Prepared for:

LCP SITE STEERING COMMITTEE

AMENDMENT #1: QUALITY ASSURANCE PROJECT PLAN FOR OPERABLE UNIT 2, SITE CHARACTERIZATION OF THE CELL BUILDING AREA

LCP CHEMICALS SITE BRUNSWICK, GEORGIA

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June 2021

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Kirk Kessler, P.G.
Senior Principal

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Appendix B Analytical SOPs
Appendix C Soil Sampling Forms
Appendix D Quality Assurance Manuals
Appendix E Laboratory Accreditations

Acronyms and Abbreviations

µg/L	micrograms per liter
AOC	Administrative Order on Consent
ARCO	Atlantic Richfield Company
BS	blank spike
BSD	blank spike duplicate
CBA	Cell Building Area
CBASI	Cell Building Area Subsurface Investigation
CBP	caustic brine pool
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CO_2	carbon dioxide
COPC	Constituent of Potential Concern
CRQL	contract required quantitation limit
CSM	Conceptual Site Model
DNAPL	Dense nonaqueous phase liquid
DoD-ELAP	Department of Defense Environmental Laboratory Accreditation Program
DQI	data quality indicator
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
EPD	Georgia Environmental Protection Division
EPS	Environmental Planning Specialists, Inc.
Eurofins	Eurofins Lancaster Laboratories Environmental LLC
FC	Federal Coordinator
FCR	Field Change Request
FD	field duplicate
Frontier	Eurofins Frontier Global Sciences LLC
FSP	Field sampling plan
ft-bgs	feet below ground surface
FTL	Field Team Leader
GIS	Geographic Information System
GW	Groundwater
Hg	mercury
HHBRA	human health baseline risk assessment

HSO	Health and Safety Officer
ICP	Inductively Coupled Plasma
ICP/MS	Inductively Coupled Plasma Mass Spectrometry
ICS	interference check solution
Kd	soil-water partition coefficient
LCP	LCP Chemicals
LCS	laboratory control sample
LPM	Laboratory Project Manager
MB	method blank
MCL	Maximum Contaminant Level
MDL	method detection limit
mg/kg	milligram per kilogram
Montrose	Montrose Environmental
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NIST	National Institute of Standards and Technology
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PAH	polyaromatic hydrocarbons
PAL	project action limit
PC	Project Coordinator
PCB	Polychlorinated Biphenyl
PETG	polyethylene terephthalate glycol
PM	Project Manager
PP	polypropylene
PPE	Personal Protective Equipment
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
RI/FS	Remedial Investigation and Feasibility Study
RL	reporting limit
RP	Responsible Party

RPD	relative percent difference
RT	retention time
Site	LCP Chemicals Superfund Site
SOP	standard operating procedure
SSE	Selective Sequential Extraction
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TB	trip blank
UFP	Uniform Federal Policy
Validata	Validata, LLC
VOC	volatile organic compound
°C	degrees Celsius

Project Summary

Honeywell, the Atlantic Richfield Company ("ARCO"), and the Georgia Power Company are Responsible Parties ("RPs") to an Administrative Order of Consent ("AOC") with the U.S. Environmental Protection Agency ("EPA"), to conduct a Remedial Investigation and Feasibility Study ("RI/FS") for the LCP Chemicals Superfund Site (the "Site") located in Brunswick, Georgia (EPA,1995)[1]. The EPA is administering the Site as three Operable Units ("OUs"): OU1 pertains to the salt marsh; OU2 pertains to site-wide groundwater (and the footprint of the former mercury cell building – both soil and groundwater); and OU3 pertains to the upland soil.

In October 2020, the RPs submitted a technical memorandum (herein referred to as the "OU2 HHRA Memo") presenting the initial elements in the development of the Human Health Baseline Risk Assessment ("HHBRA") for OU2, namely the identification of Constituents of Potential Concern ("COPCs") and the Exposure Assessment, which will form the basis for the computational risk assessment (EPS, 2020)[2]. EPA provided comment on the OU2 HHRA Memo in a letter dated January 8, 2021, to which the RPs responded in a letter (with attachments) dated February 1, 2021. An ensuing dialogue between EPA and Environmental Planning Specialists, Inc. ("EPS") (dba: Montrose Environmental Solutions ("Montrose")) resulted in the conclusion that a data gap exists regarding characterization of surficial soil (*i.e.*, the top 2 feet of the soil horizon) in the CBA due to the existence of a constructed soil cover across the CBA. (Note a revised HHRA[3] memo was submitted in March 2021 and subsequently approved by the EPA.) In response, a Revised Supplemental Site Characterization Work Plan[4] is being submitted to address this data gap. This Quality Assurance Project Plan ("QAPP") is being submitted with the Work Plan to provide the supporting procedures and criteria that will be followed to ensure the data collected and tested meets the project objective. Sections that have previously been approved and not changed with this amendment are highlighted in gray.

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[1] EPA (1995). Administrative Order by Consent for Remedial Investigation/Feasibility Study. Docket N.95-17-C.

[2] EPS (2020). Identification of Constituents of Potential Concern and Exposure Assessment, Human Health Baseline Risk Assessment Technical Memorandum, LCP Chemicals Site, Brunswick Georgia, OU2. October.

[3] EPS (2021). Revised Identification of Constituents of Potential Concern and Exposure Assessment Work Plan, Human Health Baseline Risk Assessment Technical Memorandum, LCP Chemicals Site Operable Unit Two. March.

[4] EPS (2021). Revised Supplemental Site Characterization Work Plan for Operable Unit 2: Cell Building Area Surface Soil, LCP Chemicals Site, Brunswick Georgia. June.

