary to complete testing or perform retesting. If this situation arises, "additional sample" is requested by the laboratory and/or submitted by a client to supplement current work being performed within our facility. Additional sample received is either assigned a new laboratory sample ID number and/or a comment noted on the final report to state that additional sample was received, depending on the situation. It is our goal to provide accurate traceability between sample submission and when testing is performed.

5.2 Sample Receipt and Entry

5.2.1 Sample Entry

Samples can be received at the laboratory 24 hours a day, 7 days a week, 365 days of the year. Receipt can occur in one of three ways:

- The laboratory courier services (i.e., Transportation Department
- Personal delivery
- Commercial courier

All samples received for testing are delivered to the Sample Registration group immediately upon arrival. This group is responsible for the unpacking and organizing of the samples. This process includes checking custody seals if present, paperwork agreement, signing the chain of custody, recording cooler temperatures, documenting the condition of containers, accounting for all sample bottles, and observing any safety hazards, and reporting any problems to Client Services for communication to the client. This receipt process is documented in the LIMS.

5.2.2 Sample Entry

As soon as practical after sample receipt, all samples are entered into our LIMS. Samples awaiting log-in are stored in temporary holding areas, at appropriate storage conditions to maintain sample

integrity. Samples scheduled for Volatile analysis are stored separately. If there is doubt about the suitability of items received or if items do not conform to the description provided or the testing required is not clear or specified, the client is contacted and the conversation documented.

At the time of entry, the LIMS assigns a unique laboratory job and sample number to each sample. This job number is sequentially assigned and a label is generated and is attached to the sample container. Each sample container is uniquely identified with a container descriptor and unique container letter designation. The sample number and container used are documented on laboratory data records to ensure traceability from the test data to the sample container that was used. The label includes a barcode that can be used to confirm/enter the sample identification information throughout sample processing.

Sample receipt is documented to the minute. Sample entry and subsequent analysis times are documented in the LIMS.

A sample acknowledgement is generated from the LIMS per sample entry group. Upon request, a copy of the Acknowledgement may be sent to the client on the day following sample log-in to confirm sample receipt and entry. Internally, appropriate personnel audit all applicable sample entries against the client paperwork.

5.2.3 Sample Preservation Check

Sample Registration personnel check and document preservation of non-volatile liquid samples after the samples have been entered into the LIMS and before they are released to the laboratory for testing or placed into storage. Any checks of volatile samples are performed and documented at the time of analysis.

5.2.4 Sample Rejection Policy

Regulated (e.g. drinking water, NPDES) samples are rejected if receipt requirements are not met. The laboratory's Sample Acceptance Policy is communicated to clients with each bottle order. Any time a sample is received in a condition that does not meet the method, regulatory, or client requirements, the condition of the sample is clearly documented through the LIMS using a sample registration receipt checklist and receipt comments. This information is communicated to the CSR and the client is contacted to discuss the best course of action. The client is given the option to resample or have the sample analyzed and reported with a qualifying comment. Some regulatory programs do not allow qualification. Details are provided in the Sample Acceptance Policy.

5.3 Sample Identification and Tracking

A sample label is generated for each sample and, in addition to the assigned unique sample number, the following information is displayed on the label: unique container identification, container type, storage location, client sample designation. The label includes a unique barcode that is used to track this information about the sample/container and to trace each container's storage location.

To ensure accountability of results, the unique sample number assigned is used to identify the sample in all laboratory data documentation, including notebooks, instrument printouts, and final reports. The

sample number is also used to identify additional containers of the sample that are created during sample preparation and analysis (e.g., subsamples, extracts, digests). Each container for a sample is tracked through the sample number and container designator code when there are multiple containers of the same type received. This is used to identify which specific container was used for testing.

Routine sample tracking is documented using the Laboratory Chronicle which captures the date, time and analyst for each sample preparation and analysis. The information is compiled in the LIMS using electronic record tracking from the data upload and entry functions. This displays, per sample, on each Analysis Report.

5.4 Sample Storage

After sample registration is complete, samples are placed in an assigned and identified storage location until needed for analysis. Room temperature, refrigerated, and frozen storage are available and samples are stored in accordance with regulatory, method, or client direction. The LIMS is used to assign storage locations, which assists in the orderly storage of samples. Sample storage locations are secured and monitored for accurate temperature control. Samples are stored separately from standards and reagents.

The central locked storage facility contains 3430 square feet of refrigerated space, including 2740 square feet equipped for automated sample retrieval. Samples are stored in the laboratory's automated storage and retrieval system (ASRS) or other assigned storage locations (separate volatiles areas) within the laboratory until completion of all analytical work.

When a sample is scheduled for analysis, the analyst requisitions it through the LIMS from the storage area. Barcode readers are used for LIMS documentation of the movement of the samples between storage and the laboratories. To maintain the integrity and security of the sample(s), the aliquot needed for analysis is removed and the sample(s) returned to storage as soon as possible.

5.5 Sample Return/Disposal

Samples remain in the storage area following analysis until the testing results have been verified and the analysis report has been generated. On a regular basis, a list is generated from the LIMS that summarizes samples that can be removed from the storage area. At a minimum, water samples are held for 1 week and soil samples for 2 weeks after reporting before they would be eligible for disposal. Samples are either returned to the client or disposed of in accordance with local, state, and federal regulations. Removal of the containers from storage for permanent discard is also documented in the LIMS using the barcode reader.

Due to the variety of waste generated at the laboratory, several general categories of wastes and waste streams have been identified. Identification of waste occurs through information provided by the client, historical information, and/or analytical testing. The laboratory uses a sophisticated, computerized LIMS, which includes programming to assist in the identification of hazardous wastes at time of discard.

For reasons of environmental liability, client confidentiality, proprietary product formulation protection, etc., wastes generated by the laboratory are disposed of via incineration at EPA licensed facilities. The three exceptions include bulk neutralized acid waste, COD analysis waste, and lab pack waste containing mercury. None of these exceptions involve containers with client information.

5.6 Legal Chain of Custody

Samples being tested for litigation require locked storage and documentation of the time and personnel responsible when the sample was not in storage. This level of documentation is available upon client request and procedures to define these activities are in place and include the following:

- A chain-of-custody document is initiated for each bottle type submitted by the client.
- The chain of custody is signed each time the sample is stored, removed from storage, or changes hands.
- Clients requesting legal internal chain-of-custody documentation receive the completed forms after the analysis is complete.

5.7 Representativeness of Samples

Each analytical method provides specific procedures to ensure that a representative aliquot of the sample is used for testing. These procedures include shaking water samples and mixing solid samples prior to removing the aliquot for testing. Analysts are also instructed in sampling techniques that prevent contamination of samples and for handling volatile samples to minimize loss of volatiles.

6.0 TECHNICAL REQUIREMENTS - TRACEABILITY OF MEASUREMENTS

6.1 Reagents and Solvents

The reliability of our analytical results can be directly affected by the quality of reagents used in the laboratory. Procedures are in place to address labeling, storage, and evaluation of these materials. Reagents and solvents include acids, bases, indicators, buffer solutions, colorimetric solutions (CS), test solutions (TS), and volumetric solutions (VS). The *Chemical Hygiene Plan* provides safety information in regard to the storage and handling of laboratory chemicals. All reagents are stored separately from samples.

Each analytical method includes a list of reagents needed to perform the test. Reagents/solvents are fully described, including chemical name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed. The laboratory is responsible for checking that new supplies meet the method requirements. These checks are documented and maintained.

Departmental management ensures that an adequate inventory of reagents needed to perform testing is maintained. Reagents received at the laboratory funnel through the Shipping and Receiving Department and deliveries are verified and labeled with the date of receipt. Large volume reagents (e.g., solvents, acids) are stored in a building outside of the laboratory until needed for use.

In addition to the name and concentration of the reagent, all reagents are labeled with the manufacturer/vendor, storage conditions, the date opened, and an expiration or re-evaluation date. Before using any reagent, the analyst must ensure that the material was properly stored and labeled. If a reagent has passed its expiration date or shows signs of deterioration, the material is not to be used in the laboratory and must be discarded or segregated as expired. In some method development or research work, expired reagents may be used. These must be labeled as such or stored in a designated location.

If a re-evaluation date is reached before a reagent is completely consumed, the reagent will be inspected by physical observation for signs of degradation. Physical signs include, but are not limited to, color changes, clumping or other texture changes for solids and formation of precipitate in solutions. This evaluation is performed by an experienced chemist.

Subsequent reagent solutions or mixtures prepared at the laboratory are fully documented in a log and labeled to include: unique name, concentration, date prepared, name of analyst who prepared the reagent, storage conditions or reference to the log containing these details, and expiration/re-evaluation date. The information recorded allows these solutions to be traced to the original stock solution. The reference to the log is intended for use on containers that are too small to clearly document all of the information. The "log" may be a LIMS identifier for reagents/standards with preparation tracked via the LIMS.

All reagent certificates and MSDSs are retained by the laboratory.

6.2 Calibration Standards

Written calibration procedures are required, where applicable, for all instruments and equipment used in the laboratory. The source and accuracy of standards used for calibration purposes are integral to obtaining quality data. Requirements for calibration are provided in each analytical method including specifications for the standards used. Where available and practicable, calibration measurements made by the laboratory must be traceable to national standards of measurement (e.g., NIST). Certificates of Analysis (C of As) are maintained for each material, as applicable.

The laboratory's ISO 17025 and DoD accreditations require calibration materials to be certified and purchased from a reference material producer accredited to ISO Guide 34 and ISO 17025, when available. A list of accredited suppliers is maintained by QA. This is applicable to the tests under these scopes of accreditation and can be met through the stock standards used for calibration; a standard processed under the calibration such as an ICV or LCS; or comparison to a separate reference material at a frequency defined by at the test level (i.e. annually).

Standards are usually purchased from commercial supply houses either as neat compounds or as solutions with certified concentrations. Upon receipt at the laboratory, the material must be labeled with the date of receipt. The accuracy and quality of these purchased standards is documented on a C of A and these certificates are maintained on file in the laboratory.

Most solutions and all neat materials require subsequent dilution to an appropriate working range. Records of all standard preparations include the dilution(s) made and a reference to the original and any intermediate mixtures. Solutions are labeled according to laboratory procedures and assigned unique names or code numbers that provide traceability to the original components.

All standards are stored separately from samples and in conditions as stipulated by the method or vendor (refrigerator, freezer, room temperature, etc.).

Each new preparation of standard is tested for integrity by comparison to standards from another source or previously prepared solutions. Standards are not used for sample analyses in the laboratory past their expiration date. In some method development or research work, expired standards may be used. These must be labeled as such or stored in a designated location.

6.3 Equipment and Instrumentation

The laboratory is equipped with all equipment and instrumentation required for testing the scope of work which it supports. All equipment and instrumentation is maintained in proper working order. A master list of our equipment and instruments is maintained by our accounting department and includes the date received and the condition at receipt (new v. used). Our major equipment and instrumentation capabilities are summarized in Appendix F. In addition, we have numerous other instruments including pH meters along with support equipment such as ovens, incubators, centrifuges, balances, etc.

6.3.1 General Requirements

Equipment/instrumentation is assigned a unique designation. This unique number or system identification is used to track the equipment or instrument within data documentation.

A maintenance logbook is established in conjunction with installation and is readily available to document all incidents and/or routine maintenance processes that pertain to the equipment or instrument as they occur. The corrective action taken, the date that the equipment/instrument is returned to service, and performance checks performed is documented.

All test, measuring, and inspection of laboratory systems, equipment, and instrumentation used at the laboratory is routinely calibrated and maintained in accordance with applicable standard operating procedures.

A member of the technical group, or designated individual, performs routinely scheduled maintenance and calibration of laboratory equipment and instruments as required by laboratory procedures. These activities are documented.

If appropriate standards or expertise for calibration or maintenance are not available in-house, the operation is conducted by an outside service firm, with appropriate accreditation. Certificates or other data generated by the service firm are reviewed by applicable the laboratory personnel to verify acceptability. This information is maintained on file.

All equipment or instruments taken out of service are tagged "DO NOT USE". The following minimum information is documented on the tag:

- Date taken out of service
- Employee who took the equipment/instrument out of service
- Reason for tag-out

6.3.2 Standard Operating Procedures

Information regarding operation, maintenance, and calibration of equipment and instrumentation is found in the respective SOPs. The procedures include, where applicable, a routine schedule for preventive maintenance and calibration along with acceptance criteria and remedial action to be taken in the event of failure. These procedures are maintained in the document control system and reviewed on a regular basis to verify they remain current and accurate. Vendor supplied manuals are also available to provide additional information in regard to operation and maintenance.

6.3.3 Maintenance

Instrument and equipment maintenance is performed as either a preventive or corrective operation. These processes and schedules are defined in the corresponding SOPs and Work Instruction documents.

Preventive maintenance procedures and schedules are developed for each instrument or piece of equipment, where applicable. Preventive maintenance operations are performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel). Documentation is maintained in the associated maintenance log for the procedure(s) performed as part of the preventive maintenance operation. It is the responsibility of departmental management to ensure that a preventive maintenance schedule is addressed by a procedure where appropriate and is followed.

Corrective maintenance is performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel) in response to indications of equipment or instrument malfunctions. The unit must be clearly tagged as out of service. All corrective actions taken to bring the unit back into service are documented in the associated maintenance log. After repair, further notation is made in the log regarding the functional status. Calibration activities are performed, as applicable, and documented in the log before the unit is placed back into service.

A supply of commonly needed replacement parts is maintained by the laboratory.

6.3.4 Calibration

Calibration is the establishment of, under specified conditions, the relationship between the values/response indicated by a measuring instrument or system and the corresponding known/certified

values associated with the standards used. Some types of calibrations are performed with a set frequency (e.g. daily) while others provide intermediate checks to ensure that the instrument response has not changed significantly.

All measuring and testing instruments and equipment having an effect on the accuracy, precision, or validity of calibrations and tests are calibrated and/or verified at least annually. Methods for calibration of instruments and equipment vary widely with the nature of the device and the direction given by analytical procedures, departmental procedures, manufacturer recommendations, or regulatory requirements. Frequency of calibration can also depend on additional factors including ruggedness of the instrument or equipment and the frequency of use. The calibration procedures, schedules, and acceptance criteria are defined in the corresponding SOPs and Work Instruction documents.

Departmental management is responsible for developing or acquiring written calibration procedures for the types of instruments and equipment employed within their area, as applicable. Procedures address the following aspects: description of the calibration method, frequency/schedule for calibration, acceptance criteria, and corrective actions if failure occurs.

Calibration information is recorded in a logbook that is associated with the instrument/equipment and/or a calibration certificate is maintained and/or data is generated and filed to document the activity.

Calibration measurements are traceable to national standards of measurement (e.g., NIST) where available. Physical standards, such as NIST certified weights or thermometers are re-certified on a routine basis. Calibration certificates are maintained on file, where applicable, to indicate the traceability to national standards of measurement. These physical standards are used for no other purpose than calibration.

Calibration failures are documented in the associated logbook and/or within the data generated from the instruments or equipment. Management personnel perform an evaluation and review of failures and assess any potential impact the failure might have on previously generated data. The laboratory utilizes "real-time" controls to ensure the accuracy of the data. These controls are used to assist in assessing the impact of the situation.

After repair, adjustments, or relocation that could affect instrument response, calibration/verification activities are performed, as applicable, before the unit is returned to service.

Analytical data is not reported from instrumentation or equipment with noncompliant calibration unless the client has agreed to receipt of the data and appropriate qualifiers or comments are applied to the final Analysis Report.

6.4 Computerized Systems and Computer Software

6.4.1 Computer Usage

The laboratory provides computer equipment for employees to use as a tool in performing their work. Computer equipment is the property of the laboratory and used in accordance with defined terms and conditions. Our goal is to provide standard hardware and software that meets the needs of the user. The majority of desktop PCs and laptops in use are standardized using cloning software.

6.4.1.1 Physical Security of Computer Systems

It is company policy to protect computer hardware, software and data documentation from misuse, theft, unauthorized access and environmental hazards. The corporate computer area and computer "Hot-Site" is locked and requires identification/building card access. All vendors, contractors, or other visitors must be escorted into this area. Controlled access of the laboratory buildings is outlined in Section 3.2.

6.4.1.2 Passwords

Passwords are important for the security of company data and resources. The laboratory's primary network operating system is Windows and each employee must have a user ID and password combination to access the system. Other computer systems also require a user ID password combination for access. The following procedures apply regardless of which system(s) is being utilized:

- Passwords must be created as strong passwords in accordance with Eurofins Password Policy and must be kept confidential.
- Users must log-out of a system when not in use to prevent unauthorized access. In addition, the network access will automatically timeout after a set period of inactivity, requiring a user to log-in to access the system.
- Forgotten passwords can only be reset by the IT Department or by an appropriate System Administrator.
- Network and LIMS passwords automatically expire at designated intervals. The computer prompts a user to change the password when the expiration date nears. If the password is not changed, the user will be locked out of the system.

6.4.1.3 Viruses

The laboratory centrally and continuously monitors the computer network for computer viruses. Employees are prohibited from using the company's computer equipment to propagate any virus. Anti-virus software is employed to detect viruses on the Windows network. A notification is sent when there is a particularly dangerous or virulent data destructive program that employees need to be aware of. However, employees are instructed to always be cautious and observant even if there are no current warnings. Employees must report any virus concerns to the anti-virus administrator or IT Management as soon as possible. Employees who share files between their home computer and the laboratory should install anti-virus software on their home computer. If an employee does not have such software, the laboratory can suggest various no-cost anti-virus software products.

6.4.1.4 Internet and E-mail Systems

The e-mail system is used primarily for the laboratory's business purposes. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to system usage. Employee access to the internet is restricted to those employees who have a business need for it. All employees have access to e-mail. Access to the internet is configured through a user's Windows network account. All internet and e-mail activity is subject to monitoring. All messages created, sent or received over the internet are company property and can be regarded as public information. E-mail and website filtering software is utilized.

6.4.1.5 The Laboratory's Intranet (LabLinks)

The Intranet is designed to be a useful tool for employees to acquire company information and to provide a company communication system. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to usage.

6.4.1.6 Software Policy

Copyright laws protect software, and the laboratory's intent is to abide by all software agreements.

Software purchases must be formally requested and approved by management and/or validation personnel, as necessary.

All software is used in accordance with applicable license agreements.

Employees are not to install any software on computer(s) unless authorized by the IT Department.

Software upgrades must occur in accordance with applicable change control procedures.

Employees must not give software to outsiders (e.g., clients, contractors), unless approval is granted by management.

Users must not make copies of any licensed software or related documentation without permission. Any user that illegally reproduces software is subject to civil and criminal penalties including fines and imprisonment.

6.4.1.7 Computer System Backup, Data Restoration, and Data Archival

Mission critical data is stored on several computers throughout the laboratory. These computers are connected through the local area network. Selected files on these computers are backed up using an enterprise-level backup software program. The objective of this backup is to have the ability to restore data after a total loss (e.g., theft, fire, natural disaster). Procedures are in place to perform data backups and restores.

6.4.1.8 Remote Access to Computer Systems

Designated employees are able to remotely connect to the laboratory computer systems through an encrypted (SSL) login. When logging in, users are authenticated with their Windows Active Directory

account and password.

6.4.1.9 Electronic Data

Instrument software used for processing data must, when available, have password access and audit trails enabled. All data processed through the LIMS includes tracking features to document who and when data was entered and/or changed.

6.4.2 System and Software Verification

The laboratory LIMS is an in-house developed program. The design and updates to the system are written following typical Software Development Life Cycle (SDLC) processes for initial planning through testing and implementation. Before a new computer system/program or significant modification of an existing system/program is implemented in our laboratory, it is necessary to generate a plan to specify the level of documentation required for the new or updated application. Developers, affected area management, and QA personnel review and approve the documentation.

The following are the typical documents that are compiled for these updates:

- System Change Request document – used for documenting/tracking changes in the programming
- Requirements documents – Describe the required system functionality and specifications
- Design documents – System overview, screen design, report layout, data description, system configuration, file structure and module design
- Testing documentation for system development/verification – Structural testing of the internal mechanisms and user testing of the installation and system qualification
- Periodic Review documents – periodic retesting of the programs is performed to ensure that the systems remain in a validated state.
- Retirement documents – used for documenting when a program is taken out of service
- Standard operating procedures and/or manuals

6.5 Change Control

Procedures are in place to define how to maintain facilities, processes, instrumentation, equipment, computerized systems, and computer software in a validated or controlled state through a plan of change control. Successful changes require a thorough evaluation and testing for potential consequences prior to implementation. Planning, authorizing, testing, and reviewing of proposed changes are documented throughout the change process. Changes are planned or could be made in response to an emergency situation. The following "general" elements apply to changes, as appropriate:

- Request to perform a change
- Evaluation of a change
- Authorization of a change request
- Preparation for an authorized change
- Execution and testing of the change
- Documentation of the change
- Approval of the change
- Change implementation and follow-up (Formal approval of the change is performed by designated responsible individuals and QA.)

Note: The DoD will be notified in advance of the migration to a new LIMS platform and/or relocation of the data center from the Lancaster site.

6.6 Labware Cleaning

Dedicated washroom personnel support the laboratory operations in regard to labware preparation, washing, rinsing, and drying. Labware can include, but is not limited to glassware, plastic ware, utensils, and pipettes. Procedures are in place to outline the washing process for each type of labware. Most labware is cleaned using a Miele glass washing machine. Some labware is still washed by hand and either air-dried or dried in specifically designed ovens.

Most of the labware used in the laboratory is "common or non-dedicated" labware (common to a department), but some of the labware used in the laboratory may be identified as "dedicated" labware and exclusively used for certain analyses. This labware is isolated and cleaned only with "like" labware.

All glassware is class A and 100% visually inspected for breakage (e.g., cracks, chips), cleanliness, and dryness before being returned to the laboratory for use.

Generally, each test has controls in place to ensure that results are not adversely affected by unclean labware. These controls include blanks to detect positive interferences and recovery controls to detect negative interferences.

7 PURCHASING EQUIPMENT AND SUPPLIES

7.1 Procurement

It is the responsibility of management personnel within each department to ensure that the appropriate supplies are available and/or ordered with sufficient lead-time to perform analytical testing or to provide support to the testing areas. The individual technical departments have trained personnel who

enter the supply order into the company's purchasing system. The selection of these products is based on technical input at the analyst level and authorized by technical departmental management. The Purchasing Department maintains an ordering system in which purchase requisitions are managed. Common laboratory items (e.g., beakers, flasks, reagents) are ordered directly through the purchasing system. Purchase orders over a specified dollar amount require approval from the appropriate member (s) of the Executive Management Group before an order can be placed.

Upon receipt of an order, the Shipping and Receiving Department checks the order to ensure that all items were received as specified. Products that have specific storage requirements are taken to the technical area upon receipt. It is the technical area's responsibility to ensure that the product is stored in the appropriate manner. Any checks on the quality of the materials received for use in a specific test are the responsibility of the laboratory using them. This is based upon the experience of the laboratory with the usability of the product. Generally, each test has controls in place to ensure that test results are not adversely affected by the materials.

Any problems encountered when using a material in the laboratory must be brought to the attention of the Purchasing Department and/or Quality Assurance, as applicable, to ensure that follow-up and corrective action occur.

7.2 Supplier Evaluation

Procedures are in place to evaluate vendors who supply us with: new equipment, instrumentation, computerized systems and computer software; commercially purchased glassware, including sample bottleware, reagents, chemicals, solvents, gases, media, and standards; and contracted and subcontracted services.

The laboratory strives to ensure that our suppliers continually improve their quality systems and we reserve the right to purchase from suppliers of our choice in order to best fulfill the needs of our clients and our business. When directed by a client to purchase from a specific supplier, we will do so. In this instance it is the client's responsibility to "qualify" the specified supplier. We attempt to purchase from businesses that we have an established purchase history or have previously acquired information regarding the supplier's quality programs.

The laboratory does not evaluate every supplier. Risk assessment is taken into consideration when making this decision. The risk assessment analysis includes system, material, services, and number of samples or operations the purchase may affect or support. Evaluations are not required for computer operating systems, utilities, toolsets, or systems software. They also are not required for any off-the-shelf configurable software package that has an extensive market performance history (e.g., Microsoft Word, Excel, Access).

Additional quality systems are also in place within the laboratory to further verify and support the materials used:

- C of A for every lot of purchased chemicals, where available, are reviewed and maintained on file.

- For most chemical analyses a blank and a recovery check are routinely analyzed and serve as real time suitability testing of the reagent being used.

8 ANALYTICAL METHODS

8.1 Scope of Testing

Samples are analyzed in accordance with official published methods, standard methods, client-supplied methodology, or validated in-house methods. We recognize the importance of providing verifiable results and, therefore, use methods accepted and approved by a broad range of federal and state regulatory agencies. The laboratory can also assist in developing and validating analytical methods for specific products and matrices. All methods submitted for our review, as well as all analytical results, are considered confidential.

The laboratory performs a wide variety of environmental testing in support of the Safe Drinking Water Act (SDWA); Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA/Superfund); and the Clean Air Act (CAA). Methods approved by ASTM are also used in testing. Potable water, wastewater, soil, sediment, sludge, oils, biota, tissue, soil gas, and air are among the matrices typically analyzed.

Our areas of expertise include:

Standard Services	**Specialty Services**
• Volatiles • Semivolatiles • Metals • Pesticides/PCBs/Herbicides • Petroleum Analysis • Waste Characterization • Non-potable Water Testing • Drinking Water • Soil and Surface Water Testing • Vapor and Air Analysis • Sediment and Tissue Testing • Method Development • Shale Oil & Gas Analysis	• Dioxins & Furans • Hydrazines and NDMAs • Perchlorate • 1,4-Dioxane • Pharmaceutical Manufacturing Industry (PMI) Wastewater • EPA Method 25D • PCB Congeners • Explosives • Alkyl PAHs, Alkanes, Biomarkers • PFAS • Organic Acids • Aldehydes

All current certificates and scopes of accreditation are available on the laboratory's website https://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/certifications-and-accreditations-eurofins-lancaster-laboratories-environmental/. A complete list of the tests routinely performed by the laboratory can be found in the *Schedule of Services*.

8.2 Analytical Test Methods

Each laboratory is required to establish and maintain analytical procedures for all the methods referenced in standard testing. The sources for these methods include the most recent versions of these compendia:

- Test Methods for Evaluating Solid Waste, SW-846
- Standard Methods for the Examination of Water and Waste
- Code of Federal Regulations, Chapter 40
- EPA 100 through 600 and 1600 series methods
- ASTM

The test methods used are re-written into a laboratory standard format, which provides consistency in content and allows the analysts to locate the information they need quickly. Procedures are in place to define the format, required approvals, and the control system for these method documents. Elements to address in SOPs are based on TNI and DoD required sections. The format requirements include, but are not limited to, the following:

- LIMS defined method designation, which is used extensively for scheduling and documentation purposes.
- Reference to the original source of the method (e.g. SW-846)
- Scope
- Basic Principles
- Apparatus and Reagents
- Personnel Training and Qualifications
- Safety and Waste Disposal
- Detailed procedure (including any method modifications)
- Calculations
- QA/Quality Control
- Revision Log
- Review and approval by technical management and QA personnel

Analytical methods are maintained as controlled documents to ensure that analysts are always working with the most current version and are reviewed periodically for accuracy.

8.3 Client Supplied Methods

Most of the client-supplied method requirements presented to us involve achieving specific quality control criteria, limits of quantitation (LOQ), and/or method detection limits (MDL) using standard EPA methods. These requirements are communicated to the appropriate technical groups prior to the project start up. Each technical group evaluates the scope of work and the requirements to ensure the criteria can be met using the standard EPA method. The data is monitored to ensure the criteria are met throughout the project. The CSR notifies the client if there is a more appropriate method available or if the client's criteria cannot be achieved on a certain sample matrix (i.e., due to matrix or dilutions).

Occasionally, we are asked to transfer a non-standardized method from a client into our lab or to develop a new method, when one is not available. In the case of a method transfer, we set up the client's method and perform some initial evaluation. After the initial evaluation, we may make recommendations on how to improve method performance. If the method appears to be adequate, we determine linearity, specificity, precision, accuracy, MDL, and LOQ by performing calibrations, analyzing method blanks, and carrying out method detection limit and quad studies.

In the case of method development, we work with the client and/or data user to determine the level of validation required ensuring that the method meets its intended purpose. In addition to the elements above, we also determine standard and sample stability and robustness depending on the scope of the project. Typically, a standard operating procedure is written and submitted to the client with the results of the validation. These steps are completed prior to analysis of field samples. Data related to the setup of the method are archived.

8.4 Method Validation

Before new or revised analytical methods are authorized for routine use in the laboratory, validation data is required to demonstrate that the method as performed in our laboratory and analysts performing it are capable of meeting data quality objectives for precision and accuracy. A procedure is in place to outline this process.

Many methods published by USEPA include instructions for performing an initial demonstration of capability, which typically consist of determining the method detection limit and analyzing fortified samples in quadruplicate (i.e. a quad study). This demonstration is performed and compared to acceptance limits for precision, accuracy, and detection limits, when available.

Methods that do not include specific validation requirements are validated by analyzing fortified samples or standard reference materials in replicate. The results of these analyses are used to assess accuracy and precision. Results of validation studies are documented and subject to review and approval by technical and QA management.

8.5 Procedural Deviation

Analysts are required to follow a documented method for all tests performed. Procedures are in place to ensure that deviations from analytical methods are documented, approved, and justified in an appropriate and consistent manner. We classify method deviations as either being a planned deviation or an unplanned deviation. In general, the following information is captured to document both types of situations:

- Description of the deviation
- Reason or justification for the deviation
- Impact the deviation had on the testing
- Signature/date of analyst performing the test
- Signature/date of Quality Assurance and Laboratory Management approving the deviation
- Signature/date of client approval, if necessary

Deviations to written procedures are documented in raw data records or through the ICAR (Investigation and Corrective Action Report) system. Both types of documentation require management and QA review and approval.

NOTE: Deviations to analytical methods are not permitted by PALA . If samples are analyzed for compliance to a regulatory program, deviations may be allowed with approval from the appropriate compliance officer and/or program.

9 INTERNAL QUALITY CONTROL CHECKS

9.1 Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Management is responsible for ensuring that QC is analyzed as required by the referenced method. Each analytical SOP specifies (or cross-references another procedure) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptable range.

The laboratory provides additional bottleware to the client for matrix QC sampling as determined by the method or regulatory requirements.

QA staff, at the direction of the technical department, must program the LIMS with the acceptance criteria for each QC type (other than blanks). The acceptance criteria are based on statistically

generated limits from historical laboratory data, on method defined limits, government agency recommendations, or on client/project specific limits.

These limits are used to flag samples that are out of specification.

The types of QC samples and the information each provides are discussed in the following paragraphs.

9.1.1 Method Blanks

A method blank is a designated sample designed to monitor for sample contamination during the laboratory testing processes. The method blank consists of a clean matrix (i.e. reagent water, Ottawa sand, glass beads, Teflon chips) taken through the entire sample preparation and analysis process. The method blank and field samples are treated with the same reagents, internal standards, and surrogate standards. Ideally, method blanks demonstrate that no artifacts were introduced during the testing processes. The specific acceptance criteria for each test are usually based on the required reporting limit (MDL or LOQ).

9.1.2 Surrogates

Surrogates are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the analytical method, surrogates are spiked into all the field and QC samples to monitor analytical efficiency by measuring recovery on an individual sample basis. The percent recovery is determined and compared to the acceptance criteria.

Isotope dilutions analyses use labeled isotopes, not surrogates, in each field and QC sample.

9.1.3 Matrix Spikes

A matrix spike sample is created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. Blanks are not used for matrix spike QC. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the potential matrix effects on the data relative to the parent sample. Matrix effects can cause results to be outside of the acceptance criteria. Matrix QC is reported only on the Analysis Report for the job that includes the parent sample. Batch acceptance is not dependent on matrix QC. Unless stipulated in a method or by the client, corrective actions are not applied to matrix QC outliers.

9.1.4 Laboratory Control Samples

Laboratory control samples (LCS) are samples of known composition that are analyzed with each batch of samples to demonstrate laboratory accuracy. Laboratory fortified blank (LFB) is another term used to describe a LCS. The samples are clean samples fortified with known concentrations. Percent recovery is calculated and compared to acceptance limits.

9.1.5 Duplicates and Matrix Spike Duplicates and Laboratory Control Sample Duplicates

A duplicate is a second aliquot of a sample that is treated identically to the original to determine

precision of the test. To compare the values for each analyte, the relative percent difference (RPD) is calculated by dividing the difference between the numbers by their average. Precision for analytes that are not typically found in environmental samples (i.e., organic contaminants) is determined by analyzing a pair of matrix spike duplicates, defined as two spiked samples and comparing the RPD for the spiked compounds. The acceptance criteria are described as a maximum for the RPD value.

9.1.6 Internal Standards

Internal standards are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the method, internal standards are added to every field and QC sample after extraction but prior to analysis. Comparison of the peak areas of the internal standards is used for quantitation of target analytes. Internal standard peak area and retention time also provide a check for changes in the instrument response. The acceptance criteria are stipulated in the analytical method.

9.1.7 Serial Dilutions

A serial dilution is the dilution of a sample with sufficiently high concentration by a factor of five to check for the influence of interferents. This QC check is performed for inorganics analyzed by ICP or ICP -MS. When corrected by the dilution factor, the diluted sample result must agree with the original sample within method specified limits.

9.1.8 Interelement Correction Standard

This QC check is performed for inorganics analyzed by ICP to verify interelement and background correction factors. A solution containing both interfering and analyte elements of known concentration is analyzed at the beginning and end of each analytical run or a minimum of twice per 8 hours.

9.1.9 Second Source Check

A second source check is analyzed using either the LCS and/or an Initial Calibration Verification (ICV). The second source is a standard that is made from a solution or neat purchased from a different vendor than that used for the calibration standards. For some custom mixes, the same vendor but a different lot and preparation is used. This ensures that potential problems with a vendor supply would be evident in the analysis. Some tests use the continuing calibration verification standards as a second source from the initial calibration.

9.2 Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples and the corrective action required when a QC result fails to meet the acceptance criteria.

The QC acceptance criteria are available to analysts in the laboratory through their SOPs or Work Instructions and the LIMS. If the method reference requires the use of specific limits then the laboratory uses the published limits that are documented as part of the analytical method. Many

methods require that each laboratory determine their own acceptance criteria based on statistical data obtained from performance of the method. In these cases, the limits are available to the analysts and are entered into the LIMS described below. Statistically determined acceptance criteria are subject to change as the laboratory recalculates its control limits. Due to their dynamic nature, acceptance criteria are not included in this manual.

The results of all quality control samples are entered into the LIMS in the same way as the results of client samples. The LIMS compares the individual values with the acceptance limits and identifies quality control sample results that are out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This includes, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a flag and/or comment stating the observed deviation, and actions applied to the samples in the batch (e.g. reprep, reanalysis).
Qualifiers are applied to the data report, but additional comments are **not** needed for the following scenarios:

- QC with high bias and nondetects in the associated samples.
- Matrix QC outliers
- Surrogate outliers due to dilution effects
- Blank detections where the associated sample is nondetect or has the analyte detected at >10x the blank level

The laboratory allows for marginal exceedances based on the number of analytes in the LCS. The exceedances are carefully monitored so that any systemic problems would be identified and corrective action taken. If the LCS is being reported based on the marginal exceedance allowance, a comment is added to the analytical report.

9.3 Quality Control Charts

The LIMS quality control system is used to report QC data to clients, to collect data for assessment of precision and accuracy statistical limits, and to generate control charts. Control charts are accessible to all employees through the LIMS interface. The system charts results from blanks, surrogates, matrix spike/matrix spike duplicates, duplicates, and laboratory control samples/laboratory control sample duplicates. These charts provide a graphical method for monitoring precision and bias over time. They can be used to detect quality problems by observation of patterns. The QA staff uses the charts to evaluate potential data trends.

9.4 Measurement Uncertainty

Per ISO 17025-2017 section 7.6.1 "Laboratories shall identify the contributions to measurement uncertainty. When evaluating measurement uncertainty, all contributions that are of significance, including those arising from sampling, shall be taken into account using appropriate methods of analysis." This means the laboratory must determine the uncertainty contribution of all steps in the testing process such as equipment, calibration, standards, reagents, preparation, cleanups, etc. Since, in most methods, the laboratory control sample (LCS) goes through the entire process of preparation to analysis; all factors that would contribute to uncertainty is evident through the LCS results. LCSs are performed with every batch of samples where appropriate for the method. Tests that do not have LCSs

(i.e. TCLP; paint filter test), are evaluated on a case-by-case basis by taking into account the uncertainty of each of the steps taken to perform the test. Our laboratory does not perform field sampling so our ability to assess uncertainty is limited to the processes that we perform. Thoroughly mixing samples prior to taking the testing aliquot minimizes the uncertainty risk with our aliquot.

Measurement Uncertainty reports are generated by each technical department on an annual basis using a LIMS program and submitted to QA. Measurement Uncertainty is calculated as two times the standard deviation of the LCS recoveries for the group and date range of data points selected for all applicable methods. This is reported as a percentage. It is not necessary to apply or report the uncertainty value with sample results. When a client requests the measurement uncertainty it is applied by multiplying the determined analyte concentration by the uncertainty percentage.

10 ASSURING QUALITY OF TEST RESULTS

10.1 Data Management

At a minimum, data management is initiated when the laboratory receives the samples from the client. More often the process begins with client communication of their needs and requirements for a specific project and/or testing. When requested, bottle orders for the client's sampling efforts are generated through the LIMS by the CSR. The CSRs are responsible for entering the information in the sample set up function of the LIMS. Upon receipt of the samples a unique tracking number for the sample group and the samples within the group is generated based on this information. At this point, the LIMS becomes an integral part of tracking the samples through laboratory operations. The flow of data from the time samples enter the laboratory until the data is reported is summarized in the following table:

Sample and Data Flow

Action	Personnel Involved
Bottle orders generated upon request · Bottles packed and shipped to the client under chain of custody documentation	Client Service Representative Bottles Preparation
Sample received at Lancaster Labs · Unpacked and reconciled against the client paper work or COC · Sample Entry Documentation log completed	Sample Registration
Sample is entered into the LIMS · Lab ID number assigned · Analyses entered · Storage location assigned · Electronic record of sample number · Labels generated · Acknowledgement generated (record of samples received and analyses entered)	Sample Registration
Preservation checks performed Sample stored in assigned location (refrigerator, freezer, etc.)	Sample Registration

Action	Personnel Involved
· Electronic record of sample #, container type, and location	
Acknowledgment sent to client (when requested)	Client Service Representative
Samples requisitioned and removed from storage for analysis · Electronic requisition of sample number by container type · Necessary aliquot taken · Remaining sample returned to storage	Sample Registration Technical Personnel
Analysis is performed according to selected analytical method and applicable Project Notes* · Raw data recorded · Data Reviewed · Data uploaded to the LIMS from the instrument or manually entered by the analyst* (This is tracked by the unique sample number and batch number.)	Technical Personnel
LIMS performs calculations as programmed according to methods	Data Processing
Designated analyst or supervisor verifies raw data	Technical Personnel
Generation/release of reports	Client Service Representative or designee
Data package deliverables are assembled, reviewed and released to client Electronic copy saved in the LIMS	Client Service Representative or desginee
Electronic Data Deliverables (EDDs) are generated	EDD staff
Designated Data packages are overchecked by QA prior to release	QA
Hard copy of raw data is archived Electronic data files and records are backed up and archived	Technical Personnel, Office Services, IT

*Project Notes contain client- and agency-specific requirements (i.e. DoD, PALA, NJ DKQP, CT RCP, MA MCP)

**Analyses requiring the analyst's interpretation may involve manual data reduction before entry into the LIMS.

10.2 Data Documentation

Most data are acquired, documented, and stored in the LIMS. In some cases, data are documented in bound notebooks. Analysts review data as it is generated to determine that the instruments/systems are performing within specifications. If any problems are observed during an analytical run or the testing process, corrective action is taken and documented.

Procedures are in place to ensure that all data is traceable, authentic, and complete. Electronic data records are maintained and tracked through the LIMS, requiring authorized, password protected user access. The following general requirements outline our system for notebook, logbook, and electronic documentation recording:

- Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task.
- Entries must be legible, signed, and dated. The signature may be a wet or electronic signature.
- Errors are corrected in a manner that does not obliterate the original entry, initialed and dated, and coded with an explanatory identifier. Changes to electronic data are tracked through audit trail functions.
- Blank pages or substantial portions of pages which are left blank are crossed-out to eliminate the possibility of data entry at a later date.
- Notebook pages and instrument printouts are signed/dated to indicate second party data review; this may be a wet or electronic signature.
- At periodic intervals a supervisor or data reviewer checks equipment/instrument logbook entries and temperature recordings for completeness, legibility, and conformance to procedures.
- At a minimum, the following information is recorded as part of data documentation:
  - Date of analysis/operation
  - Signature/date of analyst performing test/operation
  - Identification of client sample(s) and material(s) analyzed
  - Materials, reagents, standards used to perform the testing/operation
  - Method used to perform testing/operation (including version number and/or effective date)
  - Equipment/instrumentation used to perform testing/operation
  - Calculations and how they were derived
  - Departures, planned or unplanned, from the analytical method
  - Signature/date of person reviewing data documentation
- For computer generated data, the following information is recorded:
  - Sample(s) analyzed/operations performed

- Date of analysis/operation
- Unique instrument identification
- Name/date of person operating the instrument
- Name/date of person reviewing data
- Any manual notations made on instrument printouts are signed, dated, and reviewed

10.3 Data Calculations

Most instruments either include or are connected to a data system programmed to perform calculations to reduce the raw data to a reportable form. All calculations are maintained in the instrument manuals and/or as part of the analytical method.

In many cases, the data from the local instrument system are uploaded directly to the LIMS for review and reporting. This direct upload eliminates the need to retype data and an associated source of transcription errors from the analytical scheme.

Some instruments report data that require application of additional factors before the data is in final form. For example, an extract concentration may be reported by the instrumental data system, but additional dilution and preparation factors may be needed before the result represents the concentration of analyte in the sample. Analysts input these additional factors into the LIMS, where final calculations are performed.

Analysts manually enter collected data, such as titration data, into the LIMS, which is programmed to perform calculations for final reporting. Documentation of the programming for each calculation performed by the LIMS is maintained.

10.4 Reporting Limits

It is important to ascertain the reporting limit (RL), also referred to as the limit of quantitation (LOQ), that can be achieved by a given method, particularly when the method is commonly used to determine trace levels of an analyte. The Environmental Protection Agency has set forth one method for determining method detection limits (MDLs) from which RLs/LOQs can be extrapolated. This process is summarized in a laboratory procedure.

MDLs are determined annually using quarterly MDL analyses performed for each method across all instruments used for that method. The MDL is the basis for the RL/LOQ used in the default reporting format. Because MDLs change each time they are re-evaluated, they are not included in this manual, but are maintained in the LIMS and available to clients upon request.

The reporting limit used to determine whether a result is significant and reported as detectable is dependent upon agency and client requirements. A variety of formats are available and include use of

the MDL, RL/LOQ, method specified limits, and project specific limits. The MDL and RL/LOQ for each analyte are programmed into the LIMS for reporting purposes.

Under the DoD program, the laboratory must establish a Detection Limit (DL) and Limit of Detection (LOD). As defined by the DoD program, the DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. The laboratory determines the DL using the calculated value from the MDL Study. The DL can be derived from pooled MDL values obtained across instruments. The LOD is the smallest amount of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. It is established by spiking a quality system matrix at a concentration of 2-4 times the DL and must be less than the RL/LOQ. The LOD must be verified on a quarterly basis or with each batch of samples.

10.5 Data Review

Final review and verification of the data are performed by designated employees using the sample results, quality control information, method criteria and Project Notes entered into the LIMS. Data are initially evaluated by the analyst and then a second designated employee knowledgeable in the test, other than the employee responsible for performing the test, reviews the data. The reviews include checks for correct transcription, calculations, passing calibrations, compliant quality control results, holding time compliance, and project specific requirements. Any issues or errors identified during this stage are addressed, corrected, and reviewed with the responsible person.

After determining that all necessary requirements for valid data and for the project are met, the reviewer electronically approves the data by changing the LIMS status of the data from "1st level reviewed" to "2nd level reviewed". The lab has designated personnel to perform 2nd level review. The system is password protected to ensure traceability.

Designated projects require further review by QA prior to release of the Analysis Report and/or data package to the client. These projects are identified in the LIMS through QA review task assignment.

10.6 Data Qualification

Data qualifiers are used to provide additional information about the results reported. The most typical use for data qualifiers is for results that fall below the quantitation limit, in the region where it becomes more difficult to distinguish a positive result from the background instrument signal. The data systems used to generate and report results are programmed to flag values in this range as estimates.

Other qualifiers are applied to advise data users of any validation issues associated with the data. The laboratory makes every effort to meet all of the requirements for generation of data. Occasionally, generation of data that does not meet all the method requirements occurs due to sample matrix or other analytical problems. If the test cannot be repeated or reanalysis would not yield better quality data, qualified data is reported. Qualifiers can be in the form of comments on the analytical report or flags applied to the results.

Qualifications for regulated samples (e.g. drinking water, NPDES) may not be permissible. The process for evaluating regulatory sample qualifications is detailed in *QA-SOP11886 Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples.*

10.7 Data Reporting

When all analyses are completed and overchecked, the Analysis Report is generated and released from the LIMS. The client receives a copy of the report containing the results of the analysis and, where necessary, qualifier flags and/or explanatory comments to address non-conformances. A QC Results section is included in the default Level 2 report. To avoid ambiguity in interpreting results, a summary page that contains an explanation of all symbols and units used in reporting data is included with the Analysis Report submitted to clients. Certification status information, Sample Summary list and Method Summary are provided as well in the default Level 2 report. Copies of reports and associated supporting raw data are retained in our archives. The report contains the signature of the assigned client service representative who is the key contact for any questions concerning the results. Data release authorization is managed and tracked through the individual analysis first and second lever reviews documented in the LIMS.

The laboratory offers a variety of data reporting levels and formats, from a basic report of sample and QC results only, to a comprehensive data package of QC/calibration information and raw data. The client and any agency involved direct the selection of report type. A summary of report formats and data packages types is provided in the laboratory *Schedule of Services*. Various electronic formats are also available formatted to client-specified file structure and sent via e-mail, direct upload, secure web-site access, or common courier. The secure web-site access is used for clients that require secure transfer of electronic data.

Client confidentiality of web-site data is ensured by the use of a secured firewall internet environment coupled with the use of a user ID and password to gain login access to the system. User accounts are configured to only allow access to specific data associated with the user's business account number.

Amendments to a final report after issue are in the form of an additional document or data transfer and include a reference to the original report. When a completely new final report is required, it is uniquely identified and includes a reference to the original report it replaces.

Analytical reports are generated with a cover page that identifies the laboratory contact person's name and phone number if there is a question about the report. Within this package, each page is uniquely identified and paginated. Analytical test results for methods listed on the laboratory's accreditation scope meet all requirements of the relevant regulatory body accreditation, NELAP accreditation and ISO 17025 unless noted otherwise.

10.8 Data Storage, Security, and Archival

The laboratory has documented procedures and instructions for the identification, collection, access, indexing, filing, storage, maintenance, and disposition of data records. Records are in the form of paper records, electronic data files, magnetic tape, and CD-ROMs.

All data records are maintained in a confidential manner in an environment to minimize deterioration or damage and to prevent loss. Some records are stored in off-site facilities, in such a way that they are readily retrievable. Retention time for records is in accordance with specific procedures or instructions. Prior to the destruction of data/records, and if requested by a client or agency, the laboratory will notify the client/agency that their data is scheduled for destruction so arrangements can be made to have the original data sent to the client.

If specified in client contract(s), archived records are transferred according to their instructions in the event of a change in laboratory ownership or if the laboratory goes out of business. If not specified by the client, the sale agreement must require that archived records be maintained as scheduled by the new owners. In the case of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed.

The laboratory maintains all documentation which is necessary for historical reconstruction of data:

- Analysis reports
- Data notebooks
- Data logbooks
- Instrument output
- Correspondence and client files
- Instrument and equipment logbooks
- QA records
- Corporate documents
- Electronic records

11 AUDITS AND INSPECTIONS

11.1 Internal Quality Assurance Audits

The QA Department, which is independent of laboratory activities, performs routine and on-going system, traceability, and observation audits to objectively review current systems, operations, and procedures as well as automated data integrity audits of electronic data records. The goal of the audits is to ensure that the quality system activities are effective and in compliance with regulatory programs, including NELAP, ISO 17025, DoD, PALA, and state agencies, as well as internal policies and procedures. Audits are documented and tracked in a QA database.

Audits are scheduled and conducted following a predefined schedule, based on criticality of operation and prior audit results, with the goal of evaluating systems and technologies across the operation to identify issues or potential risks as well as best practices. If warranted, additional audits are performed to follow up on promised corrective action or areas of concern.

Results of an audit are documented in a report format and distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an audit with root cause analysis and application of a corrective action plan.

Audit reports and responses are circulated to Management to communicate the outcome of the audit and the proposed plan(s) for corrective action, if warranted. If any of the audit findings cast doubt on the validity of the results, the clients must be notified within one business day from confirmation of the issue. Should an audit issue present a major concern regarding validity of laboratory methods, QA personnel can issue a stop work notice.

All records maintained as part of an audit are kept on file for five years.

On an annual basis, an audit of the QA Department is performed as directed by the laboratory's Executive Management. The auditors assigned to carry out this operation are qualified staff members independent of the QA Department.

The specific content and findings of internal audits are considered company confidential and are not shared with clients.

11.2 Review of the Quality Assurance Program

All levels of management are continually updated on the status of quality and compliance by circulation of pertinent documents. Management review is documented by signatures on the documents, electronic records of each person's review, along with any comments or request for additional follow-up. The types of documents circulated real-time include:

- Internal, client, and agency audit reports and responses
- Proficiency test results
- Investigation and corrective action reports
- Monthly QA status reports

Executive management reviews the elements of the total quality program on an annual basis to ensure its continuing suitability and effectiveness in meeting the stated objectives outlined in Section 2.4 of this manual. The evaluation entails review of reports to management, all audit findings, client complaints, laboratory investigations, staff adequacy and training, and projected growth in workload. Patterns or trends in any of these areas are reviewed as a means to continually improve the quality

system. This review also includes an evaluation of any audit findings resulting from the audit of the QA Department. At the conclusion of this quality system review, executive management determines the need to introduce changes or improvements into the quality systems at the laboratory. The minutes from the meeting and any recommendations for improvement are documented and a copy is forwarded to the QA staff for review and follow-up.

11.3 Good Laboratory Practice Critical Phase Inspections

The laboratory no longer performs formal GLP compliance testing.

11.4 Client Audits

Because clients place great importance on compliance with applicable regulations, data quality, and project requirements, they may audit our facility as assurance that their objectives are being met. QA, management staff, CSRs, and the analytical laboratories play a key role in these audits. Visits by clients can range anywhere from a tour (to verify laboratory facilities and instrumentation) to an intensive inspection of technical operations, procedures, regulatory compliance, and/or review of specific project(s). The option for a remote audit via Skype or MSTeams types of interfacing is available.

Audits are scheduled directly with the CSR or QA. The request to audit is communicated to all applicable laboratory departments. An escort (designated laboratory employee) remains with an auditor at all times. In accordance with our policy on client confidentiality, a client is permitted to review only data and results that apply to their work, or which have been approved by laboratory management.

Responsibilities are assigned to the following groups in regard to client audits:

11.4.1 QA Department

- Research previous audit reports and laboratory responses to past deficiencies.
- Follow-up with the applicable analytical laboratory areas to ensure action items were completed from the last audit, as necessary.
- Work with client to set audit agenda.
- Function as an escort during the audit
- Answer questions the auditor has in regard to laboratory and quality systems.
- Take notes of areas where corrective action or suggestions are recommended during the audit.
- Communicate audit issues to management at the completion of the audit.
- Respond to client audit reports.

- Ensure follow-up to cited items are addressed in a timely manner.

11.4.2 CSRs

- Gather and organize relevant information (e.g., client correspondence, analysis/project requests, copies of analytical data from archives).
- Be knowledgeable about client-specific project requirements and issues.
- Function as an escort during the audit.
- Communicate issues/problems to appropriate personnel.

11.4.3 Laboratories

- Gather and organize laboratory data and documentation in preparation for client review.
- Assure corrective action was implemented from past audit findings, if necessary.
- Be prepared to discuss project data/testing results during the audit.
- Be familiar with client-specific project requirements and be prepared to answer client questions.
- Be familiar with the location of routine laboratory information and equipment (e.g., SOPs, data notebooks, calibration data, etc.).
- Be prepared to answer specific technical questions in regard to laboratory procedures and instrumentation within the area.
- Functions as an audit escort within the department during the audit.
- Laboratory managers may function as an escort during the audit.

11.5 Agency Inspections

It is laboratory policy to cooperate to the fullest extent and maintain cordial relations with all government agencies. The QA Department is assigned the responsibility of hosting and working with agency representatives. The QA role includes, escorting the investigator(s); ensuring all questions are answered promptly and accurately; making note of all unresolved issues; informing management of the audit status and outcome; responding to the audit report and ensuring that appropriate corrective action is completed. CSRs and laboratory staff responsibilities are similar to those noted above for client audits.

Inspections can be performed by investigators or auditors from the EPA, states, third-party accreditation bodies (i.e. A2LA, United States Department of Agriculture (USDA)), or other regulatory agencies.

Government agencies have the right to investigate and inspect the laboratory during normal business hours and permission to inspect is granted by Executive Management. The option for a remote audit via Skype or MSTeams types of interfacing is available.

Designated members of the QA Department are primary contacts for announced inspections. The QA Director is the primary contact for all unannounced agency inspections. If the QA Director is unavailable, Executive Management is notified, in addition to a member of the QA Department. The QA Director, or their designee, must obtain evidence of the investigator's authority either in the form of a letter or examination/explanation of credentials.

Inspections include the examination of records or the inspection of facilities. Investigators are usually concerned only with the records relating to their responsibilities. As a general rule, they are given copies of records and documents, if requested. The laboratory must have a record of all items provided to an investigator.

Investigators must be escorted through the laboratory. The laboratory is not obligated to show an investigator the following types of information: sales, financial or pricing information, or any personnel data other than training or qualification documentation. On a case-by-case basis, internal QA audit reports and investigation reports are made available for agency review. Any questions or concerns about a request made by an investigator in regard to recording devices or photographs must be reviewed with legal counsel.

The laboratory personnel are not permitted to sign affidavits. If an affidavit is presented during an inspection, all personnel are directed not to sign it, read it, nor listen to it being read. The only document that is acceptable to sign is an acknowledgement that an inspection report has been received. If there is any doubt as to what should be signed, legal counsel must be consulted.

11.6 Proficiency Testing

Many of the organizations that certify our laboratory to perform various analyses require proof of our competency. Laboratory performance is checked regularly by participation in a variety of proficiency testing (PT) programs. When available, blind samples are obtained from vendors that are accredited to provide PT samples under the TNI, ISO 17025, and/or other applicable agency standards for all test and matrices routinely tested at the laboratory. In addition, some individual certification programs require analysis of specific sets of proficiency samples.

Generally, the PT programs consist of samples or ampulated spiking solutions used to fortify laboratory samples. The laboratories analyze the samples in the same manner as a client sample and the data is sent to the agency or vendor for evaluation. After the study results are returned to the laboratory, any data falling outside the acceptance criteria is investigated, root cause is identified, and corrective action

is implemented, if needed. Results are circulated to management. No PT samples or portion of a PT sample are sent to another laboratory for analysis.

Double blind samples are submitted to the laboratories with some client projects so that the laboratory is not aware that the samples are PTs. The acceptance criteria for these double blind samples are developed statistically using data from participating laboratories, providing a source of inter-laboratory comparison. The clients will provide the results to the laboratory. Results are reviewed, investigated as needed with response to the client.

If a trend in PT failures is identified, additional blind or QC check samples are ordered for that specific test as corrective action.

12 CORRECTIVE AND PREVENTATIVE ACTION

12.1 Laboratory Investigation and Corrective Actions

Due to the technical nature of laboratory work and the broad scope of our QA program, a wide variety of laboratory issues can require investigation, root cause analysis, documentation, and corrective action. Prompt investigation and implementation of corrective action ensure that only data of known quality are reported and prevent the recurrence of errors. The following list provides "examples" of the type of issues that warrant investigation:

- Noncompliant QC results*
- Failed PT samples
- Reporting incorrect results
- Contamination issues
- Client technical complaints
- Procedural errors
- Missed holding times
- Systematic problems that compromise the accuracy or compliance of the data generated
- Problems with instrumentation and equipment which could compromise the data generated

These investigations must include the following:

- Identification of the problem
- Steps taken to investigate the problem

- Explanation of probable root cause(s) of the problem
- Steps taken to prevent future occurrence
- Determination of samples or systems affected by the problem

*Note: individual QC noncompliance does not require in depth investigation. Actions are taken as defined in the corresponding method and documented in the data. An adverse trend with noncompliance would be investigated.

Management is informed of problem situations. The QA staff track documentation, the status of the investigation activities, evaluates investigations for completeness and appropriateness, and monitors corrective action for follow-up/closure. Technical management and/or QA may issue a stop work notice if issues indicate the potential for problems on a broad scale or present a critical concern regarding the validity of the laboratory methods. The goal is to identify root cause, have the corrective action implemented promptly, and to the degree appropriate for the magnitude and risk of the problem. Tracking and trending of laboratory issues is performed by QA staff and reported to management on a monthly basis or immediately upon detection of a trend with potential for putting the laboratory or our clients at risk.

12.2 Investigation Process

All results from quality control (QC) samples are logged into the LIMS quality control system, which is programmed to alert analysts to unacceptable results. Analysts are required to review the results and determine the source of the problem. The source of the problem and proposed action must be documented. Action for QC outliers may include, but is not limited to, re-analysis, re-extraction or re-digestion, instrument maintenance, or re-calibration. If these actions do not yield compliant data within the required hold time, a Nonconformance Form is initiated to document actions and communication with the client. The original form is archived with the associated raw data. Nonconformance Forms are reviewed by the technical department's management, or designee. A copy of the form is reviewed by QA.

Missed holding times are investigated and documented using a Missed Holding Time form. The form includes documentation of the affected samples, reason the hold was missed and corrective actions taken, if applicable. Each form also has documented review and approval by the department manager, department director and the QA Director. Clients are informed of any problems involving holding time.

Other types of problems having potential impact on data quality or involve deviations to our processes are investigated and documented using an Investigation and Corrective Action Report (ICAR). This process was developed to ensure that laboratory problems are investigated, evaluated for root cause, corrective action is put into place to prevent recurrence, laboratory management review and QA approval occurs, and all steps are documented. These investigations are initiated and managed through a workflow interface (Jira). Any employee can initiate an ICAR through this system to document a laboratory problem. The investigation must be completed by designated members of

management and approved/closed by QA. Each investigation has a unique tracking number assigned by Jira. Closed investigations are routed to the laboratory President, associated laboratory Director and the QA Director. Follow-up to ensure effective corrective action is managed by QA staff.

If a laboratory error is identified from the outcome of the investigation that impacts validity of client data, the client must be notified in writing of the situation and corrected data provided as soon as possible. If the root cause of the problem has affected any other client sample results, all affected clients are notified of the problem.

12.3 Client Feedback

The laboratory is in the business of providing high quality analytical testing services. The data that we supply to our clients must be technically complete, accurate, and compliant with applicable regulations. Complaints can be received via letter, phone call, e-mail, or face-to-face meeting.

When a complaint is received, it is our responsibility to determine, to the best of our ability, the extent of the issue and what data is in question. The person receiving the complaint documents this information and promptly forwards it to the appropriate management personnel where the work in question was performed. If a data reporting error is discovered, the final report and/or data must be regenerated with the correct value(s).

The CSR is responsible for entering client concerns into the LIMS. QA reviews these issues on a monthly basis to evaluate for trends and potential risks to laboratory data/systems. In some cases, an ICAR is initiated to address and document the situation. While an individual issue may not warrant a formal investigation, QA monitors these issues for potential trends and will issue an ICAR if a trend is evident. If the client requires a formal investigation, then the CSR notifies QA so the ICAR can be initiated.
On a regular basis, the laboratory sends a client satisfaction survey to clients. The results of these surveys are compiled, routed to the laboratory executive management and the QA Director, and used to identify areas of improvement for the laboratory.

12.4 Preventative Actions

All employees are empowered and encouraged to use the concept of Preventive Action to avoid a problematic situation. The company supports, embraces and drives the process for continuous quality improvement by several means, such as: Ethics Hotline, the Suggestion Box (accessible to all employees via email to !US19_Suggestion_Box@eurofins.local), and training classes that include new hire orientation and Ethics. If an employee identifies a potential problem or an area of concern or it should be brought to the attention of his/her supervisor, Human Resources, QA Director or the Ethics Hotline.

The laboratory also utilizes a formal program to encourage preventive action through development of Lean processes. The goal of this program is to optimize processes to ensure efficiency and operational improvements while maintaining compliance. The efficiency gains are inherently coupled with minimizing errors and rework. Teams of employees learn the tools and techniques to evaluate a process, identify potential sources of errors, delays or problems in an operation, determine system

changes that will minimize these and work to implement the improvements. Each project includes thorough documentation of the evaluation, measurement, and implementation phases. The process is continually monitored to ensure that the anticipated results are sustained.

Employees are also encouraged to communicate to their supervisor any area(s) or operation(s) that they believe could be streamlined, make their job easier, would provide a quality improvement, or could provide a cost savings to the company.

Described below are some of the systems available to employees to assist with building quality and efficiency into their daily jobs. They stress a proactive approach/environment to problem solving and to review quality systems and operational efficiencies.

- "Ethics" is a course required for all employees to teach the laboratory's Statement of Values by examining how it translates to our everyday jobs and ethical decision making. Topics discussed include: Statement of Values, data integrity, ethics, confidentiality, etc.. Mandatory ethics training refresher is scheduled on an annual basis.

- The laboratory has contracted with an Ethics Hotline to provide an anonymous means of reporting ethics concerns or issues. The issue is forwarded by the service to the QA Director who will communicate internally with those who need to address the issue. All communication and actions are documented in a secure web interface managed by the hotline service company.

- The QA staff prepares monthly program status reports for management. The reports include a variety of metrics and graphs which are used to evaluate trends in laboratory performance across all quality and compliance areas. Management responds to any negative trends by developing a corrective action plan.

- The laboratory uses a Project Cycle process (further described in section 13.2) to proactively review and prepare for client projects in an effort to ensure full understanding by all laboratory staff of the client's needs and resolve any concerns in advance of receiving the work.

13 SERVICE TO CLIENTS

13.1 Service to Clients

We value our client relationships and support these partnerships through the following principles:

- Honesty and Fairness – Our corporate culture is founded on the principles of professionalism and high ethical standards in dealing with our clients. This may mean declining to provide the service requested (if we are convinced that to do so would be meaningless) or it may mean referring clients outside of our laboratory if we believe that another company can better meet their needs.

- Complete Service – We will give our clients full value on every service provided. We will provide detailed information on our methods, procedures, and QA programs if requested, and take a personal interest and initiative in helping solve our client's problems within the area of our professional expertise.

- Trustworthiness – All data and information developed for a client will be held confidential and not disclosed to a third party except on written request of the client. If information is subpoenaed, we must, by law, release it, but the client will be informed of the release.

- Commitment to Quality – We constantly strive to improve our service in quality, flexibility, and dependability, to keep our competitive edge. We will achieve this through: meeting the requirements of those we serve, staying apprised of regulatory and industry expectations, and providing prompt responses to client concerns.

- Basics of Superlative Service – Our focus is on our client's success. Through proactive collaborative communication, our leadership ensures we understand our client's expectations and strives to exceed them. We foster a service culture in our training, reward and recognition, and performance management process so each employee takes ownership to deliver superlative service to our clients. Feedback from clients, whether positive or negative, is an important part of our continuous improvement system. Ways in which feedback is gathered can include, but is not limited to, customer satisfaction surveys, client audits, and the customer complaint system, which is described within section 12.3.

We also view our fellow employees as our clients since they frequently receive the results of our labor. Meeting the requirements of the next employee in the workflow process is just as important as meeting the needs of an external client.

13.2 Review of Work Requests, Tenders, and Contracts

The laboratory places great importance on understanding and meeting client requirements for a project. We ensure, to the best of our ability, that client/project requirements are identified and communicated through the laboratory. Project evaluation can be achieved in various ways, including the review of analytical methods, protocols, business contracts, and quality project plans (QAPPs). The project review encompasses our Project Cycle process and individual topics to be evaluated for a project include, but are not limited to: scope of testing; required accreditations (i.e. individual state agencies, PALA, NELAP, DoD, and ISO 17025) held by the laboratory; appropriate and current testing methods; ability to meet project required reporting limits and QC (if applicable); inconsistencies clarified; and nonstandard work requests.

Project kick-off meetings can be arranged through the CSR or Business Development Group. These meetings allow the client and key technical personnel to discuss project issues and requirements prior to project initiation. Any differences between laboratory processes and the project requirements are discussed and addressed with the client and the laboratory staff before the project is accepted and samples arrive. Project-specific requirements are communicated to the laboratory through use of Project Notes (PNs). Accreditation-specific requirements (i.e. NJ DKQP, MA MCP, CT RCP, PALA, NELAP, DoD, and ISO 17025) have template PNs maintained by QA, and these are used to add to the project's PNs. Testing that cannot be performed at the laboratory may be subcontracted to another laboratory (see 13.4).

A key client contact, the CSR, is assigned to oversee the project. Communication between the client and laboratory staff is available and is coordinated through the CSR.

As a project continues, the CSRs provide continuous communication and status reports (if requested) about the project to the client. The CSR relays any project changes or modifications to the technical groups. If the client submits revised project documents (QAPPs, etc.) then the Project Cycle review process is repeated. The CSR also communicates any issues encountered by the technical laboratories back to the client and vice-versa.

13.3 Timely Delivery

Evaluating laboratory capacity and ability to perform specific projects is a joint responsibility between the laboratory President, Operations Director, Business Development, and the laboratory managers. We recognize that one of the most important aspects of the service we offer is turnaround time.

Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in the laboratory area creating operation flexibility for routine work. Larger projects are reviewed against capacity estimates before bids are submitted to ensure that the client's schedule is met. Turnaround time is continually measured.

Regularly scheduled meetings are held with technical and support management, and project management personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Management receives a daily report of the status of all samples in the lab, including those with priority status or those that have exceeded a preset turnaround time. This enables the planning and organizing of the workload through efficient scheduling.

Any changes to the established timeline by the client or the laboratory must be communicated to the client or laboratory as soon as possible. Upon communication of changes, a new timeline is established and agreed upon by both parties. If a client requires a change in the scope of the project (e.g., number of samples submitted, change in analyses, revised protocol) the laboratory must be informed in writing and a new timeline and cost estimate is be provided.

13.4 Subcontracting

The laboratory may subcontract tests to other laboratories if the requested testing is not routinely performed in our laboratory. To a lesser extent, samples may need to be subcontracted to an overflow laboratory to ensure hold times and/or turn-around-times (TAT) are met.

Testing is only subcontracted with the client's knowledge and approval. The CSR must notify the client in writing (email is acceptable) when any of their requested analyses will be subcontracted to another lab. Client approval must be obtained in writing (email is acceptable) before samples are shipped.

Subcontract laboratories are selected based on their qualifications and accreditations. The subcontractor is requested to sign a Laboratory Analytical Services Subcontract. See form *Q-EQA-FRM6867* to review details of the contract terms and information requested from the subcontract laboratory. If projects require a specific agency certification (i.e. individual state agencies, NELAP, DoD, PALA, ISO 17025), only an appropriately accredited laboratory is used. The client may also have a list of laboratories to be used for subcontracting. In these cases, the evaluation of the subcontract laboratory is made by the client.

Data obtained from subcontract laboratories is clearly marked as such when reported by the laboratory. The data are submitted to the client in the format obtained from the subcontractor.

13.5 Use of NELAP and A2LA Logo

It is not laboratory policy to use these logos on any company letterhead, including analytical reports.

Q-EQA-FRM6867 Laboratory Analytical Services Subcontract (ELLE)
QA-SOP11886 Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples

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Attachment:
Appendix A - Procedure Cross Reference
Appendix B – Certifications, Accreditations, Registrations, and Contracts
Appendix C – Organizational Charts
Appendix D – Personnel Qualifications and Responsibilities
Appendix E – SOPs and Analytical Methods
Appendix F – Instrument and Equipment List

End of document

Version history

Version	Approval	Revision information
16	18.MAR.2019	
17	11.JUL.2019	
18	03.SEP.2020	

NOTE: SOPs and Forms are indicated in the table with the unique D4 document number. The topic of the document is given in parentheses.

EQPM Section #	ISO 17025 2017	Title	Procedure(s)
1	5.3	Introduction	
1.1.	NA	Mission Statement	Employee Handbook
1.2.	5.7	Quality Policy	11197 (Quality Statement) Employee Handbook
1.3.	NA	Statement of Values	Employee Handbook
1.5.	NA	Certifications, Accreditations, and Registrations	Form 6840 (Cert Summary) Company website
2	5.4	Organization and Personnel	
2.1	5.1	Company Overview and History	
2.1.1		Business Continuity and Contingency Plans	13101 (Incident Response Plan) 14735 (Preparedness, Contingency) 12233 (Archiving SOP) Form 6843 (Deputies form)
2.2.	5.2	Organizational Structure	Organization Charts
2.3.	5.5	Management Responsibilities	PQDs (job descriptions) PMDs (individual job plans)
2.4.		Overview of the Quality Assurance Program	Dept 4052 SOP Series
2.5.		Quality Assurance Responsibilities	Dept 4052 SOP Series
2.6.	5.7	Communication of Quality Issues to Management	11912 (QA Reports)
2.7.	5.3	Personnel Qualifications and Responsibilities	16134 (Employee Training) PQDs (job descriptions) 16196 (PQDs and EJFs) PMDs (individual job plans) Task Specific Training
2.8.		Relationship of Functional Groups and the Quality Assurance Program	Quality Orientation TQM Training PMDs (individual job plans) Dept 4052 SOP Series 11895 (Project Cycle)
2.9.		Balancing Laboratory Capacity and Workload	PMDs (individual job plans) LIMS reports for mgt
2.10.		Identification of Approved Signatories	11186 (Date Entry, Verification and Reporting)
2.11.	5.6	Personnel Training	16134 (Employee Training) 11178 (DOCs) PQDs (job descriptions) PMDs (individual job plans) Task Specific Training
2.12.	5.6	Regulatory Training	
2.13.		Employee Safety	Analytical Methods Chemical Hygiene Plan 14735 (Preparedness) Dept 6098 SOP Series PMDs (individual job plans)

EQPM Section #	ISO 17025 2017	Title	Procedure(s)
2.14.	5.5	Client Services/Project Management Responsibilities	Dept 4039 SOP Series 11895 (Project Cycle)
2.15.	4.2	Confidentiality	Employee Handbook 16221 (E-mail System) 6824 (Client and Agency Audits)
2.16.	4.1	Business Conduct	Employee Handbook
2.17.	4.1	Operational Integrity	11176 (Manual Integration) 11882 (Chromatographic Integration) 11177 (Ethics Policy) 11197 (Quality Statement)
3		Buildings and Facilities	
3.1.		Facility	Floor Plans
3.2.		Security	12733 (Building Security)
3.3.		Disaster Recovery	13101 (Incident Response Plan) 14735 (Contingency Plan)
3.4.		Environmental Monitoring	11919 (VOA Storage) 11191 (ETM)
3.5.		Water Systems	11916 (Reagent Water)
3.6.		Housekeeping/Cleaning	15553 (Housekeeping)
3.7.		Insect & Rodent Control	16117 (Insect & Rodent Control)
3.8.		Emergency Power Supply	13101 (Incident Response Plan)
3.9.		Facility Changes	14744 (Facility Change Control) 11195 (Change Control)
4		Document Control	
4.1.		Hierarchy of Internal Operating Procedures	6823 (Writing SOPs)
4.2.		Document Approval, Issue, Control, and Maintenance	16131 (Document Control) 11189 (Method Validation)
4.3.		Client-Supplied Methods and Documentation	11193 Analytical Decision Making) 6825 (QA review of QAPPs) 11895 (Project Cycle) 12039 (Auditing Paperwork)
4.4.		Laboratory Notebooks, Logbooks, and Forms	16131 (Document Control) 11913 (Notebooks)
4.5.		Control of External Documents	16131 (Document Control) Departmental "Controlled Documents" forms
5		Sample Handling	
5.1.		Sample Collection	6830 (Sampling Instructions Form)
5.2.		Sample Receipt and Entry	Dept 6042 SOP Series
5.3.		Sample Identification and Tracking	Dept 6042 SOP Series 11184 (LSAR)
5.4.		Sample Storage	Dept 6055 SOP Series
5.5.		Sample Return/Disposal	12042 (Sample Discard) 15553 (Hazardous Wastes - Lab) 9017756 (Hazardous Wastes – Storage) 11915 (Quarantine Soils)

EQPM Section #	ISO 17025 2017	Title	Procedure(s)
5.6.		Legal Chain of Custody	11914 (Legal COC)
5.7.		Representativeness of Samples	Analytical Methods 11190 (Representative Solid Samples)
6		Technical Requirements - Traceability of Measurements	
6.1.		Reagents and Solvents	11188 (Reagents and Standards) Analytical Methods
6.2.		Calibration Standards	11188 (Reagents and Standards) Analytical Methods
6.3.		Equipment and Instrumentation	11901 (Inst. & Equip M&C) 11880 (Balance, Syringe, Pipette Verification) 11893 (Thermometers)
6.4.		Computerized Systems and Computer Software	11195 (Change Control) 11186 (Network Accounts) 16221 (E-mail System) 20940 (Computer Backup) Employee Handbook 16227 (Computer Viruses)
6.5.		Change Control	11195 (Change Control)
6.6.		Labware Cleaning	Departmental Procedures
7		Purchasing Equipment and Supplies	
7.1		Procurement	11192 (Procurement) 9018236 (Receipt of Lab Supplies)
7.2		Supplier Evaluation	11192 (Procurement) 11181 (Subcontracting) 11188 (Reagents and Standards) 6826 Preservative Checks)
8		Analytical Methods	
8.1.		Scope of Testing	Schedule of Services Company website
8.2.		Analytical Test Methods	11189 (Method Validation) 6853 (Writing Procedure Guidance)
8.3.		Client Supplied Methods	11189 (Method Validation)
8.4.		Method Validation	11189 (Method Validation)
8.5.		Procedural Deviations	11912 (ICARs)
9		Internal Quality Control Checks	
9.1.		Laboratory Quality Control Samples and Acceptance Criteria	11896 (QC Limits) Analytical Methods
9.2.		Quality Control Sample Frequency and Corrective Action	11912 (Noncompliant Data) Analytical Methods
9.3.		Quality Control Charts	6817 (End of Month QC Reports)
9.4.		Measurement Uncertainty	11896 (QC Limits)
10		Assuring Quality of Test Results	
10.1.		Data Management	11913 (Notebooks)

EQPM Section #	ISO 17025 2017	Title	Procedure(s)
10.2.		Data Documentation	11913 (Notebooks) 11186 (Date Entry, Verification and Reporting) 11197 (Quality Statement)
10.3.		Data Calculations	11186 (Date Entry, Verification and Reporting) Analytical Methods
10.4.		Reporting Limits	11892 (MDLs & LOQs)
10.5.		Data Review	11913 (Notebooks) 11186 (Date Entry, Verification and Reporting)
10.6.		Data Qualification	11912 (Noncompliant Data)
10.7.		Data Reporting	11186 (Date Entry, Verification and Reporting) 11886 (MCL Exceedance)
10.8.		Data Storage, Security, and Archival	12233 (Data Archiving) 20940 (Computer Backup)
11		Audits and Inspections	
11.1.		Internal Quality Assurance Audits	7547 (Internal Audits) 6859 (Internal Audit Checklist) 6819 (Electronic Data Audits)
11.2.		Review of the Quality Assurance Program	7547 (Internal Audits) 6822 (QA Reports)
11.3.		Good Laboratory Practice Critical Phase Inspections	N/A
11.4.		Client Audits	Employee Handbook 6824 (Client and Agency Audits)
11.5.		Agency Inspections	Employee Handbook 6824 (Client and Agency Audits)
11.6.		Proficiency Testing	11185 (PT Program) 6816 (PT Entry)
12		Corrective and Preventive Action	
12.1.		Laboratory Investigations and Corrective Action	11912 (Noncompliant Data), ICARs, Client Complaints) 26968 (Root Cause Process)
12.2.		Investigation Processes	10401 Missed Hold Procedure) 6832 (Missed Hold form) 11912 (ICARs)
12.3.		Client Feedback	11912 (Client Complaints) Annual Client Survey
12.4.		Preventive Actions	Corporate Training Lean Projects 11895 (Project Cycle) 1195 (Change Control) 7547 (Internal Audits)
13		Service to Clients	
13.1.		Service to Clients	Employee Handbook Ethics Statement 11197 (Quality Policy)

EQPM Section #	ISO 17025 2017	Title	Procedure(s)
13.2.		Review of Work Requests, Tenders, and Contracts	12039 (Client Paperwork) 11895 (Project Cycle) 6825 (QAPP Review)
13.3.		Timely Delivery	11166 (Tracking Rush Samples) 11160 (Scheduling Rush Samples) Departmental LIMS reports
13.4.		Subcontracting	11181 (Subcontractor Checklist) 11181 Subcontracting) 11895 (Project Cycle)

Agency	Parameter	Applicable Matrices	Lab ID No.
Federal Programs:			
American Association for Laboratory Accreditation (A2LA)	Dioxin, KY UST, Inorganics, Organics, PFAS, and WY Storage Tank Program, Food and Feed	Air and Emissions, Biological Tissue, Nonpotable Water, Potable Water and Solid and Hazardous Waste	0001.01
USDA Quarantine Soil Permit	All	Solid	P330-13-00350
State Programs:			
State of Alaska, Department of Environmental Conservation Drinking Water Laboratory Certification Program	Inorganics, Organics and PFAS	Potable Water	PA00009
State of Alaska, Department of Environmental Conservation Contaminated Sites Program	Inorganics, Organics, PFAS and UST analysis	Nonpotable Water and Solid and Chemical Materials	17-027
State of Arizona, Department of Health Services	Dioxin and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	AZ0780
State of Arkansas, Department of Environmental Quality	Dioxin, Inorganics and Organics	Nonpotable Water and Solid and Chemical Materials	88-0660
State of California, Department of Health ELAP	Dioxin, Inorganics ,Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemicals Materials	2792
State of Colorado, Department of Public Health and Environment	Dioxin, Inorganics and Organics	Potable Water	PA00009
State of Connecticut, Department of Public Health	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	PH-0746
State of Delaware, Health and Social Services	Dioxin, Inorganics and Organics	Potable Water	None
[3]State of Florida, Department of Health	Dioxin, Inorganics, Organics and PFAS	Air and Emissions, Nonpotable Water, Potable Water and Solid and Chemical Materials	E87997
State of Georgia, Department of Natural Resources	PFAS	Potable Water	C048
State of Hawaii	Dioxin, Inorganics, Organics and PFAS	Potable Water	None
[3]State of Illinois, Environmental Protection Agency	Dioxin, Inorganics and Organics	Nonpotable Water and Solid and Chemical Materials	200027
State of Iowa, Department of Natural Resources	Inorganics, Organics and UST analysis	Nonpotable Water and Solid and Chemical Materials	361
[3]State of Kansas, Department of Health and Environment	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water, and Solid and Chemical Materials	E-10151
Commonwealth of Kentucky, Department of Environmental Protection, Drinking Water Laboratory Certification Program	Dioxin, Inorganics and Organics	Potable Water	90088
Commonwealth of Kentucky, Department of Environmental Protection, Wastewater Laboratory Certification Program	Dioxin, Inorganics and Organics	Nonpotable Water	90088
[4]Commonwealth of Kentucky, Department for Environmental Protection – UST Branch	Organics, Metals and UST analysis	Nonpotable Water and Solids	108139
[1, 3, 5] State of Louisiana, Department of Environmental Quality	Dioxin, Inorganics, Organics and PFAS	Air Emissions, Biological Tissue (direct accreditation), Nonpotable Water and Solid Chemical Materials	30729 02055
State of Maine, Department of Health and Human Services	PFAS	Potable Water	PA00009
State of Maryland, Department of the Environment	Dioxin, Inorganics and Organics	Potable Water	100

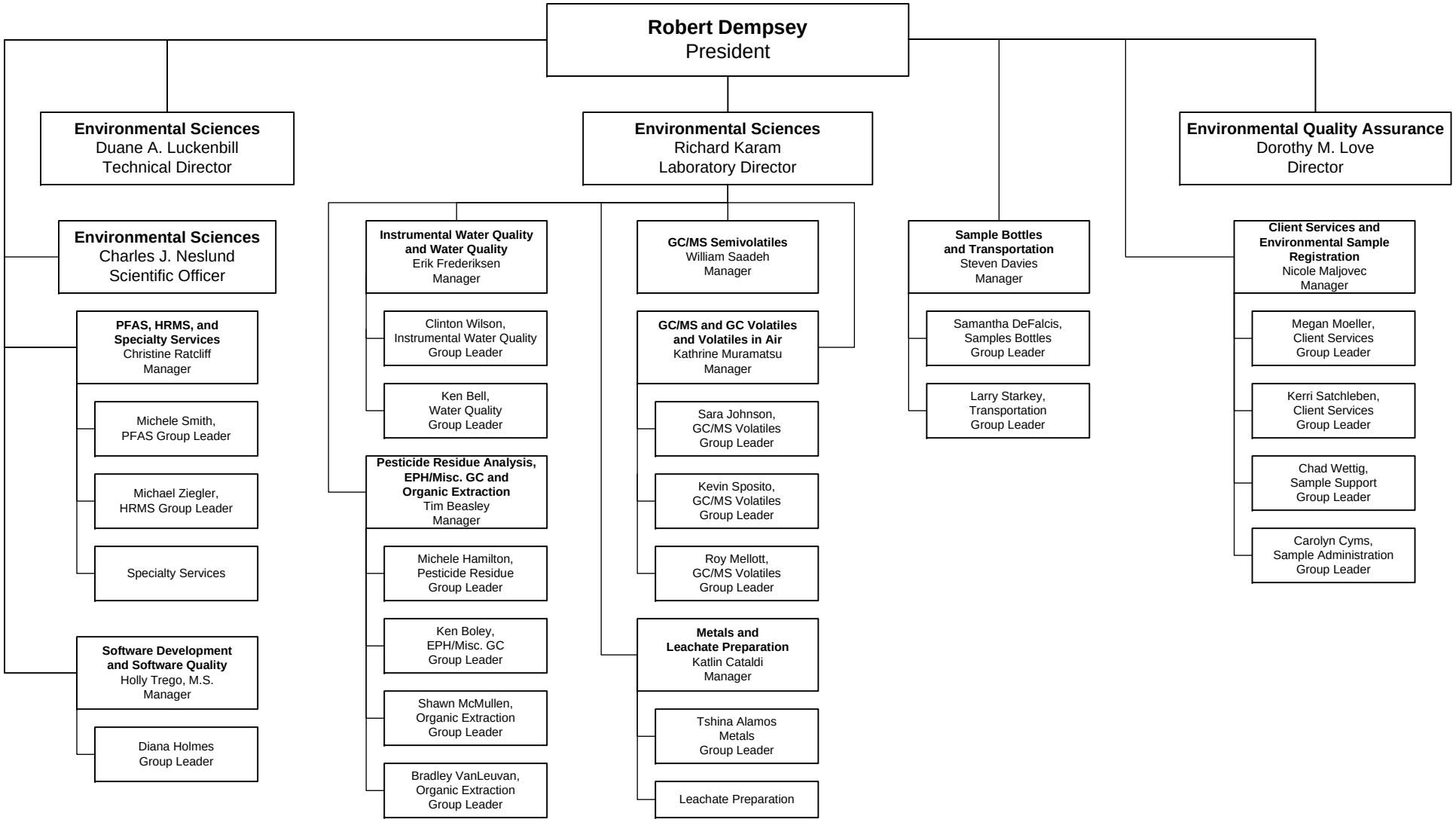
Agency	Parameter	Applicable Matrices	Lab ID No.
Commonwealth of Massachusetts, Department of Environmental Protection	Inorganics, Organics and PFAS	Nonpotable Water and Potable Water	M-PA009
State of Michigan, Department of Environmental Quality	Dioxin, Inorganics, Organics and PFAS	Potable Water	9930
State of Missouri, Department of Natural Resources	Dioxin, Inorganics and Organics	Potable Water	450
State of Montana, Department of Public Health and Human Services	Dioxin, Inorganics, Organics and PFAS	Potable Water	CERT0098
State of Montana, Department of Environmental Quality	Organics, UST analysis	Nonpotable Water and Solid and Chemical Materials	None
State of Nebraska, Department of Health and Human Services	Dioxin, Inorganics, Organics and PFAS	Potable Water	NE-OS-32-17
[3]State of Nevada, Department of Conservation and Natural Resources	Dioxin, Inorganics , Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	PA00009
[3]State of New Hampshire, Department of Environmental Services	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	2730
[3]State of New Jersey, Department of Environmental Protection (NJDEP)	Dioxin, Inorganics, Organics and PFAS	Air and Emissions, Biological Tissue, Potable Water, Nonpotable Water, and Solid and Chemical Materials	PA011
[3]State of New York, Department of Health	Dioxin, Inorganics, Organics and PFAS	Air and Emissions, Nonpotable Water, Potable Water and Solid and Chemical Materials	10670
State of North Carolina, Department of the Environment and Natural Resources	Inorganics and Organics	Nonpotable Water	521
State of North Carolina, Department of Health and Human Services	Organics	Potable Water	42705
State of North Dakota, Department of Environmental Quality	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	R-205
[3] State of Oklahoma, Department of Environmental Quality	Dioxin, Inorganics and Organics	Nonpotable Water and Solid and Chemical Materials	9804
[3]State of Oregon, Public Health Laboratory	Dioxin, Inorganics, Organics and PFAS	Air and Emissions, Nonpotable Water, Potable Water and Solid and Chemical Materials	PA200001
[2]Commonwealth of Pennsylvania, Department of Environmental Protection (Bureau of Laboratories)	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials (direct accreditation)	36-00037
State of Rhode Island, Department of Health	Inorganics, Organics and PFAS	Nonpotable Water and Potable Water	LAO00338
State of South Carolina, Department of Health and Environmental Control	Dioxin, Inorganics and Organics	Nonpotable Water and Solid and Chemical Materials	89002
State of Tennessee, Department of Environment & Conservation	Dioxin, Inorganics and Organics	Potable Water	02838
[3] State of Texas, Commission on Environmental Quality	Dioxin, Inorganics and Organics	Air and Emissions, Biological Tissue, Nonpotable Water, Potable Water and Solid and Chemical Materials	T104704194
[3]State of Utah, Department of Health	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water, Potable Water and Solid and Chemical Materials	PA00009
State of Vermont, Department of Health	Dioxin, Inorganics, Organics and PFAS	Potable Water	VT 36037
[3] Commonwealth of Virginia, Department of General Services	Dioxin, Inorganics and Organics	Air and Emissions, Nonpotable Water, Potable Water and Solid and Chemical Materials	460182
State of Washington, Department of Ecology	Dioxin, Inorganics, Organics and PFAS	Air and Emissions, Nonpotable Water and Solid and Chemical Materials	C457
State of West Virginia, Department of Health and Human Resources	Inorganics and Organics	Potable Water	9906C

Agency	Parameter	Applicable Matrices	Lab ID No.
State of West Virginia, Department of Environmental Protection	Dioxin, Inorganics, Organics and PFAS	Nonpotable Water and Solid and Chemical Materials	055
State of Wyoming and all Tribal Public Water Systems in Region 8	Dioxin, Inorganics and Organics	Potable Water	8TMS-L
[4]State of Wyoming – UST Branch	Organics, metals, UST analysis	Nonpotable Water and Solid and Chemical Materials	None

[1] NELAP Primary AB: Air and Emissions
[2] NELAP Primary AB: Potable Water, Nonpotable water, solid and chemical materials
[3] NELAP Secondary AB
[4] Approval for UST work by A2LA
[5] NELAP Primary AB: Biological Tissue

NOTE: Current copies of all scopes of accreditation are available on the laboratory website https://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/certifications-and-accreditations-eurofins-lancaster-laboratories-environmental/ and are kept on file in the Quality Assurance Department.

Eurofins Lancaster Laboratories Environmental



Job Title:	Technical Director, Eurofins Lancaster Laboratories Environmental	
Reports To:	President	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Oversee operations in accordance with policies set forth in the Key Group Documents
- Develop efficient and effective operations and systems that support the strategic goals of the company
- Utilize management operating system to track key performance indicators and drive continuous improvement
- Coach and develop individual and team to maximize performance
- Interact with clients as necessary to maintain and grow the business
- Build strategic relationships within the organization to achieve company goals
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least fifteen years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Directors, Managers, and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

Job Title:	Operations Director, Eurofins Lancaster Laboratories Environmental	
Reports To:	President	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Essential Duties and Responsibilities:

- Applies GMP/GLP in all areas of responsibility, as appropriate
- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Develop efficient and effective operations and systems that support the strategic goals of the company
- Utilize management operating system to track key performance indicators and drive continuous improvement
- Coach and develop individual and team to maximize performance
- Interact with clients as necessary to maintain and grow the business
- Build strategic relationships within the organization to achieve company goals
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President or designee
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least five years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Managers and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

Job Title:	Quality Assurance Director	
Reports To:	President and/or designee	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:

Overseeing all managerial and quality operations of the company; providing leadership and mentoring/coaching to QA staff; participating in short-term and long-term planning and goal setting for the company; facilitating adherence to government regulations; sustaining quality improvement and providing quality policy development; providing sound consultation to laboratories and clients on problems or interpretation of quality/compliance issues; keeping abreast of evolving regulatory and industry quality assurance requirements

Essential Duties and Responsibilities:

- Applies GMP/GLP in all areas of responsibility, as appropriate
- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Ensure that corrective action is appropriate; ensure that follow-up requirements are completed
- Encourage employee participation in process improvement initiatives
- Interview and make recommendations for new hires; train and develop staff; maintain job plans; handle personnel issues
- Handle agency audits, client audits, visits, and phone calls; prepare letters to clients; attendance at some local and national industry meetings
- Keep abreast of regulatory climate; assist technical operations with interpretation; advise on adjustment of lab policy as appropriate
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Coach/mentor other members of the quality team
- Oversee regulatory training program; assist with, and present departmental and corporate training at a frequency to meet regulatory expectations and ensure compliance
- Work with operations and clients to drive challenging/complex resolutions and/or negotiate appropriate position or compromise; offer compliance options
- Identify and drive system improvements; diagnose complex issues
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least six years' experience with QA
Additional preferences:	Bachelor's degree in chemistry or biology
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Provide leadership and direct management of any Group Leaders (if applicable) and other non-management employees in the department
Ability and/or Skills (BMQ):	Exhibit self-confidence and leadership; expertise in laboratory quality operations and regulatory environment; sound reasoning, decision making and problem-solving skills; good judgment and flexibility in dealing with others; ability to coordinate multiple priorities; communicate effectively in written and oral form; ability to manage the work of others and see projects through to completion; translate government regulations into laboratory policy/processes; utilize planning, organization and work management tools; ability to manage stress in self and others; dedication to quality, ethics, and customer service
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

Job Title:	Technical Department Manager	
Reports To:	Director or designee	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Performing a variety of technical and administrative tasks to develop, evaluate, and supervise staff; planning and monitoring work flow; designing, implementing, and utilizing departmental operations systems; promoting safety; remaining current on technical developments; communicating with clients; maintaining a strong commitment to quality

Essential Duties and Responsibilities:

- Applies GMP/GLP in all areas of responsibility, as appropriate
- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Utilize the MOS to track key performance indicators and drive continuous improvement
- Produce motivated and satisfied employees
- Encourage employee participation in process improvement initiatives
- Oversee inventory, maintenance, and repair of departmental machines, tools, equipment, materials, and/or products
- Manage scheduling of personnel; evaluate personnel performance
- Participate in interview process, make recommendations for new hires; train and develop staff
- Review, prepare, and approve methods, data, and SOPs
- Communicate with clients on technical matters; meet with clients to discuss operations and conduct tours and audits
- Maintain client confidentiality
- Investigate and solve laboratory problems
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least five years related experience
Additional preferences:	Bachelor's degree in chemistry or related science; supervisory experience preferred
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of the departmental Group Leaders
Ability and/or Skills (BMQ):	Knowledge of departmental techniques; manage personnel, resolve conflicts, and correct poor performance; attention to detail; tolerance for stress; integrity; computer skills; communicate effectively (verbally and written); perform multiple tasks simultaneously; logical thought; make decisions for self and others; independently develop solutions to complex problems
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

Job Title:	Support Department Manager	
Reports To:	Director	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Overseeing all managerial operations of the department, managing the department in an efficient and financially sound manner; providing leadership and coaching to assigned individuals; participating in long- and short-term planning and goal-setting for the group; coordinating functions and responsibilities of assigned department members to provide consistent service; coordinating internal efforts between departments; relaying corporate information appropriately

Essential Duties and Responsibilities:

- Applies GMP/GLP in all areas of responsibility, as appropriate
- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Administrative including human resource interviews, job plans, performance reviews, personnel issues, group meetings, and sharing of corporate information
- Training of and delegation to members of the department to provide consistent service to internal and external clients
- Work with other departments to set goals, develop pricing strategies, manage workload, and resolve problems
- Create, implement, and oversee budgets and goals for the department in the context of corporate philosophy
- Evaluate, plan for, and provide adequate staffing, equipment, consumables, etc., for the department to function in an effective manner
- Communicate verbally, in writing, and face-to-face with clients to discuss and resolve problems, build strong relationships, and increase sales
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Administrative activities (photocopying, word processing, paperwork delivery, etc.)
- Assist with financial and purchase order issues as needed
- Help coordinate interdepartmental cross-training and/or assistance as needed to balance workload
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	Five years of related experience at LL or demonstrated equivalent experience elsewhere; computer skills in a variety of software; supervisory experience
Additional preferences:	Bachelor's degree in science (chemistry preferred)
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of the Group Leaders of the department
Ability and/or Skills (BMQ):	Self confidence and leadership, ability to reason, make sound decisions, and delegate; empathy and sensitivity towards others; motivation to excel and inspire excellence in others; ability to develop strong relationships with clients resulting in client satisfaction and additional sales; ability to manage the work of others and see projects through to completion; strong communication including verbal, writing, and presentation skills; ability to communicate effectively and relate well to people; mental and emotional stability and maturity, ability to handle personal stress and diffuse stress in others; strong organizational and financial skills, ability to handle multiple priorities; good judgement and tact recognizing and solving problems; recognized as understanding, interpreting, and following company policy; sets example for others; dedication to quality, ethics, and customer service; pride in appearance, conduct, and company; sound persuasion and negotiation abilities; ability to view situations from a variety of perspectives; foresight and planning ability
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

Appendix E - SOPs and Analytical Methods

Document number	Document name	Document
US Eurofins US Lancaster Laboratories Environmental		
1.01 Document Control		
G-DC-SOP12233	Data and Record Storage, Security, Retention, Archival, and Disposal	5_EUUSLA_Env Quality Assurance_Director
G-DC-SOP16131	Document Control	5_EUUSLA_Env Quality Assurance_Director
G-DC-SOP16196	Position Qualification Descriptions (PQDs) and Essential Job Functions (EJFs)	5_EUUSLA_Env Quality Assurance_Director
G-DC-SOP16244	Writing and Reviewing ELLE Policies and Operating Procedures	5_EUUSLA_Env Quality Assurance_Director
1.02 EHS		
G-EHS-QP12356	Chemical Hygiene Plan	5_EUUSLA_Env Quality Assurance_Director
G-EHS-QP28711	Exposure Control Plan for Bloodborne Pathogens	5_EUUSLA_Env Quality Assurance_Director
G-EHS-QP14735	Preparedness, Prevention, and Contingency Plan	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP14741	Emergency Evacuation Plan	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP28741	Environmental, Health, and Safety (EHS) Assessments	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP28743	Ergonomics Program	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP25567	Fall Protection Plan	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP13101	Incident Response Plan	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP14740	Lockout/Tagout	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP22000	Management of Hazardous Wastes in the Laboratory	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP33477	Radiation Safety Program	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP14739	Reporting Work Related Incidents	5_EUUSLA_Env Quality Assurance_Director
G-EHS-SOP14738	Safety Glasses	5_EUUSLA_Env Quality Assurance_Director
1.03 Facilities		
G-FAC-SOP12733	Building Security	5_EUUSLA_Env Quality Assurance_Director
G-FAC-SOP14744	Facility Change Control Procedure	5_EUUSLA_Env Quality Assurance_Director
G-FAC-SOP15553	Facility Operation Manual	5_EUUSLA_Env Quality Assurance_Director
G-FAC-SOP16117	Insect and Rodent Control	5_EUUSLA_Env Quality Assurance_Director
G-FAC-SOP16118	Maintenance Connection Service Requestor Guidelines	5_EUUSLA_Env Quality Assurance_Director
1.04 Lists		
G-LI9946	Document List - Sorted by Chapter	5_EUUSLA_Env Quality Assurance_All
G-LI9949	List of documents by Expiration Date	5_EUUSLA_Env Quality Assurance_All
G-LI9947	List of Documents Under Revision by Chapter	5_EUUSLA_Env Quality Assurance_All
G-LI9950	Training Lists	5_EUUSLA_Env Quality Assurance_All
G-LI9948	Version List - Sorted by Chapter	5_EUUSLA_Env Quality Assurance_All
1.05 Templates		
G-TEMP-WI24324	Change Plan Template	5_EUUSLA_Env Quality Assurance_Director
G-TEMP-WI12535	Level 2 Standard Operating Procedure Template	5_EUUSLA_Env Quality Assurance_All
G-TEMP-WI12532	Level 3 Template for Work Instruction for Analysis	5_EUUSLA_Env Quality Assurance_All
G-TEMP-WI12548	Template for Revision Log for Existing SOPs	5_EUUSLA_Env Quality Assurance_All
1.06 External Documents		
1.07 D4 Help		
1.08 D4 Training Documents		
G-D4T-WI26519	FOR TRAINING PURPOSES - Document	5_EUUSLA_Env Quality Assurance_Director
2.01 Forms		
2.02 Training Forms		
2.03 Corrective Action Trainings		
CAT-32837	CAT TEMPLATE	5_EUUSLA_Volatiles in Air_Manager
3 Quality		
QA-QM11872	Environmental Quality Policy Manual	5_EUUSLA_Env Quality Assurance_All
QA-QP11177	Laboratory Ethics and Data Integrity Policy	5_EUUSLA_Env Quality Assurance_All
QA-QP11176	Manual Integration for ELLE	5_EUUSLA_Env Quality Assurance_All
QA-SOP11880	Balance, Syringe, Pipette, and Labware Verification	5_EUUSLA_Env Quality Assurance_All
QA-SOP11195	Change Control Procedures for ELLE	5_EUUSLA_Env Quality Assurance_All
QA-SOP11882	Chromatography Integration and Documentation	5_EUUSLA_Env Quality Assurance_All
QA-SOP11197	Conflict of Interest Plan	5_EUUSLA_Env Quality Assurance_All
QA-SOP11186	Data Entry, Verification and Reporting	5_EUUSLA_Env Quality Assurance_All
QA-SOP11178	Demonstrations of Capability	5_EUUSLA_Env Quality Assurance_All
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation	5_EUUSLA_Env Quality Assurance_All
QA-SOP16134	Employee Training Program	5_EUUSLA_Env Quality Assurance_Director
QA-SOP11893	Environmental Hazardous Sample Communication Procedure	5_EUUSLA_Env Quality Assurance_All
QA-SOP11895	Environmental Project Cycle	5_EUUSLA_Env Quality Assurance_All
QA-SOP11896	Establishing Control Limits	5_EUUSLA_Env Quality Assurance_All
QA-SOP11193	Guidelines for Analytical Decision Making in Environmental Testing	5_EUUSLA_Env Quality Assurance_All
QA-SOP11180	Guidelines for Writing Technical Reports	5_EUUSLA_Env Quality Assurance_All
QA-SOP11901	Instrument Maintenance and Calibration	5_EUUSLA_Env Quality Assurance_All
QA-SOP11912	Investigation and Corrective Action for Client Complaints, Noncompliant Data, and Laboratory Problems	5_EUUSLA_Env Quality Assurance_All
QA-SOP11913	Laboratory Notebooks, Logbooks, and Documentation	5_EUUSLA_Env Quality Assurance_All
QA-SOP11184	Laboratory Sample Analysis Record (LSAR) Documentation	5_EUUSLA_Env Quality Assurance_All
QA-SOP11196	Laboratory/Quality Systems Procedures Summary	5_EUUSLA_Env Quality Assurance_All

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QA-SOP11914	Legal Chain-of-Custody Documentation	5_EUUSLA_Env Quality Assurance_All
QA-SOP10401	Missed Holding Time Reports	5_EUUSLA_Env Quality Assurance_All
QA-SOP11919	Monitoring of the Volatile Organics Analysis (VOA) Storage Areas for Contamination	5_EUUSLA_Env Quality Assurance_All
QA-SOP11191	Monitoring Temperatures in Refrigerators, Freezers, Incubators, and Ovens Using the ETM	5_EUUSLA_Env Quality Assurance_All
QA-SOP11190	Obtaining a Representative Environmental Solid Sample Aliquot	5_EUUSLA_Env Quality Assurance_All
QA-SOP11886	Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples	5_EUUSLA_Env Quality Assurance_All
QA-SOP11192	Procurement of Environmental Laboratory Supplies	5_EUUSLA_Env Quality Assurance_All
QA-SOP11185	Proficiency Test Samples	5_EUUSLA_Env Quality Assurance_All
QA-SOP11915	Quarantine Soils Procedures	5_EUUSLA_Env Quality Assurance_All
QA-SOP11188	Reagents and Standards	5_EUUSLA_Env Quality Assurance_All
QA-SOP26968	Root Cause, Investigation, and Corrective Action Processes	5_EUUSLA_Env Quality Assurance_All
QA-SOP11182	Sample Requisition	5_EUUSLA_Env Quality Assurance_All
QA-SOP11181	Subcontracting Analytical Testing	5_EUUSLA_Env Quality Assurance_All
QA-SOP11183	Thermometer Use and Calibration	5_EUUSLA_Env Quality Assurance_All
QA-SOP11916	Use and Maintenance of Reagent Water Supply	5_EUUSLA_Env Quality Assurance_All
QA-SOP11189	Validation and Authorization of Analytical Methods	5_EUUSLA_Env Quality Assurance_All
3.01 Environmental Quality Assurance		
Q-EQA-WI6822	ELLE QA Reports to Management	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6825	Environmental Quality Assurance Review of Client Project and Bid Documents	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6824	Hosting of Environmental Client and Agency Audits	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6820	Maintenance of Environmental Certifications and Accreditations	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6819	Performing Electronic Data Audits using Mint Miner Software	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI7547	Performing Environmental Quality Assurance Audits	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6816	Proficiency Test Samples	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6823	QA Approval of Environmental Analytical Procedures and Standard Operating Procedures	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6826	QA Processing for Bottle Lot and Preservative Checks	5_EUUSLA_Env Quality Assurance_All
Q-EQA-WI6817	Quality Assurance Review of End-of-Month QC Reports	5_EUUSLA_Env Quality Assurance_All
4.01 Human Resources		
4.06 IT/Software Development		
R-SD-SOP20940	Computer Backup, Recovery, and Archive	5_EUUSLA_Env Quality Assurance_Director
R-SD-SOP16221	E-Mail System	5_EUUSLA_Env Quality Assurance_Director
R-SD-SOP16227	Utilizing the Services and Support of the NSC Service Desk	5_EUUSLA_Env Quality Assurance_Director
4.07 Transportation		
R-TR-WI11288	Sample Pick-Up, Transportation, and Delivery	5_EUUSLA_Transportation_Manager
R-TR-WI11294	Transportation Summary SOP	5_EUUSLA_Transportation_Manager
R-TR-WI11297	What to Do in Case of Vehicular Accident or Breakdown	5_EUUSLA_Transportation_Manager
5.01 Sample Bottles		
S-BOT-WI10641	Bottle Preparation	5_EUUSLA_Sample Bottles_Manager
S-BOT-WI10642	Packing Bottle Orders	5_EUUSLA_Sample Bottles_Manager
S-BOT-WI10643	Preparation of Acid Dilutions	5_EUUSLA_Sample Bottles_Manager
S-BOT-WI10644	Preparation of Trip Blanks	5_EUUSLA_Sample Bottles_Manager
S-BOT-WI10645	Processing Bottle Orders	5_EUUSLA_Sample Bottles_Manager
5.02 Client Services		
S-CS-WI12039	Auditing Client Paperwork	5_EUUSLA_Client Services_Manager
S-CS-WI10251	Client Concern and ISPD Code Entry	5_EUUSLA_Client Services_Manager
S-CS-WI11140	Client/Prospects Visits	5_EUUSLA_Client Services_Manager
S-CS-WI11141	Creating Bottle Orders	5_EUUSLA_Client Services_Manager
S-CS-WI11142	Creating Project Information Lists	5_EUUSLA_Client Services_Manager
S-CS-WI11143	Daily or Weekly DEP Reporting	5_EUUSLA_Client Services_Manager
S-CS-WI11152	Monthly and Quarterly DEP Reporting	5_EUUSLA_Client Services_Manager
S-CS-WI11155	Phone Log and Email Documentation	5_EUUSLA_Client Services_Manager
S-CS-WI11159	Sample Set-Up Form Creation Guide	5_EUUSLA_Client Services_Manager
S-CS-WI11160	Scheduling and Pricing of Rush Samples	5_EUUSLA_Client Services_Manager
S-CS-WI11166	Tracking and Communicating Rush Results	5_EUUSLA_Client Services_Manager
5.03 Sample Administration		
S-SA-WI10714	Assigning Sample Delivery Group Numbers and Five-Digit Sample Codes to Sample Groups	5_EUUSLA_Sample Administration_Manager
S-SA-WI10717	Entry of Environmental Samples Requiring Subcontracting	5_EUUSLA_Sample Administration_Manager
S-SA-WI10723	Environmental Sample Entry	5_EUUSLA_Sample Administration_Manager
S-SA-WI10725	Environmental Sample Receipt and Unpacking	5_EUUSLA_Sample Administration_Manager
S-SA-WI28305	ETM System Probe Calibration	5_EUUSLA_Sample Support_Manager
S-SA-WI12043	Sample Receipt at the Sample Receipt Desk	5_EUUSLA_Sample Administration_Manager
S-SA-WI10743	Taking the Temperature of Environmental Samples Upon Arrival at the Lab	5_EUUSLA_Sample Administration_Manager
5.04 Sample Support		
S-SS-WI10697	% Moisture Calculation and % Solids Calculation (Gravimetric)	5_EUUSLA_Sample Support_Manager
S-SS-WI10666	ASRS Emergency Failure Procedure	5_EUUSLA_Sample Support_Manager

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S-SS-WI10668	Automated Storage and Retrieval System (ASRS) Lockout/Tagout Procedure	5_EUUSLA_Sample Support_Manager
S-SS-WI12042	Automated Storage, Retrieval, and Discarding of Samples	5_EUUSLA_Sample Support_Manager
S-SS-WI10682	GC/MS - Bulk Solids Matrix Sample Preparation	5_EUUSLA_Sample Support_Manager
S-SS-WI10683	Glassware Cleaning	5_EUUSLA_Sample Support_Manager
S-SS-WI10685	Hardware Procedures for ASRS	5_EUUSLA_Sample Support_Manager
S-SS-WI10686	Homogenization, Sample Splitting, and Subsampling of Solid Waste Samples from Environmental Sources	5_EUUSLA_Sample Support_Manager
S-SS-WI10690	Instructions for Collecting Data on the LLENS System	5_EUUSLA_Sample Support_Manager
S-SS-WI10695	Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8	5_EUUSLA_Sample Support_Manager
S-SS-WI7963	Maintenance and Calibration of HACH Model 2100Q Laboratory Turbidimeter	5_EUUSLA_Metals_Manager
S-SS-WI10696	Maintenance of Dessicators	5_EUUSLA_Sample Support_Manager
S-SS-WI10699	Non-Automated Storage, Retrieval, and Discarding of Samples	5_EUUSLA_Sample Support_Manager
S-SS-WI10702	Outlier Quality Control Data	5_EUUSLA_Sample Support_Manager
S-SS-WI11168	Pipette Dispenser Calibration Procedure	5_EUUSLA_Sample Support_Manager
S-SS-WI11169	Preparation of Soil and Solid Samples for GC Volatile Analyses by methods SW-846-5030A and SW-846-5035A Modified	5_EUUSLA_Sample Support_Manager
S-SS-WI11170	Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035 and Method 5035A	5_EUUSLA_Sample Support_Manager
S-SS-WI11242	Preparation of Vials for Field Preservation of Soils for Volatile Analysis	5_EUUSLA_Sample Support_Manager
S-SS-WI11259	Prescreening Water and Soil Samples for Volatile Organic Compounds	5_EUUSLA_Sample Support_Manager
S-SS-WI11260	Preservation and Bottles Room Preservative Traceability	5_EUUSLA_Sample Support_Manager
S-SS-WI11268	Sample Preparation of Solid Samples Including Sieving and Milling for Extraction and Analysis by SW-846 8330B	5_EUUSLA_Sample Support_Manager
S-SS-WI11220	Sample Support Ovens	5_EUUSLA_Sample Support_Manager
S-SS-WI11225	Subsampling for Subcontracted Analyses	5_EUUSLA_Sample Support_Manager
S-SS-WI11272	Water Content (Moisture) by ASTM D 2216	5_EUUSLA_Sample Support_Manager
5.05 Data Deliverables		
S-DD-WI12037	Assembly and Review of Environmental Data Packages	5_EUUSLA_Data Deliverables_Manager
S-DD-WI11123	Overchecking the Electronic Data Deliverable	5_EUUSLA_Data Deliverables_Manager
S-DD-WI11124	Preparation of Data Packages on CD ROM	5_EUUSLA_Data Deliverables_Manager
S-DD-WI11125	Processing and Sending Data Packages	5_EUUSLA_Data Deliverables_Manager
5.06 Service Centers		
S-SC-WI13221	Preparation of Trip Blanks at BASC and STSC	5_EUUSLA_Sample Bottles_Manager
5.06.01 Bay Area Service Center		
S-SC-BA-WI11314	BASC Sample Pick-Up, Transportation, and Delivery	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-WI12044	Handling Non-Routine Analytical Services for Chevron Texaco	5_EUUSLA_Client Services_Manager
S-SC-BA-WI11326	Packing Bottle Orders at Bay Area Service Center	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-WI12309	Preparation of Acid Dilutions	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-WI12045	Processing Bay Area Service Center (BASC) Bottle Orders	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-WI11329	Project Manager	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-WI11332	Sample Receipt for the Bay Area Service Center	5_EUUSLA_Sample Bottles_Manager
S-SC-BA-EX11330	Reagent Log Book for Eurofins Service Centers	5_EUUSLA_Client Services_Manager
5.07 Business Development		
S-BD-WI11156	Preparing Quotations	5_EUUSLA_Env Sciences_Manager
S-BD-WI26410	Project Win Cycle	5_EUUSLA_Env Sciences_Manager
S-BD-WI10787	Proposal Preparation	5_EUUSLA_Env Sciences_Manager
S-BD-WI10788	Review of Client Contracts, Terms and Conditions and other non-technical documents	5_EUUSLA_Env Sciences_Manager
S-BD-WI10795	Vice President, Eurofins Lancaster Laboratories Environmental	5_EUUSLA_Env Sciences_Manager
8.02 Volatiles		
T-VOA-WI22997	1,2,3-Trichloropropane Water by CA SRL 524M-TCP by GC/MS	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8515	1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8260B/C/D in Waters and Soils	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7613	Calibrating the 1-µL Standard Delivery Groove on the Archon Model 5100A and O.I 4660 Autosampler Systems	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7627	Client Specific - Client Specific Target Compounds by GC/MS in Soils	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8221	Client Specific - Method AK101 for the Determination of Gasoline Range Organics in Soil Analysis for the State of Alaska	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7711	Client-specific Determination of Client Specific Target Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) in Waters	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7706	Determination of GRO by GC in Waters and Wastewaters by Method AK101	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8614	Determination of Target Compounds by GC/MS using Selective Ion Monitoring (SIM) by Method 8260C	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7619	GC and GC/MS Instrumentation Maintenance	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8220	GC/MS Determination of 1,2,3-Trichloropropane in Waters Using Isotope Dilution and Selective Ion Monitoring (SIM) by EPA Method 524.2, Modified	5_EUUSLA_GC/MS Volatiles_Manager

T-VOA-WI7629	GC/MS Volatile Standards Traceability	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8373	GC/MS Volatiles Audit Process	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7691	Glassware Washing	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8224	GRO in Soil and Water by GC using Northwest GX Method	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7675	GRO in Soils by GC by SW-846, Methods 8015B, 8015C, 8015D	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7690	GRO in Waters and Wastewaters by GC by SW-846, Methods 8015B, 8015C, 8015D	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8400	Level II Review of GC/MS Volatiles	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7692	Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7870	Preparation and Testing of Storage Blanks for GC/MS Volatile Analysis	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7605	Preparation and Testing of Trip Blanks for GC/MS Volatile Analyses	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8196	Preparation of Oil Samples	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7869	Preservation and Residual Chlorine Checks of Samples for GC/MS Volatile Water Analysis	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8480	Purgeable Organic Compounds in Water by GC/MS Using EPA Method 524.2	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7607	Statistical Calculations Used in the Analysis of Samples by EPA Methodology	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7717	Targeted Library Search by GC/MS	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8544	Toxicity Characteristic Leachate Procedure (TCLP); Determination of Volatile Target Compounds by GCMS in Zero Headspace Extraction (ZHE) by 8260B	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI7606	Use of 40-mL Vials for Volatile Organic Analyses	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8225	VOCs and GRO by GC/MS in Soils and Solids by EPA 8260B	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8236	VOCs and GRO by GC/MS in Soils and Solids by EPA 8260C/D	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8194	VOCs and GRO by GC/MS in Waters and Wastewaters by EPA 8260C/D	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8265	Volatile Organic Compounds in Wastewater by Isotope Dilution and GC/MS by EPA Method 1666	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8330	Volatile Organics Tentatively identified Compound Method	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8633	Volatile Organics Tentatively Identified Compound Method (Interpretive)	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8197	Volatile Target Compounds and Gasoline Range Organics (GRO) by GCMS in Waters and Wastewaters by Method 8260B	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8584	Volatile Target Compounds by GC/MS in Waters and Wastewaters by Method 6200B	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI8423	Waters for Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry using EPA Method 624	5_EUUSLA_GC/MS Volatiles_Manager
T-VOA-WI18576	Waters for Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry using EPA Method 624.1	5_EUUSLA_GC/MS Volatiles_Manager
8.03 Metals		
T-MET-WI7886	Bottletop Dispensers	5_EUUSLA_Metals_Manager
T-MET-WI11925	Client Specific - 3030 C. Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples	5_EUUSLA_Metals_Manager
T-MET-WI11939	Digestion by EPA 200.8 for the Analysis of Total Recoverable Metals in Water by ICPMS	5_EUUSLA_Metals_Manager
T-MET-WI11938	Digestion of Waters by EPA 200.7 for Analysis of Total Recoverable Metals by ICP	5_EUUSLA_Metals_Manager
T-MET-WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A	5_EUUSLA_Metals_Manager
T-MET-WI26740	Digestion of Aqueous Samples for Mercury by EPA 245.1	5_EUUSLA_GC/MS Volatiles_Manager
T-MET-WI11926	Digestion of Oils by EPA 3050B for ICP Analysis	5_EUUSLA_Metals_Manager
T-MET-WI7920	Dilute/Run and AVS/SEM Sample Handling for Metals	5_EUUSLA_Metals_Manager
T-MET-WI8732	Direct Analysis Preparation of Potable Water for ICP (EPA 200.7) or ICP-MS (EPA 200.8)	5_EUUSLA_Metals_Manager
T-MET-WI7922	Glassware Cleaning	5_EUUSLA_Metals_Manager
T-MET-WI12063	ICP Solutions and Standards Preparation	5_EUUSLA_Metals_Manager
T-MET-WI18028	Instrument Maintenance for Agilent 7500	5_EUUSLA_Metals_Manager
T-MET-WI18029	Instrument Maintenance for Agilent 7700	5_EUUSLA_Metals_Manager
T-MET-WI21590	Instrument Maintenance for Agilent 7900	5_EUUSLA_Metals_Manager
T-MET-WI18026	Instrument Operations for Agilent 7500	5_EUUSLA_Metals_Manager
T-MET-WI18027	Instrument Operations for Agilent 7700	5_EUUSLA_Metals_Manager
T-MET-WI21589	Instrument Operations for Agilent 7900	5_EUUSLA_Metals_Manager
T-MET-WI7943	Langelier Index in Water	5_EUUSLA_Metals_Manager
T-MET-WI7965	Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA	5_EUUSLA_Metals_Manager
T-MET-WI11931	Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)	5_EUUSLA_Metals_Manager
T-MET-WI11933	Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A/6020B(aqueous, solid, tissue) and EPA 200.8 (aqueous)	5_EUUSLA_Metals_Manager
T-MET-WI7971	Metals Use of the LLENS System	5_EUUSLA_Metals_Manager
T-MET-WI9084	Preparation of Mercury Solutions and Standards	5_EUUSLA_Metals_Manager
T-MET-WI11948	Preparation of Solids by EPA 7471A or B for Mercury Analysis	5_EUUSLA_Metals_Manager

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T-MET-WI8636	Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS	5_EUUSLA_Metals_Manager
T-MET-WI11937	Sample Preparation of Leachates and Other Wastewater for Analysis of Total Metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)	5_EUUSLA_Metals_Manager
T-MET-WI11941	Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry	5_EUUSLA_Metals_Manager
T-MET-WI8639	Sample Preparation of Waters for Analysis of Total Recoverable Metals by Inductively Coupled Plasma Optical Emission Spectrometry	5_EUUSLA_Metals_Manager
T-MET-WI9082	Working Instructions for Prep Solutions and Standards	5_EUUSLA_Metals_Manager
T-MET-WI12065	Working Instructions for Preparation of ICP-MS Solutions and Standards	5_EUUSLA_Metals_Manager
8.04 Pesticides		
T-PEST-WI9202	Analysis of Chlorinated Herbicides by 8151A in Water	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9232	Analysis of Pesticides by 8081B in Solid Samples using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9238	Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9845	Chlorinated Herbicides by 8151A in Solids by GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9843	CLIENT SPECIFIC - Captan and Captafol by Method 8081A in Waters and Solids using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9851	Creating Calibration Timed Events in Chrom Perfect	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9854	Data Audit Procedure for Department 4024	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9952	EDB/DBCP/and TCP by Method 8011 in Waters and Solids Using Microextraction and GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI11965	Formaldehyde and Other Aldehydes by Method 8315A in Aqueous and Solid Samples using HPLC	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9954	Interpretation of Chromatographic Data	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9961	Low Level PCBs in Water by Method 8082/8082A using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9980	Monitoring QC Data Acceptance Limits	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9981	Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9982	Nitroaromatics and Nitroamines in Water and Solids by HPLC with UV Detection by Method 8330/A	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9983	N-Methylcarbamate Pesticides by Method 8318/8318A in Solids Using HPLC	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9984	N-Methylcarbamates by Method 531.1 in Groundwater and Drinking Water using High Performance Liquid Chromatography (HPLC)	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI11966	OP Pesticides (Acephate and Methamidophos) by 8141A in Aqueous Samples using GC-NPD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI11967	Organic Acids in Water by Methods 8015B/D using HPLC/UV	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9987	PCBs in Oil by SW-846 Method 8082/8082A	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9989	Perchlorate by Method 6850 in Waters and Solids by LC/MS/MS	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9992	Pesticides by Method 8081A in Solid Samples using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9997	Pesticides in Aqueous Samples by Method 608	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI17994	Pesticides in Aqueous Samples by Method 608.3	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9998	Pesticides in Water by Method 8081A using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9999	Pesticides in Water by Method 8081B using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI9858	Picric Acid in Solid Matrix By HPLC with UV by Method 8015B	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10000	Picric Acid in Water by Method 8015B Using HPLC with UV Detection	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI11971	Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI18000	Polychlorinated Biphenyls (PCBs) by Method 608.3	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI11972	Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10004	Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10006	Prescreening Water and Soil Samples for Pesticides and PCBs	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10007	Preventative and Corrective GC Maintenance	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10008	Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10011	QC Data Acceptability and Corrective Action	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10014	Setting Retention Time Windows	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10015	Setting Up Analysis Numbers in the Departmental Database	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10016	Setting Up Single Component Initial Calibrations	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10018	Standards Preparation, Coding, and Storage	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10019	Standards Traceability and Monitoring	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10020	Uploading Data to the LIMS	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10022	Using "Datalog" Software for Data Acquisition of Multicomponent Pesticides/PCBs	5_EUUSLA_Pesticide Residue Analysis_Manager
T-PEST-WI10023	Using "Datalog" Software for Single-component Data Acquisition	5_EUUSLA_Pesticide Residue Analysis_Manager
8.05 GCMS Semivolatiles		
T-SVOA-WI11981	Analysis of Chlorinated Herbicides in Water by 8270C/D SIM by GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI31758	Client Specific Methylphenols by Method 8270D in Water Using GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI34439	Client Specific SAN Trimer by Method 525.3 in Water Using SIM by GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager

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T-SVOA-WI9613	Client Specific Semivolatile Compounds by Method 525.2 in Drinking Water using GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI31271	Client Specific Semivolatiles in Waters by Method 612 by SIM GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9590	Dioxin Screening (2,3,7,8-TCDD) of Aqueous and Solid Matrices using GC/MS SIM	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9596	GC/MS Electronic Data Management and Handling	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9598	GC/MS Preventative and Corrective Maintenance	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9594	GC/MS Semivolatile Audit Process	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9604	Monitoring GC/MS Semivolatile QC Data Acceptance Limits	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9252	Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D SIM by GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI18565	Priority Pollutants by Method 625.1 in Water Using GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9623	Semivolatile Organic Compounds, Including DRO/ORO, by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC-MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI11997	Semivolatile Organics Tentatively Identified Compound Method	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9624	Semivolatile Run/Injection Log Generation	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9995	Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9587	Tetraethyl lead (TEL) in Water and Solids by 8270D/E by GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI13634	The Determination of 1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8270C/D/E	5_EUUSLA_GC/MS Semivolatiles_Manager
T-SVOA-WI9626	THPA, THPI and PA by CELP 440 in Waters Using GC/MS	5_EUUSLA_GC/MS Semivolatiles_Manager
8.06 Instrumental Water Quality		
T-WC-WI9861	Accusterilizer - Steam Sterilizer	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10024	Ammonia Nitrogen by EPA 350.1 in Waters and Solids Using Segmented Flow Analysis and Gas Diffusion	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI29061	Chloride in Waters by SM 4500-Cl E 2011 by Spectrophotometry	5_EUUSLA_Sample Administration_Manager
T-WC-WI11621	Client Specific - Determination of Total Cyanide in Water, Wastewater, and Soils (Department of Defense) SW-846 9012B, SW-846 9012A	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11622	Client Specific - Total Cyanide Distillation (Department of Defense)	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11624	Department 4027 Chemical Inventory and Review Procedures	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11626	Determination of Inorganic Anions by Ion Chromatography in Waters and Soil by EPA 300.0, SW 846 9056, and SW 846 9056A	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11636	Determination of Total and Soluble Phosphorus in Water, Wastewater, and Soils (Colorimetric, Ascorbic Acid, Automated) by EPA 365.1 or SM 4500-P F-2011	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10037	Determination of Total Carbon in Water and Wastewater by SM-5310 C and EPA 415.1	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10039	Digestion of Total and Soluble Phosphorus in Water, Wastewater, and Soils EPA 365.1, and SM 4500-P B-2011	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11625	Hexavalent Chromium by Ion Chromatography in Solids and Waters SW-846 7199	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11640	ICS-1000, ICS 1100, ICS-2000 and ICS-3000 Ion Chromatography Systems	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11641	Low Level Hexavalent Chromium by Ion Chromatography in Waters by EPA 218.6	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI9889	Maintenance and Calibration of A.I. Scientific AIM600 Digestor	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11643	Maintenance of Continuous Flow Analyzers	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI9890	Maintenance of the OI Analytical Model 1030 Total Organic Carbon Analyzer	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10070	Moisture by Moisture Analyzer in Solids by SM 2540 G-2011	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11649	Nitrate Nitrogen in Water and Wastewater by EPA 353.2 (Colorimetric, Automated Cadmium Reduction)	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11650	Nitrite Nitrogen in Water and Wastewater (Colorimetric, Automated)	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI9891	pH Electrodes and Meters	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11651	Phenol Distillation in Solids by EPA SW-846 9065	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11619	Phenols in Water and Soils By Automated Flow Colorimetry EPA 420.4, SW-846, 9066	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11652	Quality Control for Analyses Performed in Instrumental Water Quality	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10083	Reagent Water Extraction of Ions in soil, for analysis by method EPA 300.0 or SW 846 9056	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI22922	Sulfate (turbidimetric) by SM 4500-SO4 E in Waters by Spectrophotometry	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11627	TOC and TC in Solids and Sludges by Combustion by SM 5310B, EPA 415.1, SW-846 9060/9060A, Lloyd Kahn	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10085	Total and Amenable Cyanide Distillation in Waters and Solids by SW-846 9012A/B, EPA 335.1/3/4, and SM 4500-CN G-1999/2011	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11635	Total and Available Cyanide in Water using Amperometric Detection by ASTM D 7511-09e2, -12 and Method OIA-1677-09	5_EUUSLA_Instrumental Water Quality_Manager

T-WC-WI10105	Total Cyanide Analysis of Waters and Solids by Massachusetts Contingency Plan (MCP)/NJ DKQP	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10106	Total Kjedahl Nitrogen Digestion of Solids and Soils by EPA 351.2	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10107	Total Kjedahl Nitrogen Digestion of Water and Wastewater by EPA 351.2	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI12055	Total Kjeldahl Nitrogen (TKN) by EPA 351.2, EPA 351.2 mod, SM4500-Norg or SM4500-N in Waters and Solids using Automated Flow Analysis or Discrete Analysis	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11637	Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), and Total Inorganic Carbon (TIC) by SM 5310C or EPA 415.1 in Waters	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10038	Total Organic Carbon in Water by SW-846 9060/9060A (Quadruplicate Studies)	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI11629	Total, Amenable and Weak Acid Dissociable Cyanide in Waters and Soils, Free Cyanide in Water, Reactive Cyanide of Solids, by SW-846 Method 9012A/B, EPA 335.4/3, and SM 4500-CN G/E-1999/2011	5_EUUSLA_Instrumental Water Quality_Manager
T-WC-WI10285	Weak Acid Dissociable Cyanide Distillation by method Method 4500 CN-I 2011	5_EUUSLA_Instrumental Water Quality_Manager
8.07 Leachate Preparation		
T-TL-WI7142	Calibration of the Leachate Tumblers	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7143	Glassware Cleaning for Leachate Extractions	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7144	Leachate Blank Evaluations	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7146	Manually Pressurized Zero Headspace Extractor (ZHE)	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7151	Nonvolatiles-Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7141	pH Meters and Probes	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7257	Procedure for Calculating and Reporting Weighted Average Results for TCLP Extracts	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7148	Shake Extraction of Solid Waste with Water by ASTM D3987-12, D3987-85	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7145	Subsampling and Preservation of Leachates	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7258	Volatiles by Zero Headspace Extractor (ZHE) - Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312	5_EUUSLA_Leachate Preparation_Manager
T-TL-WI7563	Waste Extraction Test Leaching Procedure for Volatile and Non-Volatile Analytes	5_EUUSLA_Leachate Preparation_Manager
8.08 Water Quality		
T-WC-WI10421	#1443 Specific Gravity by SM 2710F-1997, #6569 Bulk Density by ASTM E868-82 Sec 9.9	5_EUUSLA_Water Quality_Manager
T-WC-WI9862	Accumet Model AB30 pH/Ion/Conductivity Meter	5_EUUSLA_Water Quality_Manager
T-WC-WI10422	Acid Volatile Sulfide in Solids	5_EUUSLA_Water Quality_Manager
T-WC-WI9897	Adjustable Volume Handheld Pipettes	5_EUUSLA_Water Quality_Manager
T-WC-WI10423	Ammonia Nitrogen by Ion-Selective Electrode Method (ISE) in Solids by EPA 350.3 and SM 4500-NH3B-1997, 2011	5_EUUSLA_Water Quality_Manager
T-WC-WI10424	Ammonia-Nitrogen for Soils (Tritrimetric Distillation Procedure) by 4500-NH3 B/C - 2011, or EPA 350.2	5_EUUSLA_Water Quality_Manager
T-WC-WI11474	Ammonia-Nitrogen for Waters (Titrimetric Distillation Procedure) by 4500-NH3 B/C - 2011, or EPA 350.2	5_EUUSLA_Water Quality_Manager
T-WC-WI10425	Bellack Distillation for Fluoride in Waters and Solids by SM 4500 F B-2011, EPA 340.1 Procedure 6.1 or SM 4500 F B-1997	5_EUUSLA_Water Quality_Manager
T-WC-WI10426	BOD and CBOD in Waters by SM 5210 B-2011, Hach 10360, EPA 405.1, SM 5210 B-2001	5_EUUSLA_Water Quality_Manager
T-WC-WI9898	Calibration of Hach 2100AN Turbidimeter	5_EUUSLA_Water Quality_Manager
T-WC-WI12050	Chemical Oxygen Demand (COD) in Water by EPA 410.4	5_EUUSLA_Water Quality_Manager
T-WC-WI11478	Chemical Oxygen Demand (Low-Level) by 410.4	5_EUUSLA_Water Quality_Manager
T-WC-WI10358	Chemical Review	5_EUUSLA_Water Quality_Manager
T-WC-WI10431	Chloride (Titration) in Water by SM 4500-CL C-2011/1997 or EPA 325.3	5_EUUSLA_Water Quality_Manager
T-WC-WI11480	Chlorine Residual for waters by 4500 Cl F-2011, or EPA 330.4	5_EUUSLA_Water Quality_Manager
T-WC-WI11482	Color by 2120 B-2011, or EPA 110.2	5_EUUSLA_Water Quality_Manager
T-WC-WI11483	Colorimetric Sulfide in Waters, Sulfide as H2S, Dissolved Sulfide in Waters by 4500-S2 D-2011, 4500-S2 H-2011, or EPA 376.2	5_EUUSLA_Water Quality_Manager
T-WC-WI10609	Dissolved Oxygen by 4500 O G-2011, EPA 360.1 or Hach Method 10360	5_EUUSLA_Water Quality_Manager
T-WC-WI11616	Dissolved Oxygen Meter Calibration	5_EUUSLA_Water Quality_Manager
T-WC-WI11494	Dissolved Silica (Colormetric) in Water by SM4500SIO2 C-2011, SM4500SIO2 C-1997 or EPA 370.1	5_EUUSLA_Water Quality_Manager
T-WC-WI9900	Equipment Incubators and Refrigerators	5_EUUSLA_Water Quality_Manager
T-WC-WI9901	Equipment Muffle Furnaces and Ovens	5_EUUSLA_Water Quality_Manager
T-WC-WI11495	Ferrous Iron (colorimetric) in Waters and Solids by Method 3500-Fe B-2011	5_EUUSLA_Water Quality_Manager
T-WC-WI11496	Fixed Dissolved Solids (Calculation) by 2540 E - 2011 or EPA 160.4	5_EUUSLA_Water Quality_Manager
T-WC-WI10610	Fixed Suspended Solids (Gravimetric) (#207) Volatile Suspended Solids (Gravimetric) (#208) by SM 2540 E - 2011 or EPA 160.4 in Water	5_EUUSLA_Water Quality_Manager
T-WC-WI10348	Fixed Volume Hand-Held Pipettes	5_EUUSLA_Water Quality_Manager
T-WC-WI10437	Flash Point for Liquids and Solids by ASTM D93 or EPA 1010 A	5_EUUSLA_Water Quality_Manager

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T-WC-WI10612	Flash Point for Liquids and Solids by ASTM Method D93-07, ASTM D93-90 or SW-846 1010A	5_EUUSLA_Water Quality_Manager
T-WC-WI10352	Genesys 30 Spectrophotometer	5_EUUSLA_Water Quality_Manager
T-WC-WI11500	Hexane Extractable Material (HEM) and Silica Gel Treated Hexane Extractable materials (SGT-HEM) in Waters by EPA Method 1664A, 1664B, and 1664.	5_EUUSLA_Water Quality_Manager
T-WC-WI10436	Hexavalent Chromium (Colorimetric) in Waters (Department of Defense) by SM846 7196A and SM846 7196	5_EUUSLA_Water Quality_Manager
T-WC-WI10614	Hexavalent Chromium (Colorimetric) in Waters by CTRCP	5_EUUSLA_Water Quality_Manager
T-WC-WI10615	Hexavalent Chromium (Colorimetric) in Waters by MCP	5_EUUSLA_Water Quality_Manager
T-WC-WI10616	Hexavalent Chromium (Colorimetric) in Waters by SM846 7196A or SM846 7196 NJ DKQP	5_EUUSLA_Water Quality_Manager
T-WC-WI10618	Hexavalent Chromium in Solids (Alkaline Digestion and Analysis Methods) by SW-846 3060A and SW-846 7196A	5_EUUSLA_Water Quality_Manager
T-WC-WI10617	Hexavalent Chromium in Solids (Alkaline Digestion and Analysis Methods) by SW846 3060A, SW846 7196A NJ DKQP	5_EUUSLA_Water Quality_Manager
T-WC-WI10432	Hexavalent Chromium in Solids Alkaline Digestion and Analysis Methods (Department of Defense) by SW-846 3060A and SW-846 7196A	5_EUUSLA_Water Quality_Manager
T-WC-WI10619	Hexavalent Chromium in Solids by CTRCP (Alkaline Digestion and Analysis Methods)	5_EUUSLA_Water Quality_Manager
T-WC-WI10622	Hexavalent Chromium in Solids by MCP (Alkaline Digestion and Analysis Method)	5_EUUSLA_Water Quality_Manager
T-WC-WI11501	Hexavalent Chromium in waters (Colorimetric) by SW-846 7196A	5_EUUSLA_Water Quality_Manager
T-WC-WI10627	Ignitability of Solids by 40 CFR, Part 261.21	5_EUUSLA_Water Quality_Manager
T-WC-WI10359	Instructions for Collecting Data on the LLENS System	5_EUUSLA_Water Quality_Manager
T-WC-WI11506	Low-Level Hexavalent Chromium in waters (Colorimetric) by 3500-Cr B-2011	5_EUUSLA_Water Quality_Manager
T-WC-WI10350	Maintenance of Desiccators	5_EUUSLA_Water Quality_Manager
T-WC-WI10351	Maintenance of Hot Plates	5_EUUSLA_Water Quality_Manager
T-WC-WI10629	Methylene-Blue-Active Substances (MBAS) by 5540 C-2011 or EPA 425.1	5_EUUSLA_Water Quality_Manager
T-WC-WI11509	Moisture (Gravimetric), Total Residue, Volatile Residue, Total Fixed Residue/Ash by SM 2540 G-2011/1997 in Solids	5_EUUSLA_Water Quality_Manager
T-WC-WI11475	Multi-Parameters in Solids and Waters by ManTech Multi-Parameter System	5_EUUSLA_Water Quality_Manager
T-WC-WI11510	n-Hexane Extractable Material (HEM) and Silica Gel Treated HEM (SGT-HEM) in Solids by EPA 9071B	5_EUUSLA_Water Quality_Manager
T-WC-WI11511	Orthophosphate (Colorimetric) by EPA 365.3 in Waters	5_EUUSLA_Water Quality_Manager
T-WC-WI15537	Orthophosphate in waters by Colorimetry SM 4500 P E-2011	5_EUUSLA_Water Quality_Manager
T-WC-WI11512	Oxidation-Reduction Potential for Wastewaters and Soils by ASTM D1498, SM 2580 B-2011	5_EUUSLA_Water Quality_Manager
T-WC-WI11513	Paint Filter Liquids Test (Free Liquids Test) in Waste by SW-846 9095A, 9095B	5_EUUSLA_Water Quality_Manager
T-WC-WI11514	Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D422-63 (reapproved 2007)	5_EUUSLA_Water Quality_Manager
T-WC-WI11515	Percent Solids for GC/MS by EPA 1666, Revision A - 1998	5_EUUSLA_Water Quality_Manager
T-WC-WI11518	pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometic Methods	5_EUUSLA_Water Quality_Manager
T-WC-WI11519	pH Probes and Meters	5_EUUSLA_Water Quality_Manager
T-WC-WI10360	Quality Control Data for Wet Chemistry	5_EUUSLA_Water Quality_Manager
T-WC-WI11572	Reactive Sulfide (titration) by SW-846 9034 (1996) or Chapter 7.3 (1996) in Solid or Liquid Waste	5_EUUSLA_Water Quality_Manager
T-WC-WI11574	Reactivity of Waste	5_EUUSLA_Water Quality_Manager
T-WC-WI11578	Settleable Solids in waters by 2540 F-2011, or EPA 160.5	5_EUUSLA_Water Quality_Manager
T-WC-WI10349	SKALAR COD Robot Analyzer and COD Spectrophotometers	5_EUUSLA_Water Quality_Manager
T-WC-WI11584	Specific Conductance in Solids by SM 2510B-2011, SM 2510B-1997, SW-846 9050A, SW-846 9050, or EPA 120.1	5_EUUSLA_Water Quality_Manager
T-WC-WI10362	Standardization of 0.02 and 0.1 Normal Sulfuric Acid	5_EUUSLA_Water Quality_Manager
T-WC-WI11585	Standardization of 0.02 Normal Sodium Hydroxide	5_EUUSLA_Water Quality_Manager
T-WC-WI11586	Sulfate (turbidimetric) by EPA 375.4 in Waters	5_EUUSLA_Water Quality_Manager
T-WC-WI11587	Sulfide Titration for Waters by 4500 S2 F-2011, EPA 376.1, SW-846 Method 9034 or 4500 S2 F-2000	5_EUUSLA_Water Quality_Manager
T-WC-WI11589	Sulfite in waters by 4500-SO3 B-2011, or EPA 377.1	5_EUUSLA_Water Quality_Manager
T-WC-WI11597	Total Dissolved Solids (Calculation)	5_EUUSLA_Water Quality_Manager
T-WC-WI11598	Total Dissolved Solids (TDS)(Gravimetric) by SM 2540 C-2011, SM 2540 C-1997 or EPA 160.1 in Waters and Wastewaters	5_EUUSLA_Water Quality_Manager
T-WC-WI11600	Total Fixed Solids (TFS), Total Volatile Solids (TVS) Gravimetric by SM 2540 E-2011, SM 2540 G-2011 or EPA 160.4 in Waters, Wastewaters and Sludges	5_EUUSLA_Water Quality_Manager
T-WC-WI11603	Total Solids (Gravimetric) by SM 2540 B-2011, SM 2540 G-2011, EPA 160.3, SM 2540 G-1991, SM 2540 B-1997, or SM 2540 G-1997 in Waters, Wastewaters and Sludges	5_EUUSLA_Water Quality_Manager

T-WC-WI11604	Total Suspended Solids (TSS)-Gravimetric by SM 2540 D-2011 or SM 2540 D-1997 and Total Filtered: Total Volume Test by NJDEP in Waters	5_EUUSLA_Water Quality_Manager
T-WC-WI15618	Turbidity by EPA 180.1 Rev. 2 or SM 2130 B-2011	5_EUUSLA_Water Quality_Manager
T-WC-WI11605	Volatile Dissolved Solids (Calculation) by SM 2540 E - 2011 or EPA 160.4	5_EUUSLA_Water Quality_Manager
T-WC-WI10364	Water Quality Washroom Procedures	5_EUUSLA_Water Quality_Manager
8.09 Air Quality		
T-AQ-WI7174	Analysis of Air for Selected Volatile Organic Compounds by Gas Chromatography with Flame Ionization Detector and Photo Using EPA Method 18 and 25	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI26671	Ashcroft ATE-100 Hand Held Calibrator	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7162	Calibration of Pressure Gauges	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7165	Cleaning and Handling of Flow Controllers	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7164	Cleaning and Handling of Summa Canisters	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7172	Helium as a Tracer Gas	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7275	Low-Level Volatiles in Air by EPA Method TO-15 Using GC/MSD in SIM Mode	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7170	Oxygen and Carbon Dioxide in Air by ASTM D1946 by GC-TCD	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7168	Preparing Summa Can Order	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7163	Routine Instrument Maintenance for Volatiles in Air by GC and GC/MS	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7169	Standards Preparation, Validation, and Documentation Using EPA Method TO-14 and TO-15	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7436	The Determination of Volatile Organic Compounds in Air by GC/MS Using EPA Method TO-14 or TO-15	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7271	Volatiles in Air Audit Process	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7173	Volatiles in Air Tentatively Identified Compound Method	5_EUUSLA_Volatiles in Air_Manager
T-AQ-WI7171	Volatiles in Air Tentatively Identified Compound Method (Interpretive)	5_EUUSLA_Volatiles in Air_Manager
8.10 EPH/Miscellaneous GC		
T-GC-WI9253	Analysis of DRO/RRO by Alaska 102/103 in Waters and Soils	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9644	Carbon Dioxide in Water Using Headspace Sampling Techniques and GC-TCD, Method RSK-175 or 8015	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9656	Client Specific - Total Extractable Hydrocarbons (TEH) by Method 8015B Modified Using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9657	Common Equations Used During Chromatographic Analyses	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9663	Determination of Diesel and Residual Range Organics using Alaska 102/103 Small Volume (SV) Protocols in Aqueous Samples by GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9669	DRO/ORO by 8015B/C/D and TPH by NWTPH-Dx (Modified) in Water using Mini-Extraction and GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9671	DRO/TPH by Method 8015 (B, C, of D) in Waters using Microextraction and GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9672	EPH by Massachusetts Protocol (MA EPH) in Waters and Solids Using GC	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9676	Extraction of Soils/Solids for Glycol Analysis by 8015B/C/D	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9677	Extraction of Solids/Soils for Analysis of Alcohols by Method 8015B	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9678	Fractionated EPH using LA RECAP Ranges in Waters and Solids by GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9679	GC Routine and Nonroutine Maintenance for Instrumentation Used for VPH Analysis	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9680	Glycols by Method 8015B/8015C/8015D in Water and Solid Matrices Using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9683	Interpretation and Integration of Chromatographic Data	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9685	MA DEP VPH in Waters and Solids Using GC/FID/PID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9689	Maintenance and Troubleshooting Procedures for GC-FID Instrumentation	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9698	Monitoring QC Data Acceptance Limits	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9736	New Jersey Extractable Petroleum Hydrocarbons (NJEPH) in Waters and Solids using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9740	PMI VOCs (Direct Injection) by Method 1671A in Waters Using GC/FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9749	QC Data Acceptability and Corrective Action	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9756	Qualitative/Quantitative GC Fingerprint in Petroleum Distillates, Fuels, and Oils by 8015B/C/D using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9770	TNRCC TX Method 1005 - Total Petroleum Hydrocarbons (Gasoline Range, Diesel Range, and Extended Range Organics) in Waters and Solids	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9771	Total Petroleum Hydrocarbons with Ranges by Methods 8015B/8015C/8015D in Waters and Solids by GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9772	Total Saturated Hydrocarbons by Method 8015C in Waters and Solids using GC/FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9773	TPH by CT ETPH	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9778	TPH by Methods 8015B/C/D mod. in Waters and Solids Using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9781	TPH by NWTPH-Dx (modified) in Soils using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9783	TPH by NWTPH-Dx (modified) in Waters using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9784	TPH by TN EPH in Water and Soil using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9788	TPH DRO and TPH ORO by 8015B/8015C/8015D in Solids using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9786	TPH DRO and TPH ORO by 8015B/C/D in Water using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager

T-GC-WI9790	TPH-DRO by 8015C South Carolina Methodology Using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9791	TPH-DX with Fuel Identification in Waters by NWTPH-DX	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9792	TX 1006 Characterization of C6-C35 Petroleum Hydrocarbons in Waters and Solids by GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9794	Using "Range Compound Analysis" Software for Range Data Acquisition	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI24004	Volatile Hydrocarbons in Water by ASTM Standard Test Method D8028-17 Using Headspace Sampling Techniques and GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9796	Volatile Hydrocarbons in Water by Method RSK-175 and SW-846 8015 Using Headspace Sampling Techniques and GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9798	Volatile Organic Concentration of Waste Samples by Method 25D Using FID and ELCD	5_EUUSLA_EPH/Misc. GC_Manager
T-GC-WI9824	Water Miscible Solvents by Method 8015B/8015C/8015D Using GC-FID	5_EUUSLA_EPH/Misc. GC_Manager
8.11.01 Prep for Pesticides		
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10958	Client Specific - Microwave Extraction of Cyclopamine for a Biomass	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10907	Extraction By Method 8318/8318A for Carbamate and Urea Pesticides in Solids	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10940	Extraction for Perchlorate by Method 6850 in Solids	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10919	Extraction of Chlorinated Herbicides in Water by SW-846 8151A	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI11372	Extraction of Formaldehyde and Other Aldehydes in a Water Matrix by Method 8315A	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10942	Extraction of Nitroaromatics and Nitroamines by Method 3535A in Water	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI11373	Extraction of Solid Samples for Formaldehyde and Aldehydes by Method 8315A	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10881	Liquid/Liquid Extraction Procedure for the Determination of Organophosphorous Pesticides in a Wastewater Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI11381	Microextraction by Method 8011 for EDB, DBCP, and TCP in Water	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10956	Microextraction of EDB, DBCP, and TCP in Solids by Method 8011	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10926	Microwave Extraction Method 3546 for Pesticides in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by Method 3640A	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in a Wastewater	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10941	Soxhlet Extraction (Method 3540C) for Triazine Herbicides and Organophosphorous Pesticides in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10922	Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550C	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10939	Ultrasonic Extraction for Pesticides in a Solid Matrix by Method 3550	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10912	Ultrasonic Extraction of Chlorinated Herbicides by Method 3550B/C in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10943	Ultrasonic Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Solids	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10918	Waste Dilution by EPA 3580A for PCBs in Oil	5_EUUSLA_Organic Extraction_Manager
T-OE-PEST-WI10921	Waste Dilution by EPA 3580A for Pesticides in a Non-Water Soluble Leachate Matrix	5_EUUSLA_Organic Extraction_Manager
8.11.02 Prep for SVOA		
T-OE-SVOA-WI10280	Alumina Column Cleanup for DRO	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10938	Extraction of Semi-Volatile Organic Compounds by Method 525.2 in Drinking Waters	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI11374	Extraction Procedure for the Determination of PAHs in an XAD Air Tube Sample by TO-15A	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10933	Liquid -Liquid Extraction Procedure for the Determination of Target Compound list Analytes in a Water Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10923	Liquid/Liquid Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables by EPA 3520C in a Wastewater Matrix by Method 8270	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10916	Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10915	Low-Level Ultrasonic Extraction by Method 3550C for PAHs in a Solid Matrix by GC/MS	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10928	Microwave Extraction by Method 3546 for Semivolatiles	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10880	Microwave Extraction for the Determination of Semivolatiles in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10554	Semivolatile Extract Cleanup Using GPC by Method 3640A	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10935	Separatory Funnel Extraction (Method 3510C) or Waste Dilution (Method 3580A) of Base Neutrals and Acid Extractables in Leachates	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI11432	Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10924	Separatory Funnel Extraction by Method 3510C for Tetraethyl Lead in Waters	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10947	Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1	5_EUUSLA_Organic Extraction_Manager

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T-OE-SVOA-WI18058	Separatory Funnel Extraction of Chlorinated Herbicides in Water by SW-846 Method 8151A	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10884	Solid Phase Extraction Procedure for the Determination of THPA, THPI, and PA in a Water Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10925	Sonic Probe Extraction Procedure by EPA 3550C in Solids for the Determination of Semivolatiles by SIM	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10936	Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix by Method 3580A	5_EUUSLA_Organic Extraction_Manager
T-OE-SVOA-WI10917	Waste Dilution, EPA 3580A for Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	5_EUUSLA_Organic Extraction_Manager
8.11.03 Prep for GC		
T-OE-GC-WI10278	10g Silica Gel Cleanup by Method 3630C for Hydrocarbons by GC in Water and Solid Matrices	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10949	3 g Silica Gel Column Cleanup for DRO by Method 3630C	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI21921	Acid Cleanup Procedure for Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10932	Extraction by EPA 3546 for DRO and/or RRO in Solids for Alaska Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI11364	Extraction of Total Petroleum Hydrocarbon Organics in Waters by Texas Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI11365	Extraction of Total Petroleum Hydrocarbons in a Solid Matrix by Texas Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10906	Microextraction by Method 3511 for DRO in Water and Wastewater	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10899	Microwave Extraction for EPH in a Solid Matrix by Montana Protocol	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10930	Microwave Extraction Method 3546 for DRO and Saturated Hydrocarbons in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10883	Microwave Extraction Method 3546 for NJ EPH in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10909	Microwave Extraction, Method 3546, for MA EPH in a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10910	Quick Silica Gel Cleanup by Methods 3630C and ECY 97-602 for Hydrocarbons by GC in Solid and Water Matrices	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10911	Separatory Funnel Extraction by Method 3510C for DRO in Water by California Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10894	Separatory Funnel Extraction for DRO and RRO by AK 102/103 in a Water Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10890	Separatory Funnel Extraction for EPH in Water or Wastewater by Montana Protocol	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10893	Separatory Funnel Extraction for EPH in Water or Wastewater by Tennessee Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10914	Separatory Funnel Extraction for EPH in Waters by Massachusetts, New Jersey, and Louisiana Protocol	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10892	Separatory Funnel Extraction for ETPH in Water or Wastewater Matrix by Connecticut Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10944	Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10908	Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10879	Silica Gel Fractionation by Method 3630C for Hydrocarbons by GC in Water and Solid Matrices	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10913	Sonic Probe Extraction for TPH in Solids by Washington DX	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10957	Sonic Probe Extraction of Glycols by Method 3550C from a Solid Matrix	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10897	Sonication Extraction Method 3550B and C for DRO (CA) in Solids	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10945	Sonication Extraction Method 3550C for DRO in Soils or Solids	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10937	Ultrasonic Extraction by Method 3550C for Fingerprint on Petroleum Products in Solid Matrices	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10902	Ultrasonic Extraction for EPH in a Solid Matrix by Tennessee Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10901	Ultrasonic Extraction for ETPH in Solid Matrix by Connecticut Methodology	5_EUUSLA_Organic Extraction_Manager
T-OE-GC-WI10905	Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	5_EUUSLA_Organic Extraction_Manager
8.11.04 General		
T-OE-GEN-WI10808	Concentration Using a TurboVap LV Concentration Workstation	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11369	Determining QC Sample Volume for Organic Extractions	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10862	Electrothermal Heating Mantles	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI7154	Food and Tissue Preparation	5_EUUSLA_Leachate Preparation_Manager
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10873	Glassware Cleaning Using Automatic Washers for non-Organic Extraction Glassware	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10877	Maintenance and Calibration of the Microwave Accelerated Reaction System	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11400	Multipette Stream Operation and Calibration	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling	5_EUUSLA_Organic Extraction_Manager

T-OE-GEN-WI11408	Percentage Lipids Using Soxhlet Extraction by Method 3540C	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10871	Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10866	pH Meters and Electrodes	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI13363	Pore Water Generation Procedure	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10867	Procedure for Containment and Clean Up of Hazardous materials Spills in Organic Prep Lab	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11418	Refrigerated Recirculators	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11420	Routine Maintenance of Miele Glass Washers	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10868	Scheduling Extraction Batches	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11427	Semivolatile Extract Concentration Using a Zymark TurboVap II Concentration Workstation	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10865	Solvent, Reagent, and Amber GC Vial Lot Testing for Organic Extractions	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI11440	Soxhlet Extraction Procedure for Extractable Matter in Textiles	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10869	Spike Solution Testing and Approval	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10861	Steam Bath, N-Evap, and RapidVap Usage, Calibration, and Maintenance	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10870	Ultrasonic Probe Horn Cleaning	5_EUUSLA_Organic Extraction_Manager
T-OE-GEN-WI10860	Ultrasonic Processor Maintenance and Tuning	5_EUUSLA_Organic Extraction_Manager
8.11.05 Prep for Specialty Services		
T-OE-SSG-WI10904	Liquid/Liquid Extraction Procedure for the Determination of Neutral Extractables in a Wastewater Matrix	5_EUUSLA_Organic Extraction_Manager
8.12 PFAS by LC/MS/MS		
T-PFAS-WI21864	Client Specific Table 3 PFAS in Water and Soil Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI32768	Client Specific: Determination of Table 6 Compounds by LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI20127	Client Specific: Table 3 Compounds by Direct Injection Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI21568	Manifold and N-EVAP Cleaning for PFAS Extractions	5_EUUSLA_PFAS_Manager
T-PFAS-WI21398	New Jersey - Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples using LC/MS/MS and Isotope Dilution	5_EUUSLA_PFAS_Manager
T-PFAS-WI33376	Pennsylvania - Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples using LC/MS/MS and Isotope Dilution	5_EUUSLA_PFAS_Manager
T-PFAS-WI33671	Pennsylvania - Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Isotope Dilution using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI30676	Per- and Polyfluoalkyl Substances in Drinking Water Using Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry by Method 533	5_EUUSLA_PFAS_Manager
T-PFAS-WI12017	Perfluorinated Alkyl Substances (PFASs) in Drinking Water by Method 537 Version 1.1	5_EUUSLA_PFAS_Manager
T-PFAS-WI25232	Perfluorinated Alkyl Substances (PFASs) in Drinking Water by Method 537.1 Version 1.0	5_EUUSLA_PFAS_Manager
T-PFAS-WI21252	PFAS Data Review Procedure	5_EUUSLA_PFAS_Manager
T-PFAS-WI14355	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by EPA Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI22030	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Version 1.1 Modified QSM5.1 Table B-15 Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI12031	Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI22283	Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Version 1.1 Modified QSM 5.1 Table B-15 Using LC/MS/MS	5_EUUSLA_PFAS_Manager
T-PFAS-WI23588	Preventative and Corrective Maintenance for the API 4000 and AB Sciex 4500 Liquid Chromatograph Mass Spectrometers (LC/MS/MS)	5_EUUSLA_PFAS_Manager
T-PFAS-WI13881	Standards Management in the PFAS Laboratory	5_EUUSLA_PFAS_Manager
T-PFAS-WI18548	Total Oxidizable Precursors in Aqueous Samples by LC/MS/MS with Isotope Dilution using EPA 537 Version 1.1 modified.	5_EUUSLA_PFAS_Manager
8.13 Specialty Services		
T-SSG-WI7750	Analysis of Fluorotelemer Alcohols in Water and Wastewater	5_EUUSLA_Specialty Services_Manager
T-SSG-WI9093	Client Specific - Analysis of Glycerol Monolaurate and Propylene Glycol Monolaurate in BioPolySan by Gas Chromatography Mass Spectroscopy (GC/MS)	5_EUUSLA_Specialty Services_Manager
T-SSG-WI13642	Determination of Endothall in Aqueous Samples Using LC-MS by Method 8321B	5_EUUSLA_Specialty Services_Manager
T-SSG-WI12005	Determination of Endothall in Solid Matrix Using LC-MS by Method 8231B	5_EUUSLA_Specialty Services_Manager
T-SSG-WI23830	Determination of Ethanolamines in Waters by SPE LC/MS/MS following SW-846 8321B Modified Method	5_EUUSLA_Specialty Services_Manager
T-SSG-WI12008	Determination of Glycols in Waters by Direct Injection LC/MS/MS following SW-846 8321A Modified Method	5_EUUSLA_Specialty Services_Manager
T-SSG-WI9448	Determination of Hydrazine Monomethylhydrazine and 1,1-Dimethylhydrazine in Aqueous Samples by LC/MS/MS Using SW-846 8315A Modified	5_EUUSLA_Specialty Services_Manager

T-SSG-WI9431	Determination of Hydrazine, Monomethylhydrazine and 1,1-Dimethylhydrazine in Soil samples by LC/MS/MS	5_EUUSLA_Specialty Services_Manager
T-SSG-WI9483	Extraction of Waters for Fluorotelomer Alcohols by Method 3510C	5_EUUSLA_Specialty Services_Manager
T-SSG-WI12019	Maintenance and Tuning for Thermo Scientific TSQ Quantum Access Tandem Mass Spectrometer with a Thermo Electron Accela HPLC System (LC/MS/MS)	5_EUUSLA_Specialty Services_Manager
T-SSG-WI9963	Micromass Quattro Micro Tandem Mass Spectrometer with an HPLC System (LC/MS/MS)	5_EUUSLA_Specialty Services_Manager
T-SSG-WI7748	Thermo Scientific Trace 1310 Gas Chromatograph Tandem Mass Spectrometer (GC/MS/MS) Preventative and Corrective Maintenance	5_EUUSLA_Specialty Services_Manager
8.14 HRMS Group		
T-HRMS-WI9452	Determination of PCB Homologs in Waters and Solids by Method 680	5_EUUSLA_HRMS_Manager
T-HRMS-WI12013	Determination of Percentage Lipids in Animal and Marine Tissue using EPA Method 1613B	5_EUUSLA_HRMS_Manager
T-HRMS-WI21311	Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water and solid samples using HRGC/HRMS	5_EUUSLA_HRMS_Manager
T-HRMS-WI9476	Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 Method 8290A	5_EUUSLA_HRMS_Manager
T-HRMS-WI12003	Determination of Tetra- Through Octa-chlorinated Dioxins and Furans, Dioxin-like Polychlorinated Biphenyls, and Indicator Polychlorinated Biphenyls by HRGC/HRMS in Aqueous, Solid, Oil and Oleoresin Matrices(foods/feeds) by Methods 1613B and 1668C	5_EUUSLA_HRMS_Manager
T-HRMS-WI19229	DFS HRGC/HRMS Preventative and Corrective Maintenance	5_EUUSLA_HRMS_Manager
T-HRMS-WI9480	Extraction of Water and Soil Samples by Method 680	5_EUUSLA_HRMS_Manager
T-HRMS-WI9485	Glassware Cleaning for HRMS Extractions	5_EUUSLA_HRMS_Manager
T-HRMS-WI21285	PCB Congeners by HRGC/HRMS in Aqueous and Solid Matrices	5_EUUSLA_HRMS_Manager
T-HRMS-WI9432	PCB Congeners by Method 1668 HRGC/HRMS in Aqueous and Solid Matrices	5_EUUSLA_HRMS_Manager
T-HRMS-WI9487	Preparation of Aqueous and Solid Samples for Food and Feed Using Microwave or Soxhlet Extraction for Analysis by HRMS	5_EUUSLA_HRMS_Manager
T-HRMS-WI9489	Preparation of Oils and Oleoresins for Food and Feed Analysis by HRMS	5_EUUSLA_HRMS_Manager
T-HRMS-WI9433	Processing High Resolution Mass Spectrometry Data Using TargetQuan	5_EUUSLA_HRMS_Manager
T-HRMS-WI21528	Separatory Funnel Extraction Procedure for HRMS Analysis in an Aqueous Matrix	5_EUUSLA_HRMS_Manager
T-HRMS-WI12032	Separatory Funnel Extraction Procedure for HRMS Analysis in an Aqueous Matrix Using Method 1613B, 8290A, 1668A, and 1668C	5_EUUSLA_HRMS_Manager
T-HRMS-WI21536	Soxhlet Extraction Procedure for HRMS Analysis in a Solid matrix	5_EUUSLA_HRMS_Manager
T-HRMS-WI9488	Soxhlet Extraction Procedure for HRMS Analysis in a Solid Matrix by Methods: 1613B, 8290A, 1668C, and 1668A	5_EUUSLA_HRMS_Manager
T-HRMS-WI9446	Standards Management in the High Resolution Mass Spectrometry Laboratory	5_EUUSLA_HRMS_Manager

Instrument	# of Units	Detector Type/Manufacturer
Liquid Chromatography/Gas Chromatography/Mass Spectrometry (LC/GC/MS)		
LC/MS/MS	12	AB Sciex 4000 with Exion LC
LC/MS/MS	1	Agilent
LC/MS/MS	2	Agilent LC with Micromass Quattro micro MS/MS and Waters 2996 Photodiode Array UV-Vis Detector
LC/MS/MS	1	Thermo Scientific TSQ Quantum Access with Acella LC
GC/MS	30	Agilent
GC/MS	1	Shimadzu
GC/MS	1	DSQ II MS
GC/MS/MS	1	Thermo TSQ 8000 MSMS
HRGC/HRMS	5	Thermo Scientific DFS
Gas Chromatograph	3	Flame Ionization / Photoionization
Gas Chromatograph	2	Thermal Conductivity
Gas Chromatograph	17	Electron Capture
Gas Chromatograph	2	Nitrogen/Phosphorus
Gas Chromatograph	14	Flame Ionization
Auxiliary Equipment for Gas Chromatographs		
Most of the GC/MS and GC systems include autosamplers and approximately half are fitted with purge and trap concentrators for analysis of volatiles.		

High Performance Liquid Chromatography		
High Performance Liquid Chromatograph	2	Agilent 1100 LC
High Performance Liquid Chromatograph	2	Agilent 1200 HPLC
High Performance Liquid Chromatograph	1	Waters alliance 2695
High Performance Liquid Chromatograph	1	Waters alliance 2795

Gel Permeation Chromatography		
Gel Permeation Chromatograph	3	J2Scientific AccuPrep

Ion Chromatography		
Ion Chromatograph	1	Metrohm 881 IC Pro
Ion Chromatograph	1	Dionex ICS1000
Ion Chromatograph	1	Dionex ICS3000
Ion Chromatograph	1	Dionex ICS2000
Ion Chromatograph	4	Dionex ICS1100
Ion Chromatograph (Specialty Services)	1	Dionex ICS5000 with UltimMate 3000 Aux Pump

Atomic Absorption/Emission Spectrophotometry		
ICP	1	Thermo ICAP™ 7400 Duo ICP Analyzer
ICP	5	Thermo ICAP™ 6500 Duo ICP Analyzer
ICP/MS	1	Agilent 7500ce
ICP/MS	1	Agilent 7700cx
ICP/MS	1	Agilent 7700x
ICP/MS	1	Agilent 7900
Mercury Analyzer	3	Leeman Labs Hydra II
Prep Station	3	Thomas Cain DEENA 60

UV Vis/IR Spectrophotometry:		
UV-Vis Spectrophotometer	3	Thermo Genesys 30
UV-Vis Spectrophotomenter	1	Hach DR2800

Miscellaneous Chemistry Instrumentation		
Auto-titrator System	2	Mantech
Automated COD Analyzer	1	Skalar
Turbidimeter	1	Hach 2100AN
Block Digestion Systems	8	Environmental Express SC150
Block Digestion Systems	6	Environmental Express SC154
Centrifuge	5	Various
Chilled water recirculators		Various
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
Automated SPE HEM Extractor	2	Horizon SPE-DEX 3100
Automated SPE HEM Extractor	2	Environmental Exprerss SPE-Express
Cyanide Midi Distillation Kits	3	Various
Automated BOD Analyzer	3	Mantech
Dissolved Oxygen Meter	6	YSI
Flow Solution Autoanalyzer	1	Astoria Pacific 302
Flow Solution Autoanalyzer	2	OI FS3700
Flow Solution Autoanalyzer	1	OI FS3100
Flow Solution Autoanalyzer	1	Skalar San++
Discrete Autoanalyzer	1	Thermo Gallery Plus
Glassware washer - automated	6	Miele – (2) PG8257 (1) G7827 (1) G7704 (2) G7883
Kjehldal Distillation Apparatus	2	Fisher
Microwave Extractors	3	CEM MarsXpress
pH meters	13	Various
Phenol Midi Distillation	2	Andrews Glass
Pressurized Solvent Extractor	2	Dionex ASE200
Puck Mill	1	ESSA/2000
Sonicators	12	Various
Total Organic Carbon Analyzer	4	O.I. Corp. 1030
Total Organic Carbon Automated Combustion Analyzer	1	Skalar Primacs ATC-100
Turbidimeter	1	Hach 2100AN
Zero Headspace Extractor	74	Various Models

Microbiology Equipment		
Autoclave	2	Steris – Amsco,
Balance	5	Mettler, PB 3002
Balance	1	Mettler-Toledo, AT200
Balance	2	Mettler-Toledo, PR2002
Balance	1	Sartorius BP4100
Biological Safety Cabinet	4	NuAire NU-425-600 Type A/B 3
Biological Safety Cabinet	1	NuAire NU-435-600 Type B2 Fume Hood
Colony Counter	1	Quebec Dark Field
Incubator	1	PGC 9311-1127
Incubator	1	PS WFY20SAWI
Microscope	1	Stereoscope with Zoom, AO Model 570
Microscope	1	Zeiss
pH Meter	2	Orion Model 410A
Quanti-Tray Sealer	1	IDEXX Model 2X
Water Bath	1	Boekel Grant with Removal Heater Circulator
Water Bath	1	Thermo Electron Corp.
Water Bath	1	Precision Coliform Incubator Bath
Water Bath	1	VWR 1275PC
Water Bath	2	Thermo Scientific Model 2862
UV Light	1	Spectronics

Computer Equipment

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA Program (see section on Quality Assurance). Numerous physical and virtual servers are used to support the systems. Internet access is provided with an ASA firewall to control incoming and outgoing traffic. The laboratory uses 3 phase power supply and backup generators for life safety and sample integrity preservation.

Attachment B

AECOM Field SOPs

Utility Clearance

Procedure 3-01

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.3 The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities.

1.4 The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

1.5 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 Field and subcontractor personnel shall adhere to a site-specific health and safety plan (HASP).

3.0 Terms and Definitions

3.1 Utility

For the proposes of this SOP, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 As-Built Plans

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 One-Call

The Utility Notification Center is the one-call agency for nationwide call before you dig. The Utility Notification Center is open 24 hours a day and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number that directly connects you to your local one-call center. Additional information can be found at www.call811.com or www.texas811.org.

Calling before you dig ensures that any publicly owned underground lines will be marked so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.

- What type or work is being done.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 Toning

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

4.0 Training and Qualifications

4.1 The Task Order (TO) **Project Manager** is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Team Lead** is responsible for ensuring that all utility locating activities are performed in accordance with this procedure.

4.4 All **field personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Equipment and supplies necessary for locating subsurface utilities will be provided by the subcontractor; however, the project **Field Team Lead/Field Personnel** will provide any additional equipment and supplies as needed as well as maintain information regarding the utility clearance activities in the field logbook.

6.0 Procedure

Proceed with the following steps where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

6.1 Prepare Preliminary Site Plan

- Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the project specific QAPP. Include as many of the cultural and natural features as practical in this plan.

6.2 Review Background Information

- Search existing plan files when possible to review the as-built plans to identify the known location of utilities at the site. Move proposed sampling locations away from utilities to the extent possible.

- Include the utility location information gathered during previous investigations (e.g., remedial investigation or remedial site evaluation) in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected can be shared with the subcontractor during implementation. In many instances, this will help to reduce the amount of additional geophysical surveying work the subcontractor may have to perform.
- As needed, conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.
- During the pre-field work interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

6.3 Site Visit/Locate Utilities/Toning

- Prior to the initiation of field activities, the Field Task Manager or similarly qualified field personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manholes and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.
- Following the initial site visit by the Field Task Manager, a trained utility locating subcontractor will locate, identify, and tone all utilities depicted on the preliminary site plan. The Field Task Manager or similarly qualified field personnel shall visit the site and identify the areas of subsurface disturbance with white spray paint, chalk, white pin flags or some other easily identifiable marking. The utility locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. At a minimum, the utility subcontractor should utilize a metal detector and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods such as Ground Penetrating Radar, Radio detection, etc. as appropriate. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. All utilities near the area of subsurface disturbance should also be marked out by the utility subcontractor using the universal colors for subsurface utilities (i.e., red – electric; blue – water; green – sewer; yellow – gas; etc.). After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the Field Task Manager with a copy of the completed preliminary site plan. Alternatively, the Field Task Manager or designee shall document the results of the survey on the preliminary site plan.
- Report to the Field Task Manager anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The Field Task Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate the proposed exploration or excavation areas. If this is required, the Field Task Manager or designee shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand or use techniques such as air knife to determine the location of the utilities.

6.4 Prepare Site Plan

- Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the client, the **Project Manager**, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the client to verify its accuracy prior to initiating subsurface sampling activities.

7.0 Quality Control and Assurance

7.1 Utility locating must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

8.1 A bound field logbook will be kept detailing all activities conducted during the utility locating procedure.

8.2 The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also, a copy of the final site plan will be kept in the project file.

9.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual.* Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Caryn DeJesus Senior Scientist	Bob Shoemaker Senior Scientist	Rev 0 – Initial Issue (June 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Sample Handling, Storage, and Shipping

Procedure 3-04

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the actions to be used by personnel engaged in handling, storing, and transporting samples. The objective is to obtain samples of actual conditions with as little alteration as possible.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.

2.2 Wear powderless nitrile gloves, as defined in the Health and Safety Plan (HASP), when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

4.1 The Task Order (TO) **Project Manager** and the **Laboratory Project Manager** are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities comply with this procedure.

4.2 The **Field Team Lead** is responsible for ensuring that all samples are shipped according to this procedure.

4.3 **Field personnel** are responsible for the implementation of this procedure.

4.4 The **Program Quality Manager** is responsible for ensuring that sample handling, storage, and transport activities conducted during all TOs comply with this procedure.

4.5 All **field personnel** are responsible for the implementation of this procedure.

5.0 Procedure

5.1 Handling and Storage

Immediately following collection, label all samples according to Procedure 3-03, *Recordkeeping, Sample Labelling, and Chain of Custody*. The sample containers shall be placed directly into zipper lock (e.g., Ziploc brand) bags. Place the sample containers in an insulated cooler with water ice Place a PFAS-free absorbent material on the bottom of the cooler to contain liquids in case of spillage. Fill all empty space between sample containers with ice or PFAS-free fill material. Prior to shipping, wrap glass sample containers on the sides, tops, and bottoms with appropriate PFAS-free padding to prevent damage during transport. Prior to shipment, replace the ice in the coolers so that samples will be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through transport to the analytical

laboratory. Ship samples on a schedule allowing the laboratory to meet holding times for all requested analyses. The procedures for maintaining sample temperatures at 4°C pertain to all field samples.

5.2 Shipping

Follow all appropriate U.S. Department of Transportation regulations (e.g., 49 Code of Federal Regulations [CFR], Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

5.2.1 Hazardous Materials Shipment

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed hazardous unless enough evidence exists to indicate it is non-hazardous. If not suspected to be hazardous, shipments may be made as described in the Section 5.2.2 for non-hazardous materials. If hazardous, follow the procedures summarized below.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Perform hazardous materials identification by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment 2.

All **persons shipping hazardous materials** must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials (49 CFR HM-126F Subpart H). The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. **Carriers**, such as commercial couriers, must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labelling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment 1 shows an example of proper package markings. Refer to a copy of 49 CFR each time hazardous materials/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172; however, other labelling and packing requirements must still be followed. Attachment 2 shows the volume or weight for different classes of substances. A “Dangerous Goods in Excepted Quantities” label must be completed and attached to the associated shipping cooler (Attachment 3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment 4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO_3), sulfuric acid (H_2SO_4), and sodium hydroxide (NaOH) added to water samples if their pH or percentage by weight criteria is met. These samples may be shipped as non-hazardous materials as discussed below.

5.2.2 Non-Hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, place two copies (if possible) of the chain of custody (CoC) form inside a Ziploc bag and tape it to the inside of the insulated cooler. Then, seal the cooler with waterproof tape. Place custody seals on the coolers as discussed in Procedure 3-03, *Recordkeeping, Sample Labelling, and Chain of Custody*.

6.0 Quality Control and Assurance

6.1 Sample handling, storage, and shipping must incorporate quality control measures (e.g., the **Field Team Lead** checking the CoC forms for accuracy prior to sample shipment) to ensure conformance to these and the project requirements.

7.0 Records, Data Analysis, Calculations

7.1 Maintain records as required by implementing these procedures (e.g., maintain field copies of all CoC forms, also maintain documentation of sample shipment at least until the sample shipment has been safely delivered intact to the laboratory).

7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or Reference

8.1 Attachment 1 – Example Hazardous Material Package Marking

8.2 Attachment 2 – Packing Groups

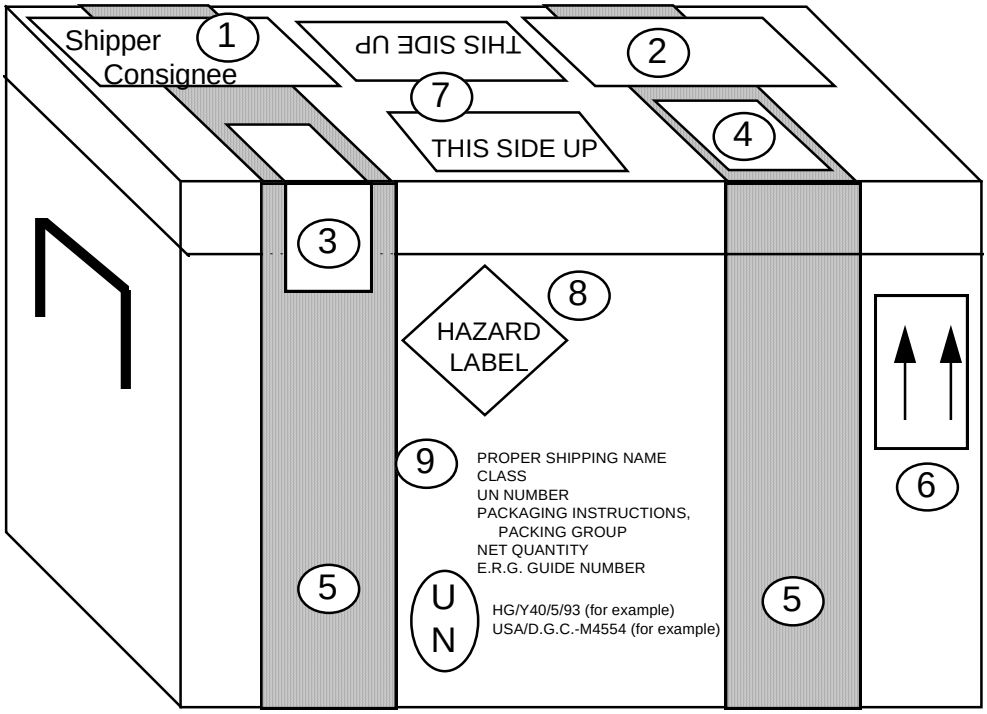
8.3 Attachment 3 – Label for Dangerous Goods in Excepted Quantities

8.4 Attachment 4 – SW-846 Preservative Exception

8.5 Procedure 3-03, *Recordkeeping, Sample Labelling, and Chain of Custody*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (June 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Attachment 1
Example Hazardous Material Package Marking



1. **AIR BILL/COMMERCIAL INVOICE**
2. **USDA PERMIT (Letter to Laboratory from USDA)**
3. **CUSTODY SEAL**
4. **USDA 2" X 2" SOIL IMPORT PERMIT**
5. **WATERPROOF STRAPPING TAPE**
6. **DIRECTION ARROWS STICKER - TWO REQUIRED**
7. **THIS SIDE UP STICKERS**
8. **HAZARD LABEL**
9. **HAZARDOUS MATERIAL INFORMATION**
10. **PACKAGE SPECIFICATIONS**

Attachment 2
Packing Groups

PACKING GROUP OF THE SUBSTANCE	PACKING GROUP 1		PACKING GROUP II		PACKING GROUP III	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK	Packaging's		Packaging's		Packaging's	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	---------- Forbidden (Note A) ----------					
2.1: Flammable Gas	---------- Forbidden (Note B) ----------					
2.2: Non-Flammable, non-toxic gas	---------- See Notes A and B ----------					
2.3: Toxic gas	---------- Forbidden (Note A) ----------					
3. Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1 Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2 Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides (Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	---------- Forbidden (Note A) ----------					
7: Radioactive material (Note D)	---------- Forbidden (Note A) ----------					
8: Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	---------- Forbidden (Note A) ----------					
9: Other miscellaneous materials (Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: *Packing groups are not used for this class or division.*
Note B: *For inner packaging's, the quantity contained in receptacle with a water capacity of 30 mL. For outer packaging's, the sum of the water capacities of all the inner packaging's contained must not exceed 1 L.*
Note C: *Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.*
Note D: *See 6.1.4.1, 6.1.4.2, and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.*
Note E: *For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.*

Attachment 3
Dangerous Goods in Excepted Quantities

DANGEROUS GOODS IN EXCEPTED QUANTITIES

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.

_____
Signature of Shipper

_____ _____
Title Date

_____

_____
Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

Class:	2	3	4	5	6	8	9
	☐	☐	☐	☐	☐	☐	☐

and the applicable UN Numbers are:

Attachment 4
SW-846 Preservative Exception

Measurement	Vol. Req. (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
MBAS	250	P, G	Cool, 4ºC	48 Hours
NTA	50	P, G	Cool, 4ºC	24 Hours

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4ºC until compositing and sample splitting is completed.

4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. for the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

6. Should only be used in the presence of residual chlorine.

Investigation Derived Waste Management

Procedure 3-05

1.0 Purpose and Scope

This standard operating procedure (SOP) describes activities and responsibilities with regard to management of investigation-derived waste (IDW). The purpose of this procedure is to provide guidance for the minimization, handling, labelling, temporary storage, inventory, classification, and disposal of IDW generated under the client contract. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions.

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (DoD, 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by the Task Order (TO) **Project Manager** and documented.

This procedure was developed to serve as management-approved professional guidance for the management of IDW generated under the client contract. It focuses on the requirements for minimizing, segregating, handling, labelling, storing, and inventorying IDW in the field. Certain IDW container inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

2.0 Safety

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, are addressed in the project Health and Safety Plan (HASP).

All **field personnel** responsible for IDW management must adhere to the HASP and must wear the PPE specified in the site-specific HASP. Generally, this includes, at a minimum, steel-toed boots or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). If safe alternatives are not achievable, discontinue site activities immediately.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for ensuring that IDW management activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Team Lead** is responsible for ensuring that all IDW is managed according to this procedure.

4.4 All **field personnel** are responsible for the implementation of this procedure.

All AECOM personnel who will perform any duties related to management of Resource Conservation and Recovery Act (RCRA) hazardous wastes or shipping of Department of Transportation (DOT) Hazardous Materials will be properly trained in accordance with 40 CFR § 262.34 and §265.16 for RCRA Waste Generators, as well as 49 CFR § 172.704 for DOT Hazardous Materials Shippers. All RCRA Hazardous Wastes are by definition DOT Hazardous Materials. See Section 6.1 for details on determining the IDW waste classification.

5.0 Equipment and Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., rolloff bins, frac tanks or other bulk tanks for liquids, [U.S. Department of Transportation] DOT approved 55-gallon open and closed top drums) and material to cover waste to protect from weather (e.g., plastic covering);
- Hazardous/non-hazardous waste drum labels (weatherproof);
- Permanent marking pens;
- Inventory forms for project file;
- Plastic garbage bags, storage bags, roll of plastic sheeting; and
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the HASP.

6.0 Procedure

The following procedures are used to handle the IDW.

6.1 Container and Drum Handling

6.1.1 IDW solids shall be containerized using rolloff bins or DOT-approved drums. The drums shall be made of steel, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Always consider IDW physical and chemical characterises to make sure the container material is compatible.

6.1.2 For storage of large quantities of liquid IDW prior to transport, frac tanks or other bulk tanks may be used

6.1.3 When using drums for liquids, verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing the drum. If the sealing ring is only partially attached to the drum lid, or if a portion of the sealing ring is missing, select another drum lid with a sealing ring that is in sound condition.

6.1.4 To prevent damage to drums, loss of drum integrity/containment, and/or presenting hazards to drum handlers, the following “Rules-of-Thumb” should be applied when filling drums.

- Liquid, soil, PPE/plastics, and construction debris must be segregated by media into individual drums.
- A **void space of 4 to 6 inches** from the top of the drum (the upper drum ring on most drums) will be left in the drum to allow room for ice expansion when filling drums with water or oil/water emulsions. Under freezing temperatures, expanding ice in a full drum can deform the bottom of a drum such that it is no longer DOT compliant, cause ruptures and/or dislodge the drum lid and present a containment breach. The consequences of this damage can be both economic and environmental.
- Compatibility between the chemical component(s) of the IDW and the drum material must be considered before choosing the type of drum/container to use. Steel drums are

susceptible to corrosion and loss of integrity when in contact with high pH water. Lime-based products (cement, concrete, grout, etc.) should not be disposed in steel drums containing water or soil water mixtures, and liquid IDW should not be disposed in steel drums used to mix lime-based products (separate reusable containers for mixing should be used when possible). If high (>12) or low (<2) pH conditions are possible, IDW liquids should be monitored for pH using a calibrated pH meter or pH test strips. The use of plastic drum liners or polyethylene drums is also recommended for high or low pH liquid IDW.

- Soil drums will be filled to no more than two thirds of the drum capacity. Drums completely full of soil can weigh over 600 pounds. Although drum handling tools and carts provide some assistance, moving such excessive weights present significant hazards, including; muscle strain, crushing (foot and fingers), and loss of drum control, such as sliding off of lift gates.
- Drums should not be overfilled filled with PPE and plastic (tubing, old macrocores) such that the material is excessively compacted. Pinch points are presented as the drum is closed under force, and the compressed material can spring up when the drums are opened.

6.1.5 Stacking full or partially full drums is prohibited.

6.1.6 To prepare IDW containers for labelling, wipe clean the outer wall surface of material that might prevent legible and permanent labelling. If potentially contaminated material adheres to the outer surface, wipe that material away Label all IDW containers and place drums on pallets for storage.

6.2 Labelling

6.2.1 Containers used to store IDW must be properly labelled. Two general conditions exist: 1) from previous studies or on-site data, waste characteristics are known to be either hazardous or nonhazardous; or 2) waste characteristics are unknown until additional data are obtained.

6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.

6.2.3 The following information shall be placed on all non-hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.4 The following information shall be placed on all hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Generator information (i.e., name, address, contact telephone number);
- EPA identification number (supplied by on-site client representative);
- Date when the waste was first accumulated.

6.2.5 When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words “waste characterization pending analysis” and the following information included on the label:

- Description of waste (i.e., purge water, soil cuttings);

- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.6 Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste.

6.2.7 Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight (faded entries should be remarked during inspections performed as specified in Section 6.2.4). It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it may also be helpful to include labels on the top of the containers to facilitate organization and disposal. In addition to a label, each drum should be numbered on the side and top with a paint pen or wax pencil for easy identification.

6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. Waste may also be tracked in a spreadsheet for easier sorting of information. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook/spreadsheet to document proper disposal of IDW.

6.3 Types of Site Investigation Waste

Several types of waste are generated during site investigations that may require special handling. These include solid, liquid, and used PPE, as discussed further below.

Solid Waste

Soil cuttings from boreholes will be placed in rolloff containers. Soil cuttings from intervals above the capillary fringe ((dry soil) will be placed in separate rolloffs from soil cuttings from the capillary frings and below the water table; the reason for this is that the moist/wet material is potentially impacted by groundwater contamination and is thus more likely to contain PFAS than dry soil from non-source areas. These two soil waste streams will be characterized for disposal separately using different soil profiles. The rolloffs will be staged in a central fenced IDW storage area with limited public access. Rolloffs will be tarped at the end of each work day; only the rolloffs being actively used will be untarped to allow filling. Rolloff containers shall be labelled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged and kept in the project file.

Non-hazardous solid waste other than soils can be disposed in an approved on-site dumpster for disposal in a municipal solid waste (MSW) landfill. It is not anticipated that hazardous waste will be generated during this project, but any hazardous wastes must be disposed off-site at an approved hazardous waste landfill.

Liquid Waste

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labelled in accordance with this SOP It is not anticipated that hazardous waste will be generated during this project, but any hazardous wastes must be disposed off-site at an approved hazardous waste facility.

Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. Otherwise, all PPE should be disposed as non-hazardous waste in an approved on-site dumpster for disposal in a MSW landfill. Trash that is generated as part of field activities may be disposed of in the MSW landfill as long as the trash was not exposed to hazardous media.

6.1 IDW Waste Classification

State and federal regulations require specific handling and storage requirements for wastes classified as hazardous, such as secondary containment and waste removal deadlines (see Section 6.2.2). The Site owner/operator must determine whether the IDW may contain a listed hazardous waste based on the source of contamination, contaminants, and waste manifests or any other documentation of wastes generated at the Site.

If there is inconclusive documentation concerning the IDW generated at the Site, then the U.S. EPA has stated the IDW is not a listed hazardous waste. However, in this case, further evaluation is necessary to evaluate whether the IDW in question exhibits a characteristic of hazardous waste. This is determined by analytical testing or knowledge. An IDW that may be characteristically hazardous should be evaluated for the following hazardous characteristics:

- Characteristic of ignitability (40 CFR §261.21)
- Characteristic of corrosivity (40 CFR §261.22)
- Characteristic of reactivity (40 CFR §261.23)
- Characteristic of toxicity (40 CFR §261.24)

If the IDW contains a listed hazardous waste, then U.S. EPA's contained-in policy (53 FR 31138, 31142, 31148, 57 FR 21453, 61 FR 18795) for contaminated environmental media should be evaluated. U.S. EPA considers IDW to contain hazardous waste:

- when it exhibits a characteristic of hazardous waste; or
- when it is impacted with concentrations of hazardous constituents from listed hazardous wastes that are above health-based levels.

Generally, IDW that does not (or no longer) contain hazardous waste are not subject to RCRA, but in some circumstances, the IDW that contained hazardous waste when first generated remain subject to land disposal restrictions (LDR) (40 CFR §268.45). There are also special LDR standards specific to contaminated debris (40 CFR §268.45).

6.2 Waste Accumulation On-Site

6.2.1 Solid, liquid, or PPE waste generated during investigation activities that are classified as nonhazardous or "characterization pending analysis" should be disposed of as soon as possible. Until off-site transport and disposal is arranged, waste containers should be moved to a staging location accessible by truck. The IDW storage location selected for this project has a large flat paved area that is secured by a perimeter fence discouraging access by the general public.

6.2.2 Solid, liquid, or PPE waste generated during investigation activities that are classified as hazardous **shall not** be accumulated on-site longer than **90 days**. All hazardous waste containers shall be stored in a secured storage area. The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labelling of waste;
- Secondary containment to contain spills;
- Spill containment equipment must be available;
- Fire extinguisher;
- Adequate aisle space for unobstructed movement of personnel.

6.2.3 When possible, drums should be segregated in the storage area by media and or classification (liquid, solid, non-hazardous, hazardous, etc.) to facilitate type identification during characterization sampling and pickup and reduce the need to rearrange drums if multiple pickups by type are required.

6.2.4 Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated. During active site work, weekly storage area inspections should be performed and documented to ensure compliance with the requirements specified above. Containers should be inventoried and inspected regularly. Waste container labels should be checked to make sure they remain legible. Inspection notes should include the condition of the staging area as this will be important when coordinating the labor and equipment the waste hauler will require. Anomalies should be documented and photographed.

6.3 Waste Disposal

6.3.1 Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers. The selected disposal facility will prepare a waste profile based on the characterization results. The waste generator (Air Force representative or authorized agent) will review and sign the profile.

6.3.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.

6.3.3 Waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.4 Regulatory Requirements

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261;
- CFR, Title 49, Parts 172, 173, 178, and 179.

6.5 Waste Transport

A state-certified waste hauler shall transport all wastes. The waste hauler is subcontracted to AECOM and coordinates with the selected disposal facility to arrange for disposal. Shipped waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

7.0 Quality Control and Assurance

7.1 Management of IDW must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

8.1 Maintain records as required by implanting the procedures in this SOP.

8.2 Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)
Joshua Millard Senior Geologist	Andrew Borden Geologist	Rev 1 – Technical (Jan 2017)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 2 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 3 – February 2020

Equipment Decontamination

Procedure 3-06

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes methods of equipment decontamination to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned prior to work at the site or before leaving the site or before use in subsequent activities.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

It is the responsibility of the **Site Safety and Health Officer (SSHO)** to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. For this project the decontamination area for large equipment will be located in a secure area away from the drilling and sampling activities. For smaller equipment, a series of buckets will be set up on a high-density polyethylene- or visqueen-lined area. Separate spray bottles containing cleaning solvents as described in this procedure and deionized water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

All **field personnel** responsible for equipment decontamination must adhere to the site-specific Health and Safety Plan (HASP) and must wear the personal protective equipment (PPE) specified. Generally, this includes, at a minimum, Tyvek® coveralls, steel-toed boots, safety glasses, and hearing protection (if heavy equipment is in operation).

In addition to the aforementioned precautions, the following sections describe safe work practices that will be employed.

2.1 Chemical Hazards associated with Equipment Decontamination

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HASP to maximize splash protection.
- Refer to safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

2.2 Physical Hazards associated with Equipment Decontamination

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.
- To avoid heat stress, overexertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.
- Take necessary precautions when handling field sampling equipment.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Team Lead** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 All **field personnel** are responsible for the implementation of this procedure.

5.0 Procedure

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, and waste is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- Location where the decontamination procedures will be conducted
- Types of equipment requiring decontamination
- Frequency of equipment decontamination
- Cleaning technique and types of cleaning solutions appropriate to the contaminants of concern (PFAS expected for this investigation)
- Method for containing the residual contaminants and wash water from the decontamination process
- Use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsections describe standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 Decontamination Area

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, and bladder pumps. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 Frequency of Equipment Decontamination

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 Cleaning Solutions and Techniques

The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a PFAS-free detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution, (2) rinse with potable water, and (3) rinse with water verified to be PFAS-free and free of other potential constituents of concern (i.e., deionized water or other approved water). If possible, disassemble equipment prior to cleaning. Add an additional soapy water wash as needed at the beginning of the decontamination process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. The decontamination sequence shall include: (1) wash with a PFAS-free detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution, (2) rinse with potable water, and (3) rinse with water verified to be PFAS-free and free of other potential constituents of concern (i.e., deionized water or other approved water).

5.5 Containment of Residual Contaminants and Cleaning Solutions

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as drill pipe, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure 3-05, *IDW Management*.

6.0 Quality Control and Assurance

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free deionized water that has been poured over or

through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a PFAS-free cotton cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

7.0 Records, Data Analysis, Calculations

Any project where sampling and analysis is performed shall be executed in accordance with the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP). This procedure may be incorporated by reference or may be incorporated with modifications described in the plan.

Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or References

8.1 ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites.* ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

8.2 Procedure 3-05, *IDW Management*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

1.5 If there are procedures, whether it be from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project-specific Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP).

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field personnel** must review the project-specific Health and Safety Plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to **field personnel**, and take appropriate actions as needed per the HASP.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes leather work gloves safety glasses, and steel-toed boots

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety and Health Officer (SSHO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSHO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;
- Biological hazards associated with work in the field; and
- Potential hazards associated with chemicals of concern (COCs) that may be located in the survey area.

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System

A global positioning system (GPS) is a system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

4.1 Commercially available GPS units typically have real-time sub-meter accuracy. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The Task Order (TO) **Project Manager** is responsible for ensuring that land surveying activities comply with this procedure. The **Project Manager** is responsible for ensuring that all **field personnel** involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for ensuring that all **field personnel** follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The **Field Team Lead** or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the Health and Safety Plan (HASP);
- Commercially available GPS unit; and
- Field Logbook.

7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 The Surveyor must be a licensed Texas surveyor. The Surveyor's on-site personnel will be required to comply with project HASP. The Surveyor shall use the most current surveying method (theodolite, total station, or GPS) to conduct the survey. Standards for all survey work shall be in accordance with State standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet. The Surveyor shall notify AECOM of any discrepancies discovered with control points or benchmarks.

7.3 The Surveyor shall lay out or use available horizontal and vertical control(s) in the project area using the North American Datum 1983 (NAD83), for horizontal control and the North American Vertical Datum 1988 (NAVD88) for vertical control in decimal feet.

7.4 For typical point features, the Surveyor will provide a Microsoft Excel and pdf table containing all coordinates and elevations. All documents shall be signed and sealed by a Registered Professional Land Surveyor in the State of Texas."

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems.
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project UFP-QAPP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly coloured weatherproof flagging and paint.
- Survey the reference point marked on the top of the monitoring well casing or well riser.

8.2 Global Positioning System to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project UFP-QAPP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly-colored weatherproof flagging and paint.
- Survey the reference point marked on the top of the monitoring well casing or well riser.

8.3 Global Positioning System to Position Sample Locations or Locate Site Features

Experienced **field personnel** may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use **field personnel** or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically, when a level of accuracy greater than 0.03 meter is required, a licensed surveyor will be required. When a level of accuracy of ±1 meter is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in geographic information system [GIS] figures) experienced **field personnel** may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or United States Geological Survey benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 1 meter as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y (easting and northing) coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units “Go To” function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labelled.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a Wide Area Augmentation System (WAAS) system at the site, this should also be noted.

9.0 Quality Control and Assurance

GPS field data to be differentially corrected and imported into GIS and checked for accuracy on a daily basis.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue
Joshua Millard Geologist	James Bourdeau GIS Specialist	Rev 1 – Technical
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 2 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 3 – February 2020

Monitoring Well Installation

Procedure 3-12

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the methods to be used during the installation of groundwater monitoring wells. It describes the components of monitoring well design and installation and sets forth the rationale for use of various well installation techniques in specific situations.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). Additionally, work will be conducted according to the Task Order (TO) Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Before well installation commences, appropriate entities (e.g., Texas 811 at texas811.org, private property owners) must be contacted to assure the anticipated well locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

2.3 Physical Hazards Associated with Well Installation

- Stay clear of all moving equipment and avoid wearing loose fitting clothing.
- When using an approved retractable-blade knife, always cut away from oneself and make sure there are no other people in the cutting path or the retractable-blade knife.
- To avoid slip/trip/fall conditions during drilling activities, keep the area clear of excess soil cuttings and groundwater. Use textured boots/boot cover bottoms in muddy areas.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and personal protective equipment (PPE), drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- To avoid hazards associated with subsurface utilities, ensure all sampling locations have been properly surveyed prior to drilling as described in SOP 3-01, Utility Clearance.
- Be aware of restricted mobility caused by PPE.

3.0 Terms and Definitions

3.1 **Annulus:** The annulus is the down-hole space between the borehole wall and the well casing and screen.

3.2 **Bridge:** A bridge is an obstruction in the drill hole or annulus. A bridge is usually formed by caving of the wall of the well bore, by the intrusion of a large cobble or boulder, or by the placement of filter pack materials during well completion. Bridging can also occur in the formation during well development.

3.3 **Filter Pack:** Filter pack is sand or gravel that is smooth, uniform, clean, well-rounded, and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation materials from entering the well and to stabilize the adjacent formation.

3.4 **Grout:** Grout is a fluid mixture of cement and water that can be forced through a tremie pipe and emplaced in the annular space between the borehole and casing to form an impermeable seal. Various additives, such as sand, bentonite, and polymers, may be included in the mixture to meet certain requirements.

3.5 **Heaving (Running) Sands:** Loose sands in a confined water-bearing zone or aquifer which tend to rise up into the drill stem when the confining unit is breached by the drill bit. Heaving sands occur when the water in the aquifer has a pressure head great enough to cause upward flow into the drill stem with enough velocity to overcome the weight of the sand.

3.6 **Sieve Analysis:** Sieve analysis is the evaluation of the particle-size distribution of a soil, sediment, or rock by measuring the percentage of the particles that will pass through standard sieves of various sizes.

4.0 Interferences

4.1 Heaving sands may be problematic in unconsolidated sands encountered below the water table.

4.2 Rotary drilling methods requiring bentonite-based drilling fluids should be used with caution to drill boreholes that will be used for monitoring well installation. The bentonite mud builds up on the borehole walls as a filter cake and permeates the adjacent formation, potentially reducing the permeability of the material adjacent to the well screen.

4.3 Drill rigs and accessory equipment (e.g., compressors, decontamination units, drill rods, plastic sleeving, etc.) should be evaluated and all PFAS-bearing parts or materials (e.g., O-rings, Teflon tape, etc.) replaced with confirmed PFAS-free parts. Special attention should be placed on evaluation of lubricants or greases used for the equipment.

4.4 If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of these fluids should be obtained and analyzed for chemical constituents that may be of interest at the site. In addition, an attempt should be made to recover the quantity of fluid or water that was introduced, either by flushing the borehole prior to well installation and/or by overpumping the well during development.

4.5 Track-mounted drill rigs are suitable for travelling on many types of landscapes that truck-mounted units cannot access, but may have limitations on extremely uneven or soft terrain.

4.6 Care should be taken to prevent cross-contamination between well locations. All drilling equipment coming in contact with potentially contaminated soil and/or groundwater will be decontaminated by the drilling subcontractor prior to initial drilling activities and between drilling locations in accordance with SOP 3-06, Equipment Decontamination.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Project Manager**, in conjunction with the subcontractor driller, shall be familiar with current local and state drilling and well installation regulations, and ensure that these regulations are followed. The **Project Manager** is responsible for ensuring that all personnel involved in monitoring well installation shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for direct supervision of the installation of monitoring wells and ensuring that procedures and specifications are implemented in the field in accordance with the approved UFP-QAPP and well installation permits. The qualifications for the **Field Team Lead** must be in accordance with local jurisdictions with authority over the operations conducted.

5.2.4 All field personnel are responsible for the implementation of this procedure.

5.2.5 The on-site hydrogeologist/engineer is expected to obtain a description of the lithologic samples obtained during the excavation and construction of a monitoring well. These data are often required to provide guidance regarding the installation of specific components of the monitoring well. Guidance for lithologic sample collection and sample description is contained within SOP 3-16, Soil and Rock Classification.

6.0 Equipment and Supplies

6.1 Materials provided by the drilling contractor may include:

- Confirmed PFAS-free drill rig, drill rods, equipment, etc.
- PFAS-free lubricants and greases
- Decontamination equipment (e.g., steam cleaner, high-pressure washer, brushes, etc.)
- Decontamination pad materials
- Well screen/riser pipe with flush-threaded couplings including riser and bottom caps (sumps)
- Clean, appropriately-sized filter sand
- Bentonite chips or pellets
- Cement grout and tremie pipe
- Portland cement for well pad completion
- Steel protective riser covers and locking caps
- Weighted calibrated Teflon-free measuring tape and water level indicator
- Containers for drill cuttings, decontamination fluids, etc.

6.2 In addition to those materials provided by the drilling contractor, equipment and materials required by the project geologist/engineer may include, but is not limited to, the following:

- Photoionization Detector (PID)
- Spill kit, including at a minimum sorbent pads and shovel (if not provided by subcontractor)
- Polyethylene plastic sheeting
- Spoon or spatula for probing soil cores
- Resealable polyethylene (e.g., Ziploc brand) plastic bags
- Boring/Well Installation Log Forms (Attachments 1 and 2)
- Decontamination materials (per SOP No. 3-06 - Equipment Decontamination)
- Soil logging materials (e.g. United Soil Classification System classification field card, millimeter rule, hand lens, etc.)
- Digital camera or smartphone
- PPE as required by the HASP and UFP-QAPP

- Planning documents including the site-specific HASP and UFP-QAPP
- Large indelible ink or paint pen
- Field logbook/field forms/site maps (non-water-repellent due to PFAS concerns)

7.0 Procedure

7.1 General Procedures

- Specific drilling, sampling, and installation equipment and methodology will be dictated by the type of well to be installed (single-cased, double-cased, triple-cased, flush-mount completion or stick-up completion) and geologic characteristics.
- For access to drilling locations in off-road locations, an appropriate route of entry should be chosen before mobilizing the drill rig or other support vehicles. If clearing of trees or ground cover is required, perform these activities in advance to avoid down time. Avoid wet or soft areas where possible or use ground mats to aid in supporting the rig as it travels. If drilling on soft material, place geomatting and ground mats under the rig tracks or stabilizers prior to drilling.
- A utility locate must be conducted to identify all underground utilities at the site prior to drilling (refer to SOP 3-01, Utility Clearance*)*. Proper clearance procedures for aboveground/overhead utilities must also be followed as specified in the HASP. Additionally, the subcontractor driller will hand probe or hand dig the first five feet of each borehole location before drilling as a final check for underground utilities.
- Although new well materials (well screen and riser pipe) generally arrive at the site boxed and sealed within plastic bags, it is sometimes necessary to decontaminate the materials prior to their use. Well materials should be inspected by the project geologist/engineer upon delivery to check for cleanliness. If the well materials appear dirty, or if local or regional regulatory guidance requires decontamination, then well material decontamination should be performed by the drilling subcontractor in accordance with SOP 3-06, Equipment Decontamination.
- The diameter of the borehole must be a minimum of 2 inches greater than the outside diameter of the well screen or riser pipe used to construct the well. This is necessary so that sufficient annular space is available to install filter packs, bentonite seals, and grout seals, and allow the passage of tremie pipe where grouting at depth is required.
- When soil sampling is required (refer to the UFP-QAPP), soil samples will be collected from the cores obtained with the drill rig. The soil will be logged by a qualified geologist and include lithologic characteristics (i.e., soil type, color, density, moisture content, etc.) using the methods described in SOP 3-16, Soil and Rock Classification. This information will be recorded on a Boring/Well Installation Log Form (Attachments 1 and 2) along with well construction details.

7.2 Drilling Techniques

Drilling of monitoring well boreholes may be accomplished by a variety of methods as described below. Preferred methods include those that temporarily case the borehole during drilling (i.e., hollow stem auger and sonic methods) using an override system. Drill rig components, drilling fluids, and consumable equipment will be evaluated for PFAS prior to the start of drilling activities, with special attention placed on evaluating any lubricants and greases used during drilling. Other methods can be used where specific subsurface conditions or well design criteria dictate.

- Sonic methods – Sonic drilling consists of advancing concentric hollow drill casings (inner and outer) using rotation in conjunction with axial vibration of the drill casing. Once the casings are advanced to the appropriate depth, the inner string is removed with a core of drill cuttings while the outer casing remains in place to keep the borehole open. Cuttings are removed from the inner casing relatively intact for logging or sampling purposes. This drilling method is used for a variety of soil types, from

heaving sands to consolidated or indurated formations. Smearing of the formation along the borehole walls is minimal since moderate vibration and rotation techniques are used to advance the casings. Since the total borehole diameter in sonic drilling is only incrementally larger than the inner casing diameter, care should be taken during installation of the monitoring well (and particularly for nested wells) to ensure the well(s) is/are centered and adequate space is available for annular materials.

- Hollow stem auger (HSA) – Borings are advanced by rotating steel hollow stem augers with an attached cutting head. Soil cuttings are displaced by the cutting head and transported to the surface via continuous spiral flights attached to each auger stem. This method is widely used for unconsolidated soils that have a tendency to collapse within the boring. A bottom plug can be placed in the bottom auger to prevent soils from entering and clogging the auger, especially in the case of heaving sands. However, a bottom plug cannot be used when soil samples are to be collected through the augers. Soil plugs that accumulate in the bottom of the auger must be removed or knocked out prior to sampling or well installation.
- Solid stem auger – This type of drilling method is similar to HSA drilling using a solid stem or sealed hollow stem auger flights to advance the boring. Solid stem, continuous flight auger use is limited to semi-consolidated sediments or to cohesive or semi-cohesive unconsolidated sediments that don't have a tendency to collapse when disturbed.
- Rotary methods (water or mud) – Rotary drilling methods consist of drill rods coupled to a drill bit that rotates and cuts through the soils to advance the borehole. Water or drilling fluid ("mud") is forced through the hollow drill rods and drill bit as the rods are rotated. The soil cuttings are forced up the borehole with the drilling fluids to the surface and the fluids recirculated. The drilling fluid provides a hydrostatic pressure that reduces or prevents the borehole from collapsing. Clean, potable, PFAS-free water must be used for water-rotary drilling to prevent introducing trace contaminants. A sample of the potable water should be collected during the course of well installation for analysis of the same parameters defined for the groundwater samples. If mud rotary is used to advance boreholes, only potable, PFAS-free water and bentonite drilling mud should be used. No chemical additives shall be mixed in the drilling fluid to alter viscosity or lubricating properties. Adequate well development is essential for removal of drilling mud and fluids from the formation materials and ensure collection of representative groundwater samples.
- Rotary methods (Air) – Air rotary methods are similar to water rotary but use high air velocities in place of drilling fluids to rotate the drill bit and carry the soil cuttings up the borehole to the surface. Care must be taken to ensure that contaminants are not introduced into the air stream from compressor oils, etc. Most compressor systems are compatible with a coalescing filter system. Cuttings exiting the borehole under pressure must be controlled, especially when drilling in a zone of potential contamination. This can be accomplished by using an air diverter with hose or pipe to carry the cuttings to a waste container. Letting the cuttings blow uncontrolled from the borehole is not acceptable.

7.3 Well Construction and Installation

- If rotary drilling techniques are used, the borehole should be flushed or blown free of material prior to well installation. If hollow stem augers are used, the soil or bottom plug should be removed and the augers raised approximately six inches above the bottom of the borehole, while slowly rotating the augers to remove cuttings from the bottom of the boring. The depth of the borehole should be confirmed with a weighted, calibrated tape.
- If building a nested well (multiple wells screened at different depth intervals in the same borehole), begin by building the deepest well in the nest. The riser pipe and screen should be connected with flush-threaded joints and assembled wearing clean, disposable gloves. No solvent or anti-seize compound should be used on the connections. The full length of the slotted portion of the well screen and unslotted riser pipe should be measured and these measurements recorded on a Well Construction Form (Attachment 1).

- If placed in an open borehole, the assembled well should be carefully lowered and placed in the borehole so that the well is true, straight, and vertical throughout. Centering can also be accomplished with the use of centralizers, if necessary. However, centralizers should be placed so that they do not inhibit the installation of filter sand, bentonite seal, and annular grout.
- If hollow stem augers are used, the well should be lowered through the augers and each auger flight removed incrementally as the filter sand, bentonite seal, and grout are tremied or poured into the annular space of the well. The well should be temporarily capped before filter sand and other annular materials are installed.
- Clean silica sand should be placed around the well screen to 2-3 feet above the top of the screen. The filter sand should be appropriately graded and compatible with the selected screen size and surrounding formation materials. As the filter pack is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer. This measurement will be recorded on the Well Construction Form (Attachment 1). If necessary, to eliminate possible bridging or creation of voids, placement of the sand pack may require the use of a tremie pipe. Tremie pipe sandpack installations are generally suggested for deeper wells and for wells which are screened some distance beneath the water table.
- A minimum 3-foot thick layer of bentonite pellets, chips, or slurry seal will be installed immediately above the filter sand to prevent vertical flow within the boring from affecting the screened interval. Bentonite chips/pellets must be hydrated if placed above the water table prior to grouting. If bridging is of concern as in the case of deep wells, powdered bentonite may be mixed with water into a very thick slurry and a tremie pipe used to place the seal to the desired depth. Placement of the bentonite seal in the borehole will be recorded on the Well Construction Form (Attachment 1).
- If building nested wells, the additional wells in the borehole will be constructed above the screened interval and bentonite seal of the deepest well in the nest. For this project, it is anticipated that the majority of the wells will be triplets installed with sonic drilling in a borehole that is 10 inches in diameter down to the total depth of the uppermost well, with the borehole telescoping to 8 inches in diameter below this depth. The additional wells in the cluster will be completed in a manner similar to the deepest well, with filter pack sand extending 2-3 ft above and below the screened interval of the well, and a minimum 3 feet thick layer of bentonite pellets or slurry seal above the filter sand. The remaining annular space around the uppermost well will be grouted from the top of the bentonite seal to the surface with a grout composed of neat cement, a bentonite cement mixture, or high solids sodium bentonite grout.
- The well will be completed within a concrete well pad consisting of a Portland cement/sand mixture. Well pads will generally be a minimum of 2 feet by 2 feet square or 2 feet round for flush-mount well completions and a minimum of 3 feet by 3 feet square for stick-up wells. However, well pads may be larger or smaller depending on site conditions and state-specific well construction standards. A minimum of 2 inches of the finished pad should be below grade to prevent washing and undermining by soil erosion.
- If completed as a flush-mount well, the well riser will be cut off approximately 4 to 6 inches below ground surface and an expandable, locking cap will be placed on the well riser. The area around the riser is dug out and a steel well vault placed over the riser and set almost flush to the ground to protect the well. The manhole cover should be water-tight and secured with bolts to prevent casual access. For nested wells, all wells sharing a common borehole will be placed inside the same well vault, and the well risers will be labelled with the well identification (well ID) for the well. The well pad will then be constructed around the well vault and slightly mounded at the center and sloping away to prevent surface water from accumulating in the well vault.
- If completed as a stick-up well, the well riser will be cut approximately 2.25 feet above the ground surface and an expandable cap placed on the well riser. An outer steel protective casing with a locking cap will be installed over the well riser(s). The bottom of the guard pipe will be set approximately 2.5

feet below ground surface and sealed by pouring concrete from the top of the annular grout around the pipe to grade. The concrete well pad should be completed at the same time. Weep holes will be drilled in the base of the guard pipe where it intersects the well pad to facilitate draining of rainwater or purge water from inside the guard pipe.

- For stick-up wells, four bumper posts or bollards will be installed at the well pad corners for well protection. The bumper posts will and extend approximately 3 feet above the ground. The bollards will have an end cap on top or be filled with cement to prevent water from seeping into the bollard.
- Stick-up well outer protective casings and well bollards will be painted yellow to match recent monitoring well construction at Reese, or another color accepted by the Air Force.

7.4 Post Installation Procedures

- Wells should be permanently labelled or marked for identification. Well tags can be used to record the site name, well number, total depth, installation date, etc. At a minimum, the well number will be written in paint on the outside of the protective casing or inside beneath the casing lid.
- A measuring point will be marked on the north side of the top of the riser pipe for taking water level measurements. The measuring point can be notched using a knife or saw. The measuring point will also be the point which will be surveyed for vertical elevation data.
- All monitoring wells will be surveyed for horizontal and vertical control by a licensed surveyor.
- Investigation-derived waste (IDW) including drill cuttings, spent materials (e.g., PPE), and decontamination water should be properly managed in accordance with SOP 3-05, IDW Management.

8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the UFP-QAPP. Certain quality control (QC) measures should be taken to ensure proper well installation and construction in accordance with this SOP, project specific UFP-QAPP, and applicable well standards.

8.2 The borehole will be checked for total open depth and extended by further drilling or shortened by backfilling with bentonite pellets, chips, or slurry as required before installation of the well materials.

8.3 Water level will be checked during well installation to ensure that the positions of well screen, filter sand, and seals relative to water level conform to project requirements

8.4 The depth to top of each layer of annular materials (i.e., filter sand, bentonite, grout) will be verified and adjusted as necessary for proper placement.

9.0 Records, Data Analysis, Calculations

All field information will be recorded in the field logbook and/or standardized field forms by field personnel. Field data recorded will include drilling contractor information, drilling methods, well material and construction information provided on the boring logs (Attachment 2) and Well Construction Forms (Attachment 1), observations or problems encountered during drilling, fluid level data, and any deviations from the procedures in this SOP and other project plans. Well Construction Forms (Attachment 1) will provide visual and descriptive information the monitoring well and are often the most critical form of documentation generated during the installation of a monitoring well. The field logbook is kept as a general log of activities and should not be used in place of the boring log.

10.0 Attachments or References

10.1 Attachment 1 – Monitoring Well Construction Form

10.2 Environmental Protection Agency, United States (EPA). 1987. *A Compendium of Superfund Field Operations Methods*. Office of Solid Waste and Emergency Response. EPA/540/P-87/001.

10.3 EPA. 1990. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*. EPA/600/4-89/034. Office of Research and Development, Washington. March.

10.4 EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.

10.5 EPA, 2008. SESD Operating Procedure SESDGUID-101-R0: *Design and Installation of Monitoring Wells*. USEPA, Science and Ecosystem Support Division (SESD), Athens, Georgia. Effective Date February 18, 2008.

10.6 U.S. Army Corps of Engineers. 2008. Manual No. EM 385-1-1. *Safety and Health Requirements*. 15 November 2008. http://140.194.76.129/publications/eng-manuals/em385-1-1/2008_English/toc.html.

10.7 SOP 3-01, *Utility Clearance*

10.8 SOP 3-05, *IDW Management*

10.9 SOP 3-06, *Equipment Decontamination*

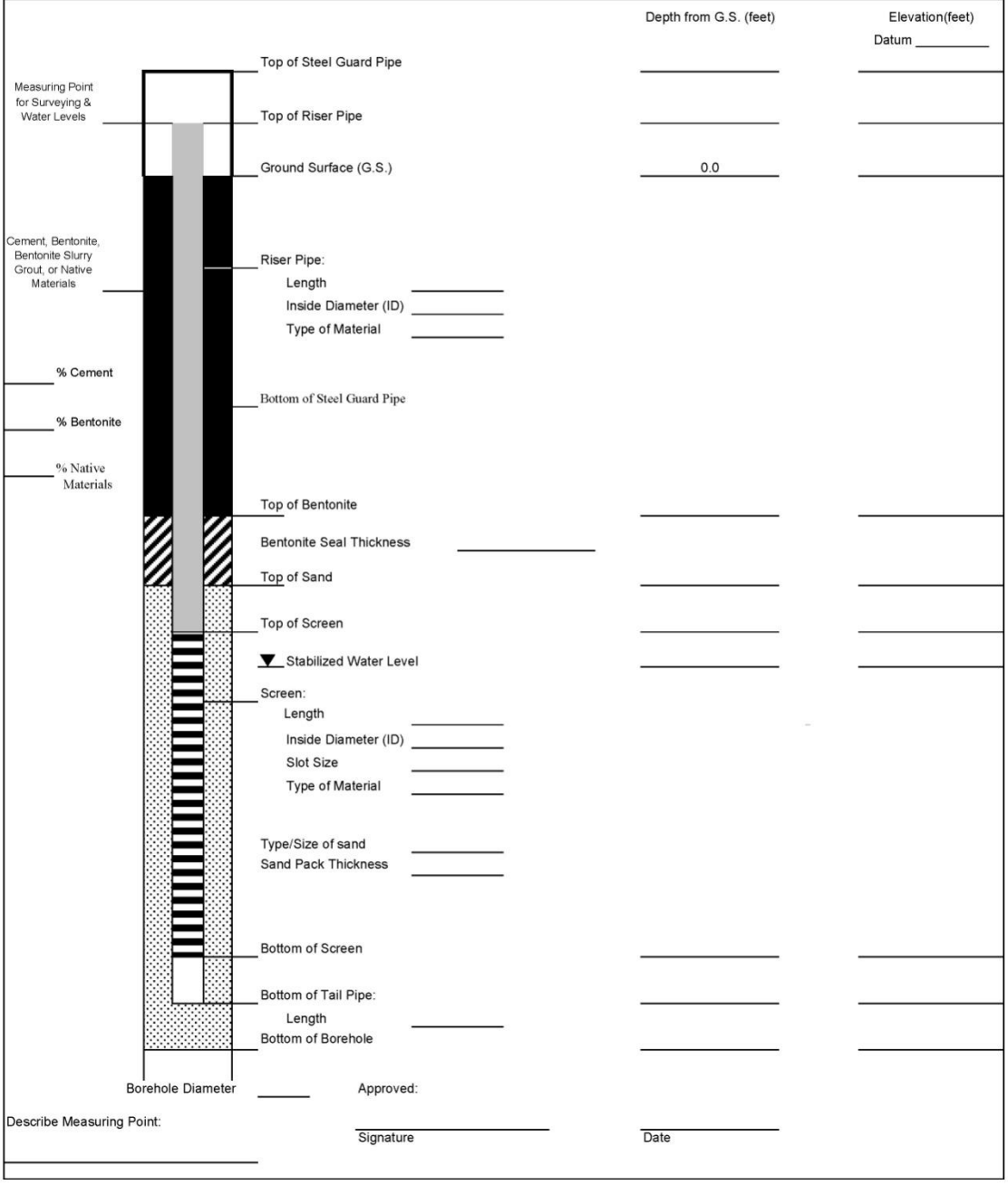
10.10 SOP 3-16, *Soil and Rock Classification*

Author	***Reviewer***	***Revisions (Technical or Editorial)***
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Attachment 1
Monitoring Well Construction Form

	Client:	***WELL ID:***
	Project Number:	
	Site Location:	*Date installed:*
	Well Location: *Coords:*	*Inspector:*
	Method:	*Contractor:*

MONITORING WELL CONSTRUCTION DETAIL



Monitoring Well Development

Procedure 3-13

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures used for developing newly-installed monitoring wells and/or redeveloping existing wells.

1.2 The purpose of well development is to remove interferences from a well to provide better connection between the well and the formation, to improve pumping performance of the well, and to be able to collect more representative information from the well (e.g., samples, aquifer test results, etc.). Proper well development will:

- Remove drilling residuals (e.g., water, mud) from the borehole and surrounding formations;
- Improve or restore hydraulic conductivity of the surrounding formations which may have been disturbed during the drilling process; and
- Remove residual fines from the well screen and sand pack (filter pack) materials, thus reducing turbidity of groundwater and permitting the collection of more representative groundwater samples.

1.3 There may be circumstances where well development is not desirable, for example, in the presence of non-aqueous phase liquids (NAPL) or other significant contamination if development could worsen the contaminant impact. If NAPL begins to intrude during development, the development process will be halted until the issue can be discussed with the Task Order (TO) **Project Manager** and other stakeholders, as applicable.

1.4 The applicable well development procedures for a particular site may be subject to State or local regulatory requirements. In all cases, the project team should consult their local regulatory requirements and document the selected well development procedure in the project-specific Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP). For project-specific information refer to the UFP-QAPP, which takes precedence over these procedures.

1.5 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). Work will be conducted according to the TO UFP-QAPP and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Monitoring well development may involve chemical hazards associated with potential contaminants in the soil or aquifer being characterized and may involve physical hazards associated with use of well development equipment.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Equipment/materials used for development may react with the groundwater during development. Appropriate development equipment has been selected for the anticipated condition of the groundwater.

4.2 Appropriate development methods such as using a surge-block to flush suspended fines in the groundwater in and out of the well screen can improve the yield of wells and improve their potential to be developed successfully. However, the effectiveness of development can be significantly reduced in wells that do not yield sufficient water to allow this flushing to take place.

4.3 For formations with a significant content of fine-grained materials (silts and clays), or wells with improperly sized screens, it may not be possible to reduce turbidity to commonly acceptable levels. Possible solutions may include collecting a sample even if excessively turbid or installing a replacement well.

4.4 Development itself disturbs the surrounding formation and disrupts equilibrium conditions within the well. Groundwater samples will not be collected until a minimum of 24 hours after a well is developed to allow conditions to stabilize. For sites with fine-grained formations (silts and clays) or highly sorptive contaminants, a longer time period between development and sampling should be considered.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that well development activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in well development shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for ensuring that all well development activities are conducted according to the either this procedure or the applicable procedure presented in the project-specific UFP-QAPP.

5.2.4 **Field personnel** are responsible for the implementation of this procedure.

5.2.5 **Field personnel** and/or the **Field Team Lead**are responsible for directly supervising the well development procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

6.0 Equipment and Supplies

6.1 This equipment list was developed to aid in field organization and should be used in planning and preparation. Depending on the site-specific requirements and the development method selected, additional or alternative material and equipment may be necessary. In addition, for sites where groundwater is expected to be contaminated, the materials to be placed down the well and in contact with groundwater should be evaluated so that they are compatible with the chemical conditions expected in the well.

6.2 Equipment and materials used for well development may include, but is not limited to:

Well development equipment

- Surge block
- HDPE or other non-PFAS bailers, appropriate to the diameter of the well(s)
- Watterra® footvalve
- PFAS-free (e.g., Teflon-free) electric submersible pump
- 12-volt power source for electric pump
- High density polyethylene (HDPE) tubing appropriately sized for Watterra® footvalve and/or electric submersible pump
- Drums or containers for storage of purge water
- Nephelometer to measure turbidity
- Multi-parameter water quality meter(s) to measure temperature, potential of hydrogen (pH), conductivity, dissolved oxygen (DO), and oxidation reduction potential (ORP)
- Instrument calibration solutions
- Teflon-free water level meter

General equipment

- Project-specific plans including the site-specific HASP and UFP-QAPP
- Non-water-repellent field notebook/field forms/site maps
- Ball point pens or fine-point indelible marker
- HDPE or polypropylene tank or other suitable container for well development water

Equipment decontamination supplies (refer to SOP 3-06, Equipment Decontamination)

- Health and safety supplies, including personal protective equipment (PPE) as specified by the HASP
- Appropriate hand tools
- Keys or combinations to access monitoring wells
- PFAS-free deionized water supply
- Disposable bailer string (polypropylene)
- Plastic trash bags

7.0 Procedure

Development generally consists of removing water and entrained sediment from the well until the water is clear (to the extent feasible) and the turbidity is reduced, which indicates the well is in good hydraulic connection with the surrounding formation. In addition to simply removing water, development can be improved when flushing through the well screen and filter pack takes place in both directions, that is, both into the well and into the formation. This action breaks down sediment bridges that can occur in the formation or sand pack, which reduce the connection between the well and the formation

7.1 General Preparation

- All down-well equipment should be decontaminated prior to use and between well locations in accordance with SOP 3-06, Equipment Decontamination
- Although equipment is decontaminated between well locations, if wells are known or suspected to be contaminated based on observations during well installation, it is recommended that well development be conducted in order from the least contaminated to the most contaminated well to minimize the chances of cross-contamination.

- Management of investigation-derived waste (IDW), including development purge water and miscellaneous expendable materials generated during the development process, will be conducted in accordance with SOP 3-05, IDW Management.
- Prior to accessing the well, the wellhead should be cleared of debris and/or standing water. Nothing that has touched the ground surface should be allowed to enter the well unless it has first been decontaminated.
- The depth to water and total well depth should be measured to the nearest hundredth of a foot with a Teflon-free water level meter and recorded in the field logbook or on a Well Development Record (Attachment 1). This information will be used to calculate the volume of standing water (i.e., the well volume) within the well, and plan the specific details of the well development. If wells are suspected to contain NAPL, an oil/water interface probe should be used to measure liquid levels and depth to bottom of the well.
- Permanent monitoring wells will be developed no sooner than 24 hours after well installation is completed in order to allow well completion materials to set properly.

7.2 Monitoring Well Development Procedures

Generally, development will begin by gently surging the well with a surge block or bailer as described in Sections 7.2.1 and 7.2.2, respectively. Surging can become more vigorous as development progresses but initially the well must be gently surged to allow material blocking the screen to become suspended without damaging the well. Next, a bailer can be used to remove the sediment settled at the base of the well. A bailer, Watterra® pump, or electric submersible pump will then be used to purge the well, per Sections 7.2.2, 7.2.3, or 7.2.4, respectively. The well will be purged until the removed water becomes less turbid or per the requirements of the project-specific UFP-QAPP, or State or local requirements. At this point the well will be surged again with a surge block or bailer. The well can be surged more vigorously at this point. After surging, the well will be purged again until the turbidity once again decreases. The surge/purge cycle should be completed at least three times during the development process. After the last surge, the well will be purged until the development completion criteria outlined in 7.3.2 or per the project-specific UFP-QAPP are met.

7.2.1 Surge Block

The default method of well development is the use of a surge block in conjunction with pumping or bailing to remove sediment-laden water.

- The construction of the surge block must be appropriate for the diameter of the well. The surge block must be mounted on rods or other stiff materials to extend it to the appropriate depths and to allow for the surge block to be moved up and down in the well.
- Insert the surge block into the well and lower it slowly to the screened or open interval below the static water level. Start the surge action by slowly and gently moving the surge block up and down in the well. A slow initial surging, using plunger strokes of approximately 1 meter or 3 feet, will allow material which is blocking the screen to separate and become suspended.
- After 5 to 10 plunger strokes in each interval of the well screen, remove water from the well using a separate bailer (Section 7.2.2) or pumping techniques (Sections 7.2.3 or 7.2.4). The returned water should be heavily laden with suspended fines. The water will be discharged to an appropriate storage container to be managed per the requirements presented in the project-specific UFP-QAPP.
- In some cases, the bailer or Watterra® foot valve can act as a surge block, flushing water in and out of the well screen as groundwater is removed.
- Repeat the process of surging and pumping/bailing. As development continues, slowly increase the depth of surging to the bottom of the well screen. Surging within the riser portion of the well is neither necessary nor effective.

7.2.2 Bailer

- Tie a string or other cable securely to the bailer. Lower it to the screened or open interval of the monitoring well below the static water level.
- The bailer may be raised and lowered repeatedly within the screened interval to attempt to simulate the action of a surge block by pulling fines through the well screen and pushing water out into the formation to break down bridging.
- With the bailer full of water, remove it from the well and discharge the water into an appropriate storage container to be managed per the requirements presented in the project-specific UFP-QAPP.
- The Watterra® system (Section 7.2.3) or electric submersible pump (Section 7.2.4) may be used as a complementary development method to the bailer, especially when removal of additional water at a faster rate is beneficial.
- Continue alternately surging and bailing, monitoring the purge water periodically (Section 7.3.1) until development completion criteria are met (Section 7.3.2).

7.2.3 Watterra® system

- Attach high-density polyethylene (HDPE) tubing to the decontaminated Watterra® pump foot valve.
- Lower the foot valve and tubing assembly near the bottom of the well.
- Lift and lower the tubing to allow water to enter the Watterra® foot valve and travel up the tubing and discharge the water into an appropriate storage container to be managed per the requirements presented in the project-specific UFP-QAPP.
- The lifting and lowering action of the Watterra® system will cause some surging action to aid in breaking up fine material in the surrounding formation.
- A bailer (Section 7.2.2) may be used as a complementary development method to the Watterra® system, especially during the initial stages of development when a high volume of sediment may be required to be removed.
- An electric submersible pump (Section 7.2.4) may also be used as a complementary development method to the Watterra® system, especially when more volume of water is desired to be pumped or the turbidity criteria cannot be met due to the surging action of the Watterra® system.
- Continue alternately surging and pumping, monitoring the purge water periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

7.2.4 Electric Submersible Pump

- Attach HDPE tubing to the decontaminated electric submersible pump.
- Lower the pump and tubing assembly near the bottom of the well, at least a few inches above the well total depth.
- Begin pumping, discharging the water into an appropriate storage container to be managed per the requirements presented in the project-specific UFP-QAPP.
- Continue alternately surging and pumping, monitoring the purge water discharge periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

7.3 Discharge Monitoring

7.3.1 Monitoring the Progress of Development

The progress of the development is evaluated through visual observation of the suspended sediment load and measurement of the turbidity and other parameters in the purged discharge water. As development progresses, the water should become clearer, measured turbidity

should decrease, and specific capacity (pumping rate divided by drawdown) should stabilize. Water quality parameters, including DO, conductivity, ORP, pH, temperature, and turbidity may be measured and recorded periodically to determine the progress of development using the criteria outlined in Section 7.3.2 or per the project-specific UFP-QAPP. Water quality parameters should be measured on each well volume removed.

7.3.2 Completion of Development

The well will be considered developed when the following criteria are met:

- A minimum of three times the standing water volume in a well (to include the well screen and casing plus saturated annulus, assuming 30 percent porosity) is removed.
- Groundwater parameters for three consecutive well volumes are within the following:
  - pH – within ± 0.2 units
  - Specific conductivity – within ± 3%
  - ORP – within ± 10 mV
  - Temperature – within ±1 degree Celsius
  - Turbidity – at or below 10 nephelometric turbidity units (NTU) or within ± 10% if above 10 NTU.
- The sediment thickness remaining within the well is less than 1 percent of the screen length or less than 30 millimeters (0.1 ft) for screens equal to or less than 10 feet long.

Dissolved oxygen (DO) readings may be recorded but DO readings will not be used as development completion criteria because DO may not stabilize.

If the well has slow groundwater recharge and is purged dry, the well will be considered developed when bailed or pumped dry three times in succession and the turbidity has decreased. Water quality parameters may be recorded if feasible using the flow-through cell.

If any water is added to the well's borehole during development or drilling, three times the volume of water added will also be removed during well development.

7.4 Development of Wells with Low Yield

Water is the primary mechanism to remove fines and flush water through the gravel pack for effective development. Therefore, development can be a challenge in wells that do not yield sufficient water to recharge when water is removed. However, often these wells are the most in need of development to improve their performance as they are typically installed in low-permeability formations with a high content of fines. Development of these wells can improve their yield.

The surging portion of the development can be successfully performed in a well with standing water regardless of its yield. It is the subsequent removal of fine materials that is hindered when insufficient water is recharged to the well. When wells go dry or draw down significantly during development, development can be performed intermittently, allowing sufficient water to recharge prior conducting the next stage of surging. These intermittent procedures can take place hours or even days apart, depending on project-specific time constraints.

7.5 Wells containing NAPL

Additional care should be taken when planning development of wells that contain NAPL. If the NAPL is flammable, there are health and safety as well as handling issues to consider. If NAPL in excess of a persistent sheen is noted, the recharge rate will be evaluated through hand bailing. In most cases, it is generally preferable to remove NAPL by bailing to the extent practicable prior to performing development. Groundwater parameters, excluding turbidity, will not be collected during well development if NAPL or excessive sheen is noticed in the purged water during development to ensure the meter probes are not fouled or destroyed.

Development by surging or pumping the well dry can result in the spreading of NAPL vertically in the soil column around the well. These methods can be used, if information exists describing the vertical thickness of the NAPL smear zone around the well, and if the methods do not result in mounding or drawdown that exceeds this thickness. Alternate methods such as bailing may also be used, but any method should not allow the well to be pumped dry or result in significant drawdown that would spread the NAPL vertically.

8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific UFP-QAPP.

8.2 Quality control (QC) requirements are dependent on project-specific sampling objectives. The project-specific UFP-QAPP will provide requirements for equipment decontamination (frequency and materials) and IDW handling.

9.0 Records, Data Analysis, Calculations

9.1 All data and information (e.g., development method used) must be documented on field data sheets (Attachment 1) or within site logbooks with permanent ink. Data recorded may include the following:

- Well Location
- Weather conditions
- Date and Time
- Purge Method
- Reading/measurements obtained

10.0 Attachments or References

Attachment 1 – Well Development Record

SOP 3-05, *IDW Management*.

SOP 3-06, *Equipment Decontamination*.

Author	Reviewer	Revisions (Technical or Editorial)
Shawn Dolan Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (June 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Attachment 1
Well Development Record

Well/Piezometer Development Record

Well ID:

Client: _____

Project No: _____ Date: _____ Developer: _____

Site Location: _____

Well/Piezometer Data

Well ☐ Piezometer ☐ Diameter _____ Material _____

Measuring Point Description _____ Geology at Screen Interval (if known) _____

Depth to Top of Screen (ft.) _____

Depth to Bottom of Screen (ft.) _____ Time of Water Level Measurement _____

Total Well Depth (ft.) _____ Calculate Purge Volume (gal.) _____

Depth to Static Water Level (ft.) _____ Disposal Method _____

Headspace _____

Original Well Development ☐ Redevelopment ☐ Date of Original Development _____

DEVELOPMENT METHOD _____

PURGE METHOD _____

Time	Total Volume Purged (gal.)	Flow Rate (gpm)	Turbidity (NTU)	Color	pH	Temp	Other

ACCEPTANCE CRITERIA (from workplan)

Minimum Purge Volume Required _____ gallons
Maximum Turbidity Allowed _____ NTUs
Stabilization of parameters _____%

	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Has parameters stabilized	☐	☐	☐

If no or N/A explain below:

_____

_____

_____

Signature _____ Date: _____

Monitoring Well Sampling

Procedure 3-14

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the actions to be used during monitoring well sampling activities and establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples that are representative of aquifer conditions with as little alteration to water chemistry as possible.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. All **field personnel** responsible for sampling activities must review the project-specific Health and Safety Plan (HASP) paying particular attention to the control measures planned for the well sampling tasks. Conduct preliminary area monitoring of sampling wells to determine the potential hazard to **field personnel**. If significant contamination is observed, minimize contact with potential contaminants in both the vapor phase and liquid matrix through the use of appropriate personal protective equipment (PPE).

2.2 Observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes nitrile gloves and steel-toed boots. Refer to the project-specific HASP for the required PPE.

2.3 Physical Hazards associated with Well Sampling

- To avoid lifting injuries associated with pump retrieval, use the large muscles of the legs, not the back.
- When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Potential interferences could result from cross-contamination between samples or sample locations. Minimization of the cross-contamination will occur through the following:

- The use of clean sampling tools at each location as necessary.
- Avoidance of material that is not representative of the media to be sampled.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The Task Order (TO) **Project Manager** is responsible for ensuring that monitoring well sampling activities comply with this procedure. The **Project Manager** is responsible for ensuring that all **field personnel** involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for ensuring that all **field personnel** follow these procedures.

5.2.4 **Field personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the groundwater sampling procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

6.0 Equipment and Supplies

6.1 Purging and Sampling Equipment

- Pump (Portable Bladder, Submersible)
- HDPE bladders (for portable bladder pumps)
- Bladder pump controller (for portable bladder pumps)
- Air compressor or compressed gas cylinder/regulator (for portable bladder pumps)
- 12-volt power source for electric pumps
- HDPE inlet and discharge tubing
- HDPE bailer appropriately sized for well
- Disposable bailer string (polypropylene)
- Individual or multi-parameter water quality meter(s) with flow-through cell to measure temperature, pH, specific conductance, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity
- Teflon-free water level meter
- Oil/water interface probe

6.2 General Equipment

- Sample kit (i.e., bottles, labels, preservatives, custody records and tape, cooler, wet ice)
- Sample Chain-of-Custody (COC) forms
- Sample Log forms
- Sample packaging and shipping supplies
- Fine-tipped Sharpie® marker (can be used to complete sample labels, but should not be used when sample containers are open or bottle filling is occurring; minimize use of Sharpie® markers wherever possible)

- Deionized water supply
- HDPE water dispenser bottles
- HDPE flow measurement cup, graduated cylinder, or bucket
- 5-gallon buckets
- Instrument calibration solutions
- Stopwatch or watch
- Disposable, powderless nitrile gloves
- Cotton towels
- Trash bags
- Zipper-lock (e.g., Ziploc brand) bags
- Equipment decontamination supplies (e.g., Alconox®, Liquinox®, NOT Decon 90™)
- Health and safety supplies (as required by the HASP)
- Approved plans such as: project-specific HASP and Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)
- Well keys or combinations
- Monitoring well location map(s)
- Field project logbook/ballpoint pen

7.0 Calibration or Standardization

7.1 Field instruments will be calibrated daily according to the requirements of the UFP-QAPP and manufacturer's specifications for each piece of equipment. Equipment will be checked daily with the calibration solutions at the end of use of the equipment. Calibration records shall be recorded in the field logbook or on an appropriate field form.

7.2 If readings are suspected to be inaccurate, the equipment shall be checked with the calibration solutions and/or re-calibrated before any additional sampling is conducted.

8.0 Procedure

8.1 Site Background Information

Establish a thorough understanding of the purpose of the sampling event prior to field activities. Conduct a review of available data obtained from the site and pertinent to the water sampling. Review well history data including, but not limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of non-aqueous phase liquid (NAPL), historical water levels, and general hydrogeologic conditions.

Previous groundwater development and sampling logs give a good indication of well purging rates and the types of problems that might be encountered during sampling, such as excessive turbidity and low well yield. They may also indicate where dedicated pumps, if present, are placed in the water column. To help minimize the potential for cross-contamination, well purging and sampling should proceed from the least contaminated to the most contaminated well to the extent practicable based on previous analytical results. This order may be changed in the field if conditions warrant it, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging

and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

8.1.1 Groundwater Analysis Selection

Establish the requisite field and laboratory analyses prior to water sampling. Decide on the types and numbers of quality assurance/quality control (QA/QC) samples to be collected (refer to the project-specific UFP-QAPP), as well as the type and volume of sample preservatives, the type and number of sample containers, the number of coolers required, and the quantity of ice or other chilling materials. The **field personnel** shall ensure that the appropriate number and size sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. Refer to the project-specific UFP-QAPP for the project analytical requirements.

8.2 Groundwater Sampling Procedures

Groundwater sampling procedures at a site shall include:

1) An evaluation of the well security and condition prior to sampling;
2) Decontamination of equipment;
3) Measurement of well depth to groundwater;
4) Assessment of the presence or absence of NAPL;
5) Purging of static water within the well and well bore;
6) Assessment of purge parameter stabilization; and
7) Obtaining a groundwater sample.

Each step is discussed below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events. In all cases, consult the State and local regulations for the site, which may require more stringent time separation between well development and sampling.

8.2.1 Well Security and Condition

At each monitoring well location, observe the conditions of the well and surrounding area. The following information may be noted on a Well Purge Form (Attachment 1) or in the field logbook:

- Condition of the well's identification marker.
- Condition of the well lock and associated locking cap.
- Integrity of the well – well pad condition, protective outer casing or vault condition, condition of the bollards if present, obstructions or kinks in the well casing, presence of water in the annular space, and the top of the interior casing.
- Condition of the general area surrounding the well.

8.2.2 Decontamination of Equipment

If dedicated equipment is not being used, establish a decontamination station before beginning sampling. The station shall be large enough to fit the appropriate number of wash and rinse buckets and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event. Further details are presented in SOP 3-06, Equipment Decontamination.

Decontaminate each piece of downhole equipment prior to placing it in the well. It is only necessary to decontaminate dedicated sampling equipment prior to installation within the

well. Do not place clean sampling equipment directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without on-site decontamination.

8.2.3 Measurement of Static Water Level Elevation

Before purging the well, measure the water level in the well If the well cap is not vented, remove the cap several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

Measure the depth to water and the total depth of the well to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). When measuring water levels, use the marked reference point on the well.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate in order to reliably obtain a measurement to the nearest 0.01 foot. A Teflon-free electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a well is highly contaminated, an inexpensive weighted tape measure can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

At each location, measure water levels several times in quick succession to ensure that the well has equilibrated to atmospheric conditions prior to recording the measurement. As stated above, measure all site wells (or wells within the monitoring well network) prior to sampling whenever possible. This will provide a water level data set that describes water levels across the site at one time (a synoptic sampling). Prior to sampling, measure the water level in each well immediately prior to purging the well to ascertain that static conditions have been achieved.

8.2.4 Detection of Immiscible Phase Layers

Complete the following steps for detecting the presence of NAPL before the well is purged for conventional sampling. These procedures may not be required for all wells.

1) Sample the headspace in the wellhead immediately after the well is opened for organic vapors using either a PID or an organic vapor analyzer and record the measurements.

2) Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record the measurements.

3) In needed, confirm the presence or absence of an immiscible phase by slowly lowering a clear bailer to the appropriate depth, then visually observing the results after bailer recovery.

4) If the well contains an immiscible phase, it may be desirable to sample this phase separately. It may not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPL or DNAPL. Consult the **Project Manager** and **Program Quality Manager** if this situation is encountered.

8.2.5 Purging Equipment and Use

General Requirements

The water present in a well prior to sampling may not be representative of in situ groundwater quality and should be removed prior to sampling. Handle all groundwater removed from potentially contaminated wells in accordance with the IDW handling procedures in SOP 3-05, IDW Management. Purging shall be accomplished using low-flow techniques.

According to the U.S. Environmental Protection Agency (EPA) (EPA, 1996), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.3 liters/minute. EPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated corrosion or reaction products in the well. EPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. In addition, a low purge rate will reduce the likelihood of increasing the turbidity of the sample due to mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The field sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Excessive water level drawdown issues should be anticipated based on the results of either the well development task or historical sampling events. In general, place the intake of the purge pump in the middle of the saturated screened interval within the well to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. Water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless a slow recharging well is encountered where large water level drawdown is unavoidable. During the well purging procedure, collect water level measurements to assess the hydraulic effects of purging, with an effort to maintain total well drawdown to a level less than 0.5 feet if possible. The purge rate will be lowered as needed to the lowest level sustainable by the sampling pump if the water level drawdown nears or exceeds 0.5 feet of drawdown. If the well is purged dry, allow the well to recover sufficiently to provide enough water for the specified analytical parameters, and then sample it.

Evaluate water samples on a regular basis during well purging and analyze them in the field preferably using in-line devices (i.e., flow through cell) for temperature, pH, specific conductance, dissolved oxygen (DO), oxidation-reduction (redox) potential, and turbidity.

Readings should be taken every 2 to 5 minutes during the purging process; longer periods between readings are acceptable early in the well purge if readings are changing rapidly and additional purging time is needed to obtain stable readings. These parameters are measured to demonstrate that the natural character of the formation waters has been restored.

Purging shall be considered complete when three consecutive field parameter measurements stabilize within the following ranges:

- Temperature within ±1 degree Celsius (°C)
- pH within ± 0.2 standard pH units
- Specific conductance within ±5%
- DO within ±10% or ≤0.5 mg/L
- ORP within ±10% or ±10 millivolts (mv) for -100 mv≤ORP≤100mv

- Turbidity is at or below 10 nephelometric turbidity units (NTU) or within ±10% if ≥10 NTU.

Enter all information obtained during the purging and sampling process into a Well Purge Form. Attachment 1 shows an example of a Well Purge Form and the information typically included in the form. Whatever form is used, all entries on the form should be completed during field sampling.

Groundwater removed during purging shall be collected and stored according to SOP 3-05, IDW Management.

Purging Equipment and Methods

Submersible Pump

A stainless steel submersible pump may be used for purging both shallow and deep wells prior to sampling the groundwater. Steam clean or otherwise decontaminate the pump and discharge tubing prior to placing the pump in the well. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of water that will flow back down the drop pipe into the well. Place the pump in the middle of the saturated screened interval within the well and maintain it in that position during purging and sampling.

Bladder Pump

A stainless-steel bladder pump can be utilized for purging and sampling wells for volatile, semivolatile, and non-volatile constituents. Use of the bladder pump is most effective in low to moderate yield wells and are often the preferred method for low-flow sampling. When sampling for VOCs and/or SVOCs and PFAS, polyethylene (non-LDPE) bladders and PFAS-free O-rings and pump accessories should be used.

Either compressed dry nitrogen or compressed dry air, depending upon availability, can operate the bladder pump. The driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontaminate the bladder pump prior to use.

Bailer

A bailer is a sub-optimal method to purge and/or sample a well because it can result in overdevelopment of the well and generally results in more turbid, more aerated, lower-quality samples than pumps. If a bailer must be used, the bailer should either be dedicated or disposable. An HDPE bailer with polypropylene string mounted on a reel is recommended for lowering the bailer in and out of the well. Lower the bailer below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well.

8.2.6 Monitoring Well Sampling Methodologies

Groundwater Sampling Methodology

Groundwater will be sampled when it is representative of aquifer conditions per the methods described in Section 8.2.5. Prior to sampling the flow-through cell shall be disconnected from the pump discharge tubing and the samples collected directly from the tubing. Flow rates shall not be adjusted to fil sample bottles once stable conditions are met.

Sampling equipment (e.g., especially bailers) shall never be dropped into the well, as this could cause aeration of the water upon impact. Additionally, the sampling methodology utilized shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers, minimizing exposure to sunlight, and immediately placing the sample on ice once collected.

Sampling equipment shall be constructed of PFAS-free material. Equipment or sampling supplies containing low-density polyethylene (LDPE), polytetrafluoroethylene (PTFE), fluorinated compounds including fluorosurfactants, Viton®, Teflon®, or aluminium foil are not acceptable when sampling for PFAS. High-density polyethylene (HDPE) tubing and sampling materials are acceptable for use, as is silicone tubing. Glass sample containers shall not be used for PFAS samples. Blue ice will not be used for cooling samples or for any other purpose. If bailers are used, polypropylene string, stainless steel wire or cable, or other approved material shall be used to raise and lower the bailer. Dedicated equipment is recommended where possible.

Submersible Pumps

The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and HDPE, sample discharge lines composed of HDPE) and must have a control mechanism allowing the required low-flow rate. Adjust the pump rate so that flow is continuous to avoid aeration and agitation within the sample discharge lines. Run the pump for several minutes at the low-flow rate used for sampling to ensure that the groundwater in the lines was obtained at the low-flow rate.

Bladder Pumps

A gas-operated stainless steel bladder pump with adjustable flow control equipped with a polyethylene (non-LDPE) bladder and HDPE tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents.

When using a compressor, take several precautions. If the compressor is being powered by a gasoline engine or generator, position the engine or generator downwind of the well. Ground fault circuit interrupters (GFCIs) should always be used when using electric powered equipment. Do not connect the compression hose from the compressor to the pump controller until after the engine has been started.

When all precautions are completed and the compressor has been started, connect the compression hose to the pump controller. Slowly adjust the control knobs to discharge water in the shortest amount of time while maintaining a near constant flow. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near constant flow rate.

For those samples requiring filtration, it is recommended to use an in-line high capacity filter after all non-filtered samples have been collected.

Bailers

A single- or double-check valve HDPE or stainless steel bailer equipped with a bottom discharging device can be utilized to collect groundwater samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, and aeration; the possibility of creating high groundwater entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Therefore, use bailers for groundwater sampling only when other types of sampling devices cannot be utilized for technical, regulatory, or logistical reasons.

Dedicated or disposable bailers should always be used in order to eliminate the need for decontamination and to limit the potential of cross-contamination. Each time the bailer is lowered to the water table, lower it in such a way as to minimize disturbance and aeration of the water column within the well.

8.2.7 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable and require preservation. The U.S. EPA document entitled, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods (SW-846)* (EPA 1997), includes a discussion of appropriate sample preservation procedures. In addition, SW-846 provides guidance on the types of sample containers to use for each constituent or common set of parameters. The laboratory will supply the necessary sample bottles and required preservatives. In some cases, **field personnel** may add preservatives as needed in the field.

Improper sample handling may alter the analytical results of the sample. Therefore, transfer samples in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the project-specific UFP-QAPP. It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Collect groundwater samples and place them in their proper containers in the order of decreasing volatility and increasing stability.

When sampling for VOCs, collect water samples in vials or containers specifically designed to prevent loss of VOCs from the sample. The analytical laboratory performing the analysis shall provide these vials. Collect groundwater from the sampling device in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. Fill the vial above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that has high concentrations of dissolved gasses. In these cases, **field personnel** shall document the occurrence in the field logbook and/or sampling worksheet at the time the sample was collected. Likewise, the analytical laboratory shall note in the laboratory analysis reports any headspace in the sample container(s) at the time of receipt by the laboratory.

Special Handling Considerations

In general, samples for organic analyses should not be filtered. Consult the project-specific UFP-QAPP for details on filtering requirements. Samples shall not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container.

Because there is some evidence that PFOS may sorb onto glass-fiber filters, it is preferred not to filter samples for PFAS analysis in the field or laboratory. Field filtration is generally prohibited unless specifically requested by a client. If filtering is required by client's and regulatory agency's request, it is recommended that the following be considered and discussed with the client and regulatory agency:

- Evaluate if filtered results are meaningful, and, therefore, if filtering in the field or laboratory is required.
- Consider use of low flow sampling in the field to reduce the need for sample filtering.
- Consider use of a centrifuge in the laboratory to reduce the need for sample filtering.
- If filtering is required, determine the nature of the filters used and do not use glass-fiber filters.

Field Sampling Preservation

Preserve samples immediately upon collection. Ideally, sampling containers will be pre-preserved with a known concentration and volume of preservative. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. Guidance for the preservation of environmental samples can be found in the U.S. EPA *Handbook for Sampling and Sample Preservation of Water and Wastewater* (EPA 1982). Additional guidance can be found in other U.S. EPA documents (EPA 1992, 1996).

Field Sampling Log

The Well Purge Form provided as Attachment 1 shall document the following:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Total purge volume and measured pumping rates throughout the purging period
- Time/date that the well was purged
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data (e.g., pH, temperature)
- Name(s) of sampler(s)
- Weather conditions
- Other notable field observations or approved deviations from SOPs

9.0 Quality Control and Assurance

9.1 **Field personnel** will follow specific quality assurance (QA) guidelines as outlined in the project-specific UFP-QAPP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.

9.2 Quality control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The project-specific UFP-QAPP will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various QC samples such as trip blanks, field blanks, equipment rinse blanks, and field duplicate samples.

10.0 Data and records management

10.1 Records will be maintained in accordance with SOP 3-03, Recordkeeping, Sample Labelling, and Chain-of-Custody. Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms may include:

- Well Purge Forms (Attachment 1);
- Non-water repellent field logbook;
- Chain-of-custody forms; and
- Shipping labels.

10.2 Well Purge Forms will provide descriptive information for the purging process and the samples collected at each monitoring well.

10.3 The field logbook is kept as a general log of activities and should not be used in place of the Well Purge Form.

10.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.

10.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

11.0 Attachments or References

Attachment 1 – Well Purge Form

ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites.* ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

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SOP 3-03, *Recordkeeping, Sample Labelling, and Chain-of-Custody*.

SOP 3-05, *IDW Management.*

SOP 3-06, *Equipment Decontamination*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Attachment 1
Well Purge Form

Well ID:

Groundwater Sample Collection Record

Client: _____ Date: _____ Time: Start _____ am/pm
Project No: _____ Finish _____ am/pm
Site Location: _____
Weather Conds: _____ Collector(s): _____

1. **WATER LEVEL DATA: (measured from Top of Casing)**
   a. Total Well Length _____ c. Length of Water Column _____ (a-b)
   b. Water Table Depth _____ d. Calculated Well Volume (see back) _____

Casing Diameter/Material _____

2. **WELL PURGEABLE DATA**
   a. Purge Method: _____
   b. Acceptance Criteria defined (see SAP or Work Plan)
   - Minimum Required Purge Volume (@ _____ well volumes) _____
   - Maximum Allowable Turbidity _____ NTUs
   - Stabilization of parameters _____ %

   c. Field Testing Equipment used: Make Model Serial Number

Time (min)	Volume Removed (gal)	Temp. (°C)	pH s.u.	Spec. Cond. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Flow Rate (ml/min)	Drawdown (m)	Color/Odor/etc.

(continued on back)

   d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☐	☐	☐

   If no or N/A - Explain below.

3. **SAMPLE COLLECTION:** Method: _____

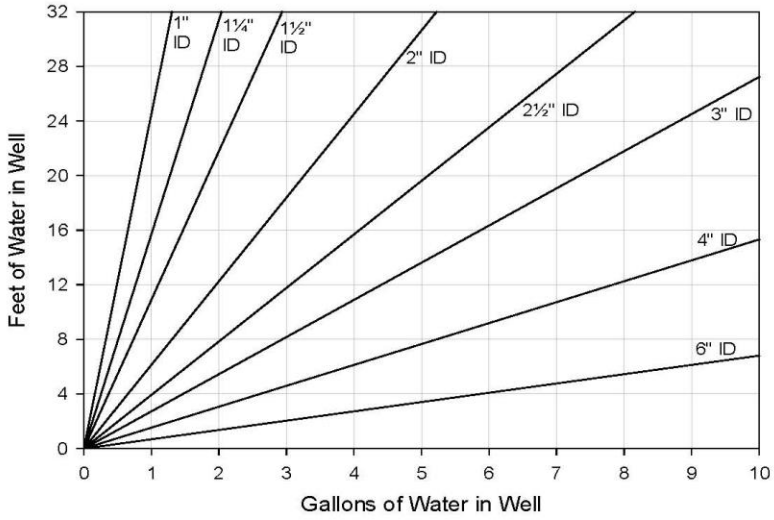
Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time

Comments _____

Signature _____ Date _____

Purge Volume Computation

Well ID:



Volume / Linear Ft. of Pipe		
ID (in)	**Gallon**	**Liter**
¼	0.0025	0.0097
3/8	0.0057	0.0217
½	0.0102	0.0386
¾	0.0229	0.0869
1	0.0408	0.1544
1¼	0.0637	0.2413
1½	0.0918	0.3475
2	0.1632	0.6178
2½	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

(continued from front)

Time (min)	Volume Removed (gal)	Temp. (°C)	pH s.u.	Spec. Cond. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Flow Rate (ml/min)	Drawdown (m)	Color/Odor/etc.

Signature _____ Date _____

Soil and Rock Classification

Procedure 3-16

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) to thoroughly describe the physical characteristics of the sample and classify it according to the Unified Soil Classification System (USCS).

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP).

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling. All **field personnel** responsible for sampling activities must review the Health and Safety Plan (HASP), paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to **field personnel**. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety and Health Officer (SSHO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSHO.

2.4 The health and safety considerations for the work associated with soil classification include:

- At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.

- Stay clear of all moving equipment and be aware of pinch points on machinery. Avoid wearing loose fitting clothing.
- When using cutting tools, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and in case of extreme cold, wear insulating clothing.

3.0 Terms and Definitions

None.

4.0 Interference

None.

5.0 Training and Qualifications

5.1 The Task Order (TO) **Project Manager** is responsible for ensuring that the soil and rock classification procedures comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.3 The **Field Team Lead** is responsible for ensuring that all project **field personnel** follow these procedures.

5.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for **field personnel** require that one individual on the field team shall have a minimum of 6 months of experience with soil and rock classification.

5.5 The supervising geologist and/or **Field Team Lead** is responsible for directly supervising the soil and rock classification procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the **Program Quality Manager** and then documented in the field logbook and associated report or equivalent document.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP
- Field log book and pen with indelible ink
- Boring log
- Munsell Soil Color Chart
- Scoopula, spatula, and/or other small hand tools
- California Sampler
- Hand-held penetrometer

7.0 Calibration or Standardization

None.

8.0 Procedure

8.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The USCS was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log, logbook, and/or electronic field data collection device. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as ”shorthand“ for classifying soil into 15 basic groups:

GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)

GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)

GM[1] Silty gravel (>50 percent gravel, >15 percent silt)

GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)

SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)

SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

SM[1] Silty sand (>50 percent sand, >15 percent silt)

SC[1] Clayey sand (>50 percent sand, >15 percent clay)

ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.

CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)

MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)

CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)

OL Organic low plasticity silt or organic silty clay

OH Organic high plasticity clay or silt

PT Peat and other highly organic soil

Figure 8-1 defines the terminology of the USCS. Flow charts presented in Figure 8-2 indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

8.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term “trace”.
7. The percentages of gravel, sand, and fines must add up to 100 percent. “Trace” is not included in the 100 percent total.

8.1.2 Soil Dilatancy, Toughness, and Plasticity

8.1.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

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[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words “with sand” or “with gravel” (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words “sandy” or “gravely” (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use “sandy.”

2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 8-1. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Table 8-1: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

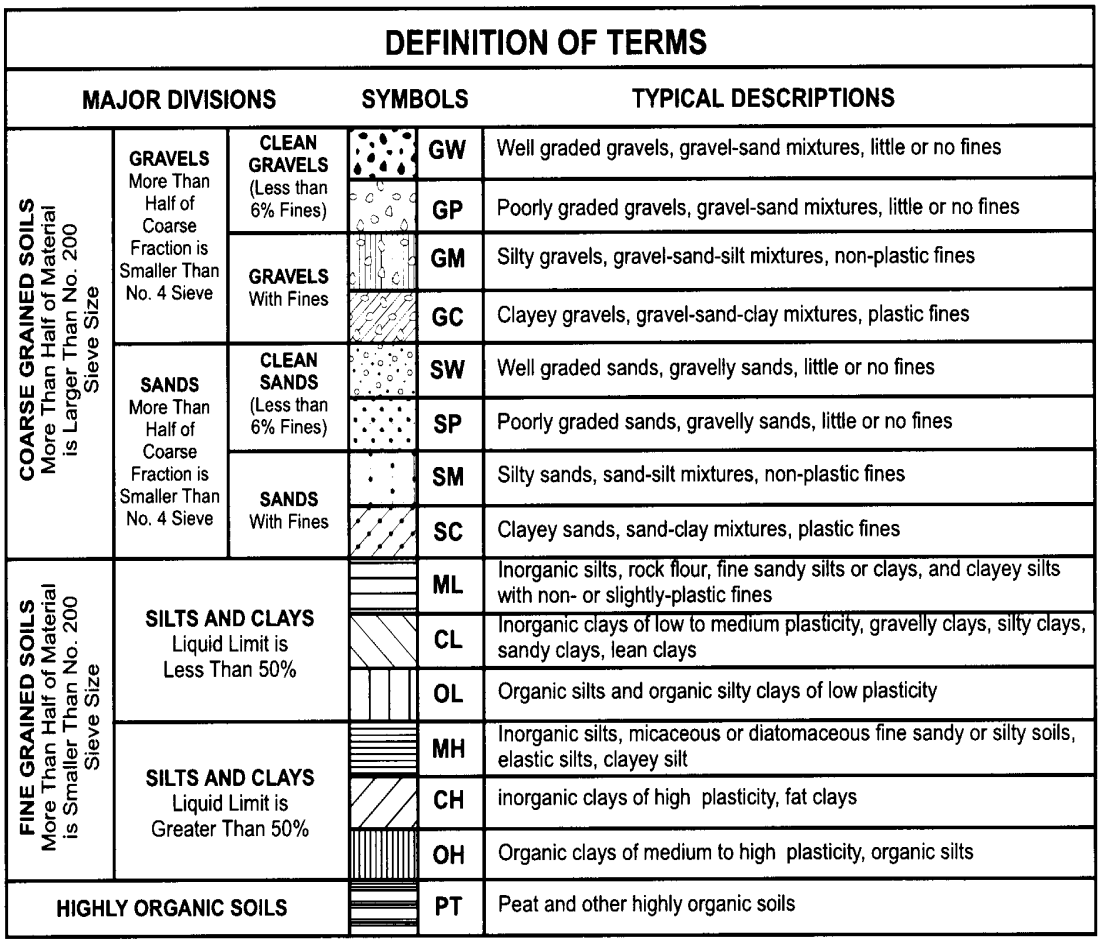
8.1.2.2 Toughness

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 8-2.

Table 8-2: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

Figure 8-1: Unclassified Soil Classification System (USCS)



DEFINITION OF TERMS					
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN GRAVELS (Less than 6% Fines)		GW	Well graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS With Fines		GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN SANDS (Less than 6% Fines)		SW	Well graded sands, gravelly sands, little or no fines
				SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS With Fines		SM	Silty sands, sand-silt mixtures, non-plastic fines
				SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	SILTS AND CLAYS Liquid Limit is Less Than 50%			ML	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines
				CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is Greater Than 50%			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt
				CH	inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils

GRAIN SIZES								
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS	
	FINE	MEDIUM	COARSE	FINE	COARSE			
200	40	10	4	3/4"	3"	12"		
U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS				

Figure 8-2: Flow Chart for Fine Grain Soil Classification

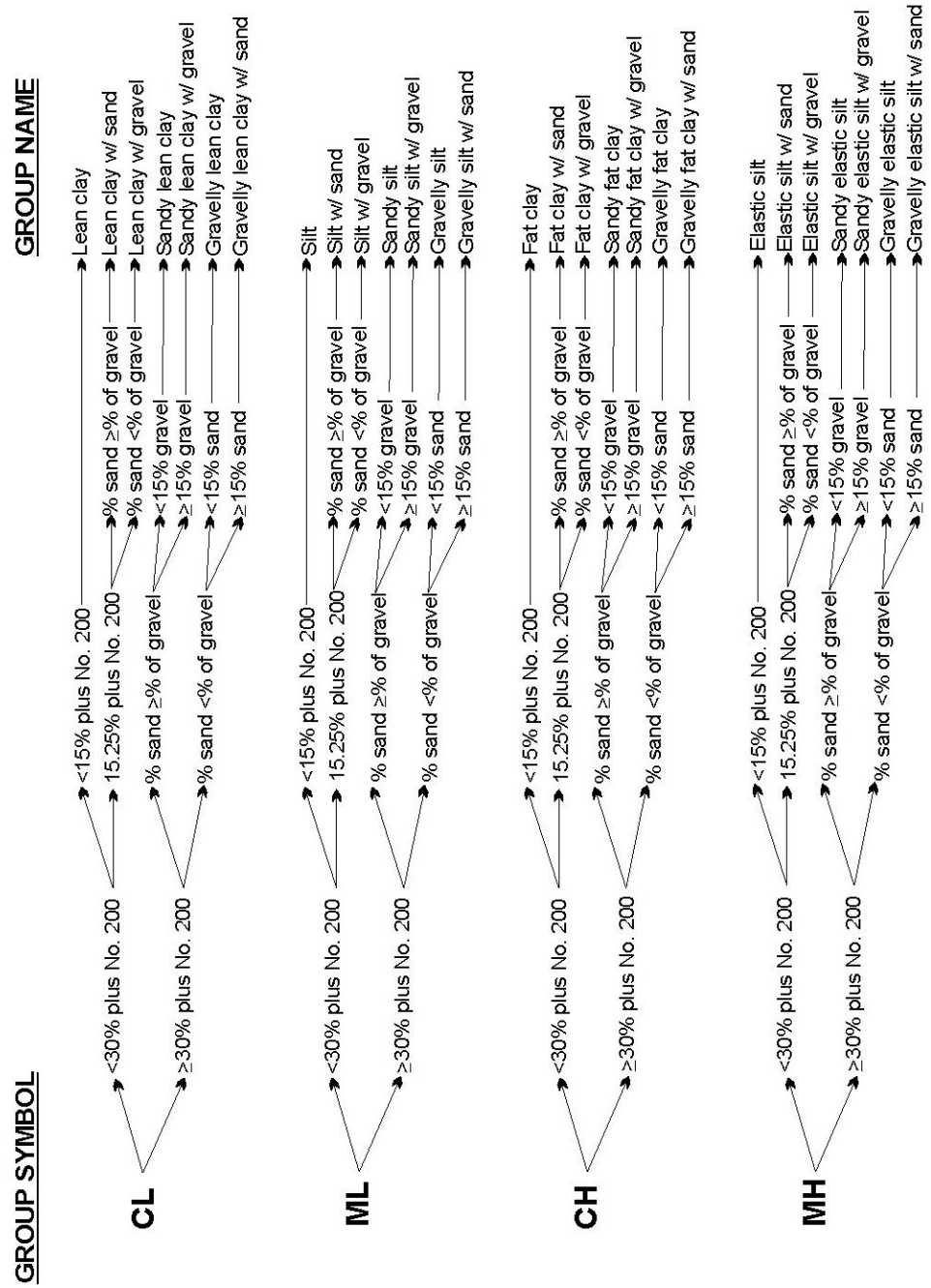
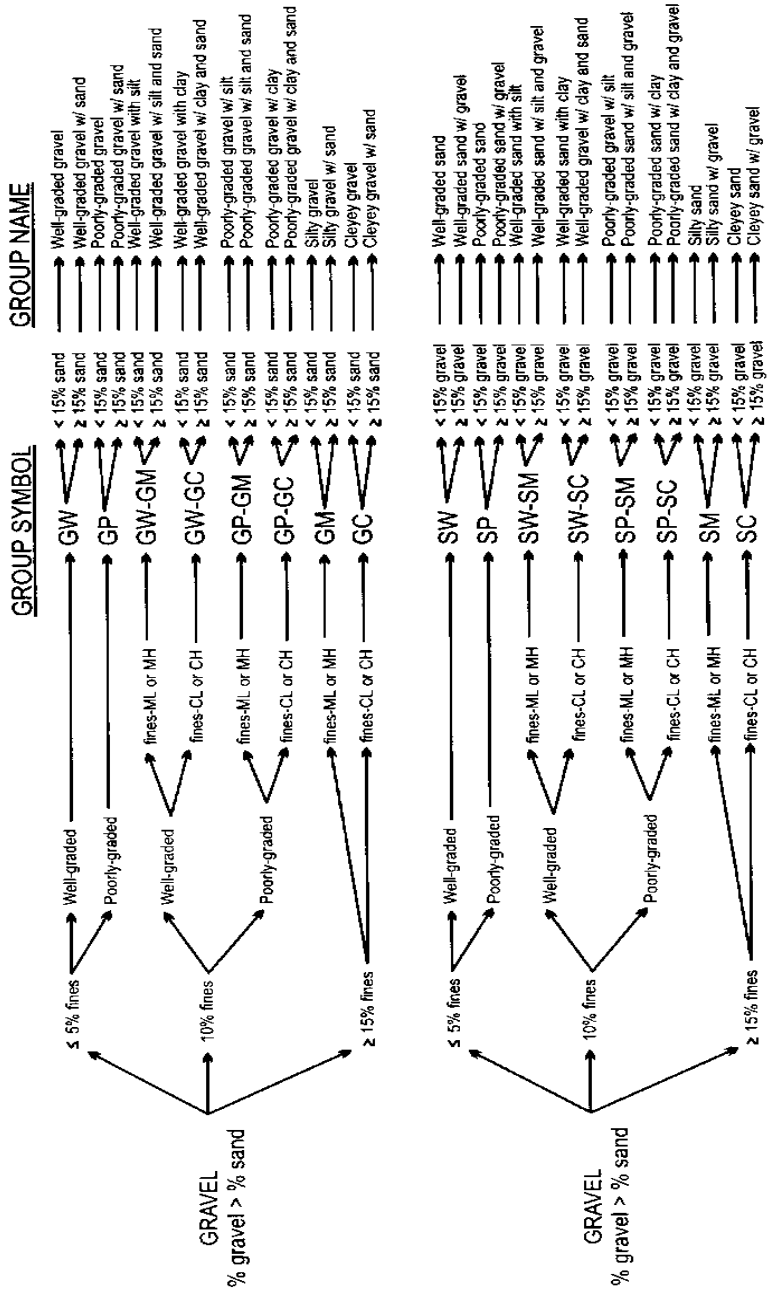


Figure 8-3: Flow Chart for Soil with Gravel



8.1.2.3 Plasticity

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 8-3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table 8-3: Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

8.1.3 Angularity

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides but have well-rounded corners and edges.
- **Subangular** particles are similar to angular but have somewhat rounded or smooth edges.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

8.1.4 Color, Moisture, and Odor

The natural moisture content of soil is very important. Table 8-4 shows the terms for describing the moisture condition and the criteria for each.

Table 8-4: Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists. The Munsell Color Chart is a small booklet of numbered color chips with names like "5YR 5/6, yellowish-red." Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

8.1.5 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

8.1.5.1 Density/Consistency

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term "density" is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term "consistency" is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs. (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance," or the "N-value." The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless-steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed "refusal" and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of

blows will represent the N-value for this sampling interval. Table 8-5 and Table 8-6 present representative descriptions of soil density/consistency vs. N-values.

Table 8-5: Measuring Soil Density with a California Sampler – Relative Density (Sands, Gravels)

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.43 factor
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	> 50	> 71

Table 8-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	> 32	> 36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or Shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 8-7):

Table 8-7: Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1000
Stiff	1000–2000
Very Stiff	2000–4000
Hard	>4000

Consistency can also be estimated using thumb pressure using Table 8-8.

Table 8-8: Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

8.1.5.2 Cementation

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

- Quartz – siliceous
- Chert – chert-cemented or chalcedonic
- Opal – opaline
- Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
- Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
- Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
- Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

- Weak – friable; crumbles or breaks with handling or slight finger pressure
- Moderate – friable; crumbles or breaks with considerable finger pressure
- Strong – not friable; will not crumble or break with finger pressure

8.1.5.3 Structure

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular – spherically shaped aggregates with faces that do not accommodate adjoining faces
- Stratified – alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- Laminated – alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky – cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- Lensed – inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- Prismatic or Columnar – particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top

- Platy – particles are arranged about a horizontal plane

8.1.5.4 Other Features

- Mottled – soil that appears to consist of material of two or more colors in blotchy distribution
- Fissured – breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- Slickensided – fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

8.1.6 Development of Soil Description

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

8.1.6.1 Coarse-grained Soil

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is “sand-sized.” It is classified as a gravel if over 50 percent of the coarse fraction is composed of “gravel-sized” particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY-SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

8.1.6.2 Fine-grained Soil

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

8.1.6.3 Organic Soil

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some

organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

8.2 Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

8.3 Rock Classification

The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the **Project Manager** and the **Program Quality Manager** must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities.

In order to provide a more consistent rock classification between geologists, a rock classification template has been designated as shown in Figure 8-4. The template includes classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a boring log or logbook. The items essential for classification include (i.e., metamorphic foliated):

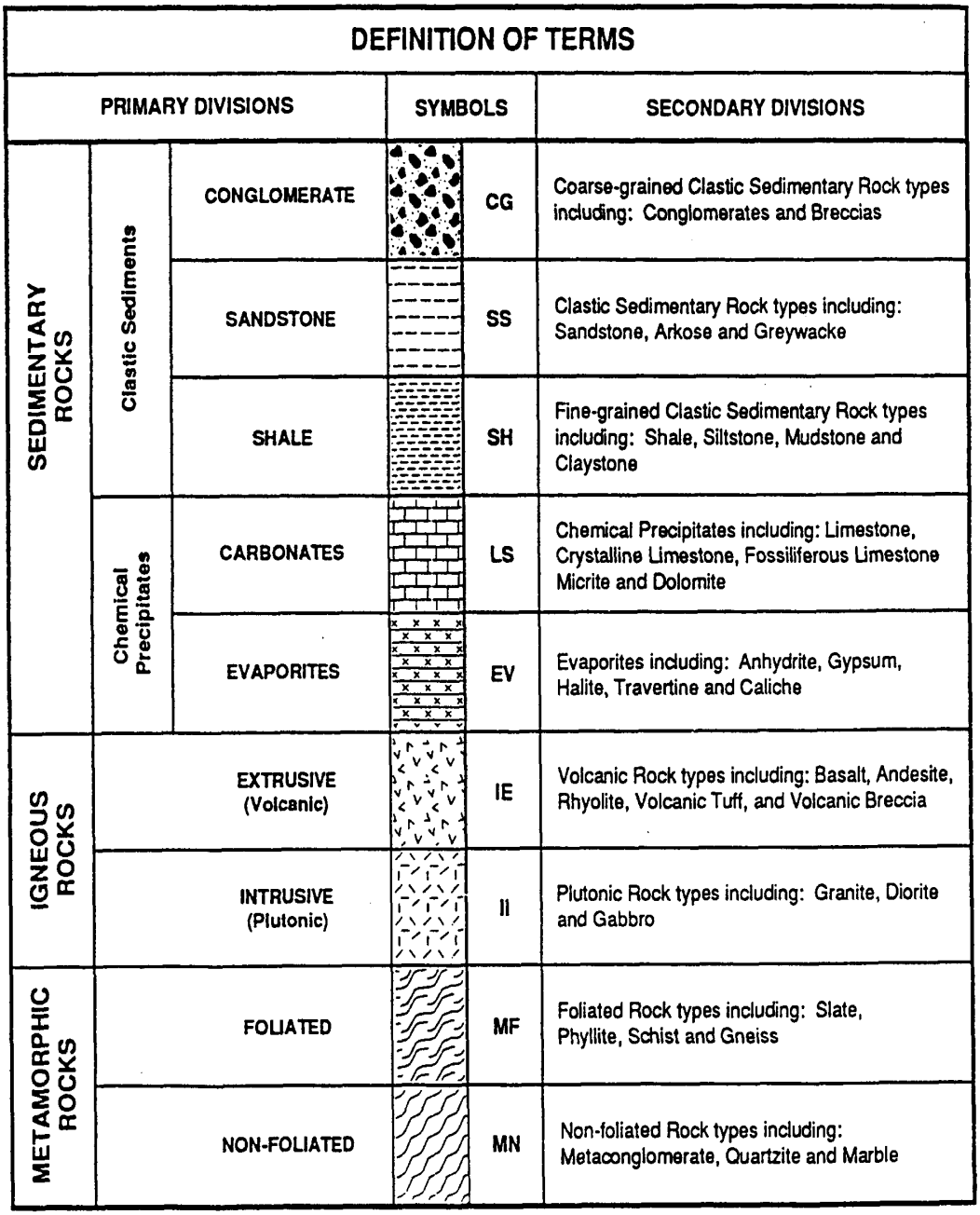
- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphlitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

9.0 Quality Control and Assurance

None

Figure 8-4: Rock Classification System



DEFINITION OF TERMS					
PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS
SEDIMENTARY ROCKS	Clastic Sediments	CONGLOMERATE		CG	Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias
		SANDSTONE		SS	Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke
		SHALE		SH	Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone
	Chemical Precipitates	CARBONATES		LS	Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite
		EVAPORITES		EV	Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche
IGNEOUS ROCKS	EXTRUSIVE (Volcanic)			IE	Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia
	INTRUSIVE (Plutonic)			II	Plutonic Rock types including: Granite, Diorite and Gabbro
METAMORPHIC ROCKS	FOLIATED			MF	Foliated Rock types including: Slate, Phyllite, Schist and Gneiss
	NON-FOLIATED			MN	Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble

10.0 Data and Records Management

10.1 Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be sent to the **Project Manager** for the project files.

10.2 Field notes will be kept during coring activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. The information pertinent to soil classification activities includes chronology of events, sample locations (x,y,z), time/date, sampler name, methods (including type of core liner/barrel, if applicable), sampler penetration and acceptability, sample observations, and the times and type of equipment decontamination. Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

11.0 Attachments or References

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Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Operation and Calibration of a Photoionization Detector

Procedure 3-20

1.0 Purpose and Scope

1.1 Purpose and Applicability

1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

1.1.2 PIDs routinely used by **field personnel** include the Photovac Microtip, Thermoelectron 580EZ, MiniRAE 2000, and MiniRae 3000. Personnel responsible for using the PID should read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp can be ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive-biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

1.2.4 In service, the analyzer is first calibrated with a gas of known composition representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low PID sensitivity.

1.3 Specifications

1.3.1 Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 parts per million (ppm) isobutylene equivalent.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, are addressed in the project Health and Safety Plan (HASP). Work will also be conducted according to the Task Order (TO) Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

4.2 Moisture will generate a positive interference in the concentration measured by a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or fouling the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that the operation and calibration activities comply with this procedure. The **Project Manager** is responsible for ensuring that all **field personnel** involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.

5.2.4 All **field personnel** are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated (i.e., up to 50-75 ppm expected PID readings if the PID is calibrated using 100 ppm isobutylene in air);
- Regulator for calibration gas cylinder;
- Approximately 6 inches of HDPE or silicone tubing (LDPE and Tygon® tubing are not permitted on PFAS sampling projects);
- Approved bag or other container for holding calibration gas at near-ambient pressure (at the time of this SOP update, Tedlar bags have not been tested/approved for use on AECOM PFAS sampling projects);
- Commercially-supplied zero grade air (optional);
- PFAS-free pen or marker (fine point Sharpie® pen use is acceptable when open sample bottles are not present in the area);
- PID with battery charger;
- PID in-line moisture traps;
- Manufacturer's instructions; and
- Field data sheets or logbook/pen.

7.0 Procedure

7.1 Preliminary Steps

7.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment. If the instrument is rented, these steps are typically undertaken by the equipment rental company.

7.2 Calibration

7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing minimal/no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor (e.g., 100 ppm isobutylene in air), is then used to set the sensitivity.

7.2.2 Calibrate the instrument according to the manufacturer's instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field logbook or PID calibration form.

7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4) or replaced.

7.3 Operation

7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer's instructions. Record the calibration information in the field records.

7.3.3 The instrument is now operational. Readings should be recorded in the field records.

7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a "bump" test should be performed periodically prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a bag containing a small amount of span gas to the inlet tubing on the unit. If the reading is not within ±10% of the expected concentration, the PID must be recalibrated.

7.3.5 Recharge the battery after each use (Section 7.4).

7.3.6 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 Routine Maintenance

7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.

7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 Troubleshooting Tips

7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

8.0 Quality Control and Assurance

8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific UFP-QAPP.

8.2 Calibration of the PID will be conducted at the beginning of each day of sampling and will be checked whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

9.0 Records, Data Analysis, Calculations

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number;
- Instrument manufacturer, model, and identification number;
- Operator's signature;
- Date and time of operation;
- Calibration gas used;
- Calibration check at beginning of day (meter readings before adjustment);
- Span (non-zero) calibration gas reading after calibration adjustment;
- Meter readings (monitoring data obtained);
- Instances of erratic or questionable meter readings and corrective actions taken; and
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 7.5) or similar test.

10.0 Attachments or References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Surface and Subsurface Soil Sampling Procedures

Procedure 3-21

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures for soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pits, direct-push, sonic drilling, and split-spoon equipment.

1.2 For project specific information (e.g., sampling depths, equipment to be used, and frequency of sampling), refer to the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and/or UFP-QAPP addenda, which takes precedence over these procedures. Near-surface soil sampling (0-2 ft) is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval without the need of extracting excess material above the target depth. These methods can dramatically reduce time and cost associated with disposal of material from soil cuttings compared to test pit sampling. In addition, direct-push, sonic drilling, and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials, such as medium to fine sands, silts, and silty clay soils. Sonic drilling sampling works well in all types of soil and bedrock. Split-spoon sampling works well in all types of soil but is somewhat slower than direct-push and sonic drilling methods. Except for volatile organic compounds (VOCs) samples, the soil sample interval is composited so that each sample contains a homogenized representative portion of the sample interval. Due to potential loss of analytes, samples for VOC analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are best collected with Shelby Tubes (not covered in this SOP). They are collected, sealed, and sent directly to the laboratory for analysis without homogenizing.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, are addressed in the project Health and Safety Plan (HSP). Work will also be conducted under direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Before soil sampling commences, appropriate entities must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and an insufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

4.2 Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect samples that may contain asphalt. If the collection of samples potentially

containing asphalt is unavoidable, note the sampling depths at which the presence of asphalt is suspected.

4.3 Cross contamination from sampling equipment must be prevented by using sampling equipment constructed of stainless steel or other approved materials that is adequately decontaminated between samples.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The Task Order (TO) **Project Manager** is responsible for ensuring that soil sampling activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in soil sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Team Lead** is responsible for ensuring that all soil sampling activities are conducted according to this procedure.

5.2.4 **Field personnel** are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the UFP-QAPP and/or UFP-QAPP addenda. The following details equipment typically needed for soil sampling, based on the various methods.

6.1 Depending on the nature of suspected contamination, field screening instrumentation may be used for direct sampling. Appropriate instrumentation and calibration standards should be available. If VOCs are suspected and a photoionization detector (PID) will be used, refer to the equipment and instrumentation listed in SOP 3-20 Operation and Calibration of a Photoionization Detector. Equipment in this SOP includes but is not limited to:

- PID;
- Calibration gas; and
- Gas bags (for PID calibration).

6.2 Appropriate decontamination procedures must be followed for sampling equipment. Refer to SOP 3-06 Equipment Decontamination. Equipment in this SOP includes but is not limited to:

- Alconox® or Liquinox®;
- Deionized water (confirmed PFAS-free);
- Plastic buckets or washbasins;
- Brushes; and
- Polyethylene (not low-density polyethylene) sheeting.

6.3 The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls;
- Stainless steel trowels;
- Appropriate sample containers for laboratory analysis;
- Personal Protective Equipment (PPE);
- Non-water-repellent logbook;
- Cooler and ice for preservation; and
- Stakes and flagging to document sampling locations.

6.4 The following additional equipment is needed for VOC sampling:

- Syringes or other discrete soil core samplers.

6.5 The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

6.6 The following additional equipment may be needed for soil sampling from direct push and/or split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered.

Note: All subsurface drilling equipment will be provided and maintained by the drilling or direct-push subcontractor.

7.0 Procedure

7.1 General Soil Sampling Procedure for All Soil Sampling Methods

For all soil sampling methods, the following general procedures will be followed:

- Clear vegetation if necessary and check/record the sampling location identification number and pertinent location details.
- Verify that the sampling equipment is properly decontaminated and in working order.
- Cover surfaces onto which soils or sampling equipment will be placed (i.e., tables with polyethylene sheeting).
- Follow the appropriate procedures listed below for either surface, split-spoon, sonic drilling, direct push, or test pit sample collection (7.2, 7.3, 7.4, 7.5, and 7.6, respectively).
- Collect soil samples according to procedures listed in Section 7.7 depending on required analyses.
- Record date/time, sample ID, and sample descriptions in the field logbook or field form. A sketch or description of the location may also be recorded so the sample location can be reconstructed, especially if the location will not be surveyed or recorded using global positioning system (GPS) equipment.
- Immediately label the sample containers and place them on ice, if required for preservation. Complete the chain-of-custody form(s) as soon as possible.
- Dispose of all excess excavated soil in accordance with the UFP-QAPP.
- If required, mark the sample location with a clearly labelled wooden stake or pin flag. If the location is on a paved surface, the location may be marked with spray paint.
- Decontaminate the sampling equipment according to SOP 3-06 Equipment Decontamination.

7.2 Surface Sampling

7.2.1 The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials);
- Other relevant soil characteristics;
- Site features;
- Screening results;
- Predetermined sampling approach (i.e., grid or random); and
- Sampling objectives as provided in the UFP-QAPP.

7.2.2 The following procedures are to be used to collect surface soil samples with hand tools including a stainless-steel trowel, hand auger, and/or shovel. Soils samples collected with hand tools are typically collected up to 5 feet below ground surface, though deeper samples may be collected manually due to access and/or specific project needs (clearing for utilities, total depth requirements, etc.). The UFP-QAPP should be consulted for direction on sampling methods for specific locations and depths. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs may be taken as needed or as specified in the UFP-QAPP.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from the exposed sampling area with a stainless-steel trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless-steel bowl for homogenizing. Monitor the breathing zone and sampling area as required in the HSP.
3. For VOC analyses, collect representative soil samples directly from the recently-exposed soil using a syringe or other soil coring device (e.g., TerraCore®, EnCore®). Follow procedures in Section 7.7.1 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless-steel bowl. Homogenize the soil sample thoroughly to obtain a uniform soil composition, removing any non-soil objects and breaking apart any clumps.

7.3 Split-Spoon Sampling

7.3.1 Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.

After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using the PID. Scan the recovered soil by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil in the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations.

7.3.2 Place the recovered soil from the split spoon into a stainless-steel bowl. Homogenize the soil sample thoroughly to obtain a uniform soil composition, removing any non-soil objects and breaking apart any clumps.

7.4 Sonic Drilling Sampling

7.4.1 Sonic drilling methods, also known as vibratory drilling, use an eccentrically oscillating drill head to produce high-frequency vibratory energy that is then transmitted down the drill string to a core barrel to quickly advance through the subsurface. Sonic drilling utilizes a double-cased system using an inner core barrel and a larger override casing. This ensures that the

borehole is continuously cased to the total depth, minimizing the potential for borehole collapse and providing the means to alter casing diameters to telescope through semi-confining units to prevent downhole cross contamination.

7.4.2 Upon retrieval of the core barrel, place the tubular plastic sleeve (confirmed PFAS-free) with sealed bottom over the bottom of the core barrel. The core barrel will then be vibrated, causing the soil sample to be extruded into the sleeve. Place the sleeve on the work surface (i.e. PFAS-free polyethylene- covered table or ground). Open the sleeve and measure the recovery of soil.

7.4.3 If a PID will be used for screening, immediately scan the recovered sample for VOCs using the PID. Scan the recovered soil by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil in the tip of the PID. Take PID readings every 6 inches along the soil core and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations.

7.4.4 Place soil from the desired sample interval into a stainless-steel bowl. Homogenize the soil sample thoroughly to obtain a uniform soil composition, removing any non-soil objects and breaking apart any clumps.

7.5 Direct Push Sampling

Typically, samples with direct-push equipment are collected in 4-foot (ft) intervals, but smaller and larger (e.g., 5 ft) intervals are also possible.

1. Sample using Macro-Core samplers with acetate liners to obtain discrete soil samples.
2. Cut open the acetate liner. If required in the UFP-QAPP, immediately scan the recovered soil boring for VOCs using a PID by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil in the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations.
3. Place soil from the desired sample interval into a stainless-steel bowl. Homogenize the soil sample thoroughly to obtain a uniform soil composition, removing any non-soil objects and breaking apart any clumps.

7.6 Test Pit Sampling

7.6.1 Excavate the test pit to the desired depth.

7.6.2 Using the excavator bucket, collect soil samples as needed. Collect the soil sample for lab analysis from the center of the excavator bucket to avoid potential contamination from the bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples.

7.6.3 Collect the remainder of the sample volume required into a stainless-steel bowl. Homogenize the soil sample thoroughly to obtain a uniform soil composition, removing any non-soil objects and breaking apart any clumps.

7.7 Sample Collection Methods

7.7.1 Volatile Organics Sampling

For soils collected for analyses of VOCs, including Total Petroleum Hydrocarbons (TPH) or other purgeable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include three 40-mL VOA vials and one soil jar. Two 40-mL

VOA vials will contain either reagent water or sodium bisulfate and magnetic stir bars (i.e., low level vials). The third VOA vial will contain methanol with no magnetic stir bar (i.e., high level vial). These vials are provided by the laboratory and are pre-weighed, with the tare weight recorded on the affixed sample label. No additional sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the sample label using an indelible PFAS-free marker. The soil jar is provided for percent solids determination. For VOC or TPH analyses, samples are collected prior to sample homogenization for non-volatile analyses. Collect the VOC sample in accordance with the procedure described below.

1. Determine the soil volume necessary for the required sample weight, typically 5 grams:
    a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.
2. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.
3. Gently swirl the vial so that all of the soil is fully wetted with the preservative.
4. Fill the other low level 40 mL VOA vial in this manner.
5. Repeat the process for the high-level VOA vials, only for the high-level VOA vial either two or three 5-gram aliquots (i.e., 10- or 15-grams total) should be extruded into the high-level VOA vial. Check with the **Project Chemist** to verify the correct quantity of soil to extrude into the high-level VOA vial. The mass of soil in grams should typically be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).
6. Collect any additional QC samples (e.g., field duplicate, MS, and MSD) in the same manner as above.
7. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

7.7.2 Soil Sampling Method (All other analyses except VOC/TPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 7.2.2. Collect enough volume to fill all the remaining sample containers at least 3/4 full for all other analyses. Homogenize the soil in a decontaminated stainless-steel bowl, removing visible asphalt, rocks, sticks, or other non-soil objects and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

8.0 Quality Control and Assurance

8.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the UFP-QAPP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the UFP-QAPP and/or UFP-QAPP addenda describe/will describe the collection of a sufficient quantity of field duplicate, field blank, and other samples.

8.2 Quality control requirements are dependent on project-specific sampling objectives. The UFP-QAPP and/or UFP-QAPP addenda provide/will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and

shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

9.0 Records, Data Analysis, Calculations

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site logbooks with permanent ink. Data recorded may include the following:

- Weather conditions;
- Arrival and departure time of persons on site;
- Instrument type, lamp (PID), make, model and serial number;
- Calibration gas used;
- Date, time and results of instrument calibration and calibration checks;
- Sampling date and time;
- Sampling location;
- Samples collected;
- Sampling depth and soil type;
- Deviations from the procedure as written; and
- Readings obtained.

10.0 Attachments or References

SOP 3-06, *Equipment Decontamination*

SOP 3-19, *Headspace Screening for Total VOCs*

SOP 3-20, *Operation and Calibration of a Photoionization Detector*

Author	***Reviewer***	***Revisions (Technical or Editorial)***
Robert Shoemaker, PMP Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)
Ken O'Donnell, PG Geologist	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Robert Shoemaker, PMP Senior Scientist	Josh Millard, PG, CPG	Rev 2 – Addition of Sonic Drilling Methods (January 2020)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 3 – February 2020

Water Quality Parameter Testing

Procedure 3-24

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for water quality parameter testing for groundwater or surface water sampling. This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to complete this task. Specific information regarding sampling locations can be found in the associated Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP).

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the client contract.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the **Task Order (TO) Manager** or **Program Quality Manager**. Deviations to this SOP will be documented in the field records.

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first surface water sampling location. All **field personnel** responsible for sampling activities must review the project-specific Health and Safety Plan (HASP), paying particular attention to the control measures planned for the sampling tasks.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes protective eyewear, powder-free nitrile gloves, and steel-toed boots

2.3 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Terms and Definitions

3.1 **Barometric Pressure (BP)**: The density of the atmosphere, which varies according to altitude and weather conditions.

3.2 **Conductivity/Specific Conductance**: A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature. Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.

3.3 **Dissolved Oxygen (DO):** The amount of oxygen present in water and available for respiration. DO is typically measured in milligrams per liter (mg/L). Oxygen is less soluble in warm and salty waters, so the instrument compensates the apparent percent saturation for changes in temperature and conductivity. Most probes measure the current resulting from the electrochemical reduction of oxygen (at a gold cathode) diffusing through a selective membrane. Because oxygen is being removed from the sample to perform the measurement, sample flow is required to prevent false low readings due to depletion of oxygen in the solution near the probe. Optical DO probes do not remove oxygen from the sample and are less affected by salts. The common range of DO in groundwater is 0.0 to 3.0 mg/L. Measurements outside of this range suggest that the meter may not be operating correctly.

3.4 **Nephelometric Turbidity Unit (NTU):** Units of turbidity measurement, related to the measurement of light passing through a sample based on the scattering caused by suspended particles.

3.5 **Potential of Hydrogen (pH):** A measure of acidity and alkalinity of a solution using a logarithmic scale on which a value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers are increasingly basic/alkaline.

3.6 **Oxidation-Reduction Potential (ORP):** Also known as redox or eH, ORP is a measurement of the potential for a reaction to occur, which generally indicates the oxygen status of a sample. The probe consists of a platinum electrode, the potential of which is measured with respect to a reference electrode that rapidly equilibrates with the potential of the sample solution. A positive value indicates that oxygen is present. A negative value indicates an anaerobic environment or reducing condition. For this reason, negative ORP readings should be associated with DO readings of less than 0.5 mg/l. With negative ORP readings the water may also exhibit a sulfur odor or gray color. Positive ORP readings should be associated with DO readings greater than 0.5 mg/L and a lack of sulfur odors. Because of the complex relationship between ORP and temperature, no compensation is attempted; it is thus best to report both the ORP and temperature of a water sample.

3.7 **Total Dissolved Solids:** A measure of the quantity of materials in water that are either dissolved or too small to be filtered.

3.8 **Turbidity:** Measure of the clarity of water in NTUs. Potable water typically has NTU values between 0.0 and 0.3 NTUs, depending on the state or regulatory program.

4.0 Interferences

4.1 During field testing, water quality data that is documented from field testing equipment may be influenced by certain outside factors that are unrelated to the actual site water quality. Such parameters and equipment include the following:

4.2 **pH Meters:** Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use isopropyl alcohol very sparingly so that the electronic surface is not damaged.

Poorly buffered solutions with low specific conductance (less than 200 microsiemens per centimeter) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

4.3 **Dissolved Oxygen**: Dissolved gases (e.g., hydrogen sulfide, halogens, sulfur dioxide) are a factor with the performance of DO probes. The effect is less pronounced on optical DO meters. Meter type and potential interferences should be considered based on potential sulfate/sulfide or nitrate/nitrite reducing environments.

Exposure of the sample to the atmosphere will cause elevated DO measurements.

4.4 **Turbidity Meter**: If the weather is warm and humidity is high, condensation may collect on the sample cuvette if a standalone turbidity meter is used. This can cause turbidity readings that are biased high.

To avoid this, allow the sample to warm and dry the outside of the cuvette before making the measurement.

4.5 **Temperature**: Sample temperature will change rapidly when there are significant differences between the sample and ambient air, or when the tubing used to convey the water from the well of the flow-through cell is in direct sunlight.

5.0 Training and Qualifications

5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The Project Manager is responsible for ensuring that field activities comply with this procedure. The Project Manager or designee shall review all water sampling forms on a minimum monthly basis. The Project Manager is responsible for ensuring that all field personnel involved in water quality parameter testing shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Field Team Lead is responsible for ensuring that all field personnel follow these procedures.

5.2.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for field personnel require that one individual on the field team have a minimum of 1 year of experience with water quality parameter testing.

5.2.5 The field personnel and/or Field Team Lead are responsible for directly supervising the surface water sampling procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected during sampling. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the Program Quality Manager and then documented in the field logbook and associated report or equivalent document.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Copy of the UFP-QAPP including SOPs
- Maps/Plot plan
- Non-water-repellent field logbook
- Pump (Portable Bladder, Submersible)
- Bladders for portable bladder pumps (low-density polyethylene [LDPE] bladders are unacceptable for PFAS-sampling projects, high-density polyethylene {HDPE} is approved for PFAS)
- Bladder pump controller (for portable bladder pumps)
- Air compressor (for portable bladder pumps)
- Nitrogen cylinders (for portable bladder pumps)

- 12-volt power source
- HDPE or silicone inlet and discharge tubing
- HDPE bailer appropriately sized for well
- Disposable bailer string (polypropylene)
- Individual or multi-parameter water quality meter(s) with flow-through cell to measure temperature, pH, specific conductance, DO. ORP, and/or turbidity
- Teflon-free water level meter
- Oil/water interface probe, if needed

6.2 **Equipment/Apparatus**: **Field personnel** shall consult the site UFP-QAPP to review the equipment requirements for the sampling procedures to be followed during the sampling effort. The specific apparatus and materials required will depend on the water quality parameters being monitored. **Table 1** shows the common equipment used in water quality parameter testing.

Table 1
Water Quality Parameter Testing — Common Equipment

Water quality Parameter Instrument	Calibration Standards Required	Other Equipment
pH Meter	Yes - 2- or 3-point calibration using a pH 7 standard (zero) plus typically a pH 4 and/or pH 10 standard. The standards chosen should bracket the expected range of groundwater pH values	Container or flow-through cell for holding sample
Specific Conductance	Yes	Container or flow-through cell for holding sample
ORP Meter	Yes	Container or flow-through cell for holding sample
Turbidity Meter	Yes	Container or flow-through cell for holding sample
DO	No, calibrated to 100% saturation based on current conditions	Container or flow-through cell for holding sample
Thermometer	No	Container or flow-through cell for holding sample
Flow Rate	No	Container or flow-through cell for holding sample

Notes:
ORP = Oxidation Reduction Potential
DO = Dissolved Oxygen

7.0 Calibration or Standardization

7.1 Instrument or Method Calibration

Most monitoring instruments require calibration before use, and this calibration must be conducted in the field under the ambient climatic conditions that will be present during field sampling. Calibration of monitoring instruments shall be performed in accordance with the manufacturer's specifications and recorded in the provided form in Attachment 1. The following minimum calibration requirements apply to the various types of meters used to gather water quality measurements.

Initial Calibration (IC): Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a calibration standard. An

IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following IC by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

Continuing Calibration Verification (CCV): After use, the instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter.

7.2 Calibration Checks

Calibration checks are conducted by measuring a known standard. They must be completed after calibration and should be performed at least one other time (i.e., after lunch) and anytime suspect measurements are encountered. Table 2 provides general acceptance ranges to be used during calibration checks. If a meter is found to be outside of the acceptance range, the meter must be recalibrated. If the meter remains out of range, the project manager and/or the supplier of the meter should be contacted to determine alternative measures.

Table 2
Calibration Check Acceptance Limits

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature
pH	±0.2 standard pH Units
Specific Conductance	±5% of the standard value
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard >100 NTU: ±5% of the standard

Notes:
Mg/L = milligrams per liter
Mv = millivolts
NTU = nephelometric turbidity units

7.3 Possible and Suspected Ranges

The concentration for each parameter range should be known so that concentrations outside of the range can be noted. Table 3 presents the maximum range of the parameter in groundwater. The table also presents the suspected range. Measurements outside of the maximum/minimum range should be considered in error and the measurement method should be checked. Concentrations outside the normal range should be treated as suspect but may be the result of contaminant impact. For example, a pH of 2.0 would be out of the normally suspected range for groundwater but not at a site impacted with an acid.

Table 3
Minimum and Maximum Result Ranges

Parameter	Units	Possible Minimum	Possible Maximum	Normal Minimum	Normal Maximum	Notes
Dissolved Oxygen	mg/L	0.0	14.6 (0°C) 10.1 (15°C) 8.3 (2°C)	0.0	5	The colder the sample, the higher the DO reading. DO greater than 1 mg/L, ORP should be positive and water should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP should be negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
pH	SU	0	14	5	9	pH values exceeding 10 could indicate grout contamination in well
ORP	mv	-2,000	+2,000	-300	+300	DO greater than 1 mg/L, ORP should be positive and water should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP should be negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
Specific Conductance	µS/cm	varies	varies	varies	varies	
Temperature	°C	0	100	5	30	
Turbidity	NTU	0	Greater than 1,000	0	Greater than 1,000	50 NTU or greater suggests visible cloudiness in water.

Notes:
mg/L = milligrams per liter
°C = degrees Celsius
DO = dissolved oxygen
SU = standard units
ORP = oxidation reduction potential
Mv = millivolts
mS/cm =micro Siemens per cm
NTU = nephelometric turbidity units

7.4 Field Instruments and Calibration Criteria

7.4.1 pH Meters

For the most accurate pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH ranges expected at the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7, 4, and 10. If groundwater pH is outside the calibration range of the solution standards, special buffers should be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter's manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.

pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For

example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only.

A percent slope of less than 90 percent indicates a bad electrode that must be changed or repaired. If percent slope cannot be determined, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

7.4.2 Specific Conductance Meters

For field measurements, it is strongly preferred that specific conductance be measured/recorded rather than conductivity. Specific conductance is conductivity corrected to standard temperature (25 °C). Specific conductance readings are thus more readily compared between wells than conductivity readings.

For IC, use a standard potassium chloride (KCl) solution that is in the range of the expected sample conductivities. Accept the calibration if the meter reads within +/- 5 percent of the value of the calibration standard used to verify the calibration.

Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.

For CCV, check the meter with the KCl standard. The reading for the calibration verification must also be within +/- 5 percent of the standard value.

7.5 Dissolved Oxygen Meters

Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.

If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.

Most DO meters must be calibrated based on an environment of 100 percent humidity and a known barometric pressure (BP).

For 100 percent humidity, place the probe in the calibration container with a moist towel or small quantity of water (follow manufacturer's instructions for calibration) and allow the probe to remain, undisturbed, for 10 to 20 minutes.

The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.

Use the same procedure as above for CCV.

7.6 ORP Meters

Verify electrode response before use in the field.

Equilibrate the standard solution to the temperature of the sample. The standard solution is based on a 25°C temperature; however, the calibration solution standard's value will require adjustment based on the temperature.

Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on.

Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ±10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

7.7 Turbidity Meters

Perform an initial calibration using at least two primary standards.

If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.

Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value (refer to Table 3).

Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs.

To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

CCV: Perform a CCV using at least one primary or secondary standard. The calibration acceptance criteria are the same as those for an ICV.

8.0 Procedures

8.1 Purpose

The procedures will vary depending on parameters being measured, method of sampling, and the method of measurement used. The information here is a general guidance and the site-specific documents and manufacturer manuals supersede these procedures.

8.2 Cautions

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

8.3 Direct Measurements

Direct measurements with meters are the most common methods and can be accomplished by placing a sample in a container with the probe or by allowing the water to flow past the probe in a flow-through cell. The use of a flow-through cell improves measurement quality by allowing the constant flow of water over the probes and reduces interaction of the sample with the atmosphere. Sample cups should be avoided when possible.

Following calibration of required probes, connect the bottom flow-cell port to the discharge line of the pump. Connect the top port to a discharge line directed to a bucket to collect the purge water. Allow the flow cell to completely fill. As the water flows over the probe, record the measurements. Continue to record the measurements at regular intervals, as specified in *SOP 3-03 – Monitoring Well Sampling*.

When the ambient air temperatures are much higher or lower than the temperature of the water sample, it is best to keep the length of tubing between the wellhead and the flow cell as short as possible to prevent heating or cooling of the water. Tubing and flow-through cell should not be exposed to direct sunlight, particularly in the summer, if at all possible, to avoid heating of water samples.

8.4 Data Acquisitions, Calculations, and Data Reduction

8.4.1 Specific Conductivity Correction Factions

If the meter does not automatically correct for temperature (i.e., read Specific Conductivity) record Conductivity along with temperature. The following equation can be used to convert Conductivity to Specific Conductivity.

$$K = \frac{(Km)(C))}{1 + 0.0191(\mathrm{T} - 25)}$$

Where:

K = Conductivity in µmhos/cm at 25°C

Km = Measured conductivity in µmhos/cm at T degrees Celsius

C = Cell constant

T = Measured temperature of the sample in degrees Celsius;

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(Km)}{1 + 0.0191(\mathrm{T} - 25)}$$

8.4.2 Percentage Difference Calculation

For evaluating slope of readings from either a flow cell or a sample cup.

$$\%Difference = \frac{(Highest\ Value - Lowest\ Value)}{(Highest\ Value)}\ x\ 100$$

8.4.3 Convert mm mercury (mmHG) to inches mercury (inHG)

$$mmHG = inHG\ x\ 25.4$$

8.4.4 True Barometric Pressure

For Converting BP obtained from a public domain source that is expressed in BP at sea level to BP at the subject site.

$$TrueBP = (BP) - \frac{(2.5\ x\ [Local\ Altitude])}{100}$$

Where: BP is in mmHG and Local Altitude is in feet

Example: BP at Site A is 30.49 inHG and elevation is 544 feet, calculate TrueBP

Convert inHG to mmgHG:

mmHG = 30.49 inHG x 25.4 = 774.4 mmHG

Calculate TrueBP:

TrueBP = (774.4 mmHG) – [2.5*(544/100)] = 774.4-13.6 = 760.mmHG.

9.0 Quality Control and Assurance

9.1 **Field personnel** will follow specific quality assurance (QA) guidelines outlined in the UFP-QAPP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.

9.2 Quality Control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The UFP-QAPP provides requirements for sample preservation, holding times, container types, as well as various QC samples such as trip blanks, field blanks, equipment blanks, and field duplicates.

10.0 Data and Records Management

10.1 Field notes will be kept during sampling activities in accordance with *SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody*. During the completion of sampling activities, fill out the sample logbook and transmit forms to the **Project Manager** for storage in project files.

10.2 Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

11.0 Attachments or References

Attachment 1: Example Field Instrument Calibration Form
Attachment 2: Solubility of Oxygen at Given Temperatures
Attachment 3: Example Field Data Form

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue
Amanda Martin Engineer	Claire Mitchell, PE, PMP Senior Engineer	Rev 1 – PFAS sampling update (July 2019)
Drew Corson Senior Scientist	Hallie Garrett P.G.	Rev 2 – February 2020

Attachment 1
Example Field Instrument Calibration Form

EQUIPMENT CALIBRATION DAILY LOG	
Date:	Project Name:
Project Number:	Recorded By:

PID	Model:		Bulb:		Morning Calibration	Evening Check	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
First Point Calibration	Vapor conc. (ppm)	0.0 (ambient air)	NA	NA	Initials:	Value:	
Second Point Calibration	Vapor conc. (ppm)	100 (isobutylene)			Initials:	Value:	

COMB. GAS/O_2 METER	Model:		Bulb:		Morning Calibration	Evening Check	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
First Point Calibration	O_2 (%)	20.9%			Initials:	Value:	
	H_2S (%)	25 ppm			Initials:	Value:	
	CO (%)	50 ppm			Initials:	Value:	
	% LEL Pentane	50% (methane)			Initials:	Value:	

WATER QUALITY METER	Model:				Morning Calibration/Check	Evening Check (one point only)	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
First Point Calibration (Auto)	pH	4.00			Initials:	Value:	
	Conductivity (mS/cm)	4.49				Value:	
	Turbidity (NTU)	0				Value:	
	DO (mg/L)	8.9-9.1 (ambient air)	NA	NA		Value:	
Second Point Calibration	pH	7.0			Initials:	Value:	
	Conductivity (mS/cm)					Value:	
	Turbidity (NTU)	100				Value:	
Third Point Calibration	pH	10.0			Value:	Value:	
	Conductivity (mS/cm)				Value:	Value:	
	Turbidity (NTU)				Value:	Value:	

Additional Remarks:

Attachment 2
Solubility of Oxygen at Given Temperatures

Field Measurement of Dissolved Oxygen

Solubility of Oxygen in Water at Atmospheric Pressure			
Temperature	**Oxygen Solubility**	**Temperature**	**Oxygen Solubility**
°C	**mg/L**	**°C**	**mg/L**
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

Notes:
The table provides three decimals to aid interpolation
Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated
°C = degrees Celsius
mg/L = milligrams per liter