Worksheet #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

Site Name/Project Name

LCP Chemicals OU2

Site Location

Brunswick, Glynn County, Georgia

Contract/Work Assignment Number

Not applicable

Document Title

Amendment#1: QAPP For Operable Unit 2, Site Characterization of the Cell Building Area (Revision 1)

Lead Organization

RPs: Honeywell and ARCO

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Preparation Date

June 25, 2021

Investigative Organization's Project Manager

Kirk Kessler, P.G.
Senior Principal / EPS

Signature: _____ Date: ___6/25/21_____

Investigative Organization's Quality Assurance Officer

Timmerly Bullman P.E./ EPS

Signature: _____ Date: ___6/25/21_____

Worksheet #1 & 2 (continued)

Lead Organization's Project Coordinator

Prashant Gupta
Remediation Manager / Honeywell

Signature: _____ Date: _____

Federal Regulatory Agency

Robert Pope, Acting Chief
Office of Superfund Remediation and Technology Innovation (OSRTI)
EPA Region 4

Signature: _____ Date: _____

State Regulatory Agency

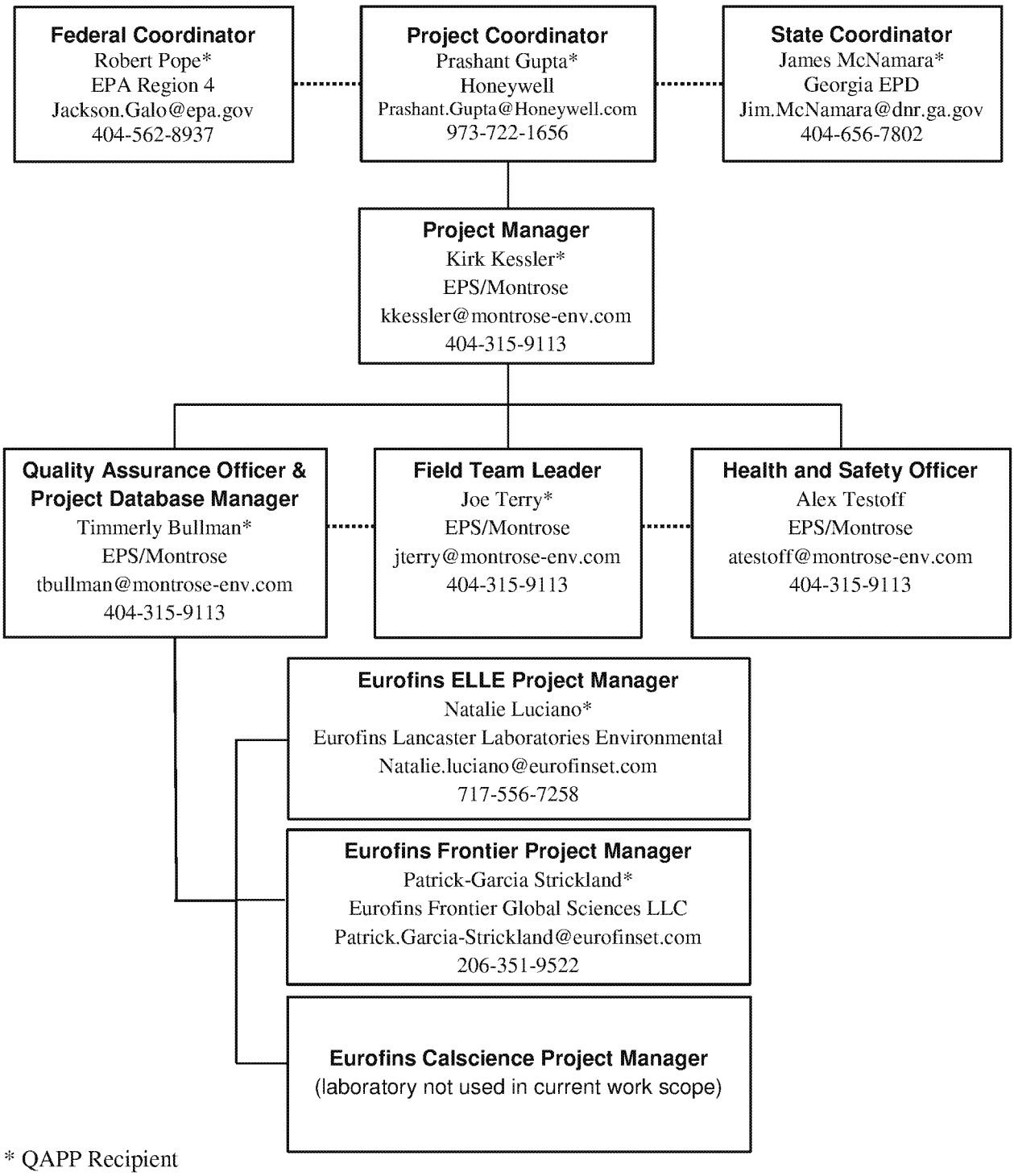
James McNamara
Unit Manager / Hazardous Waste Corrective Action Program
Georgia Environmental Protection Division (EPD)

Signature: _____ Date: _____

Previous Investigations

Extensive site investigations and analyses in the CBA have been performed since the mid-1990s. Refer to Worksheet #10 and #11 for details.

Worksheet #3 & 5: Project Organization and QAPP Distribution
(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)



* QAPP Recipient
Lines of Authority ———
Lines of Communication ·····

Worksheet #4, 7 & 8: Distribution List and Sign-off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

QAPP Recipient	Project Title/Role	Organization	Signature/Date *
Prashant Gupta	Project Coordinator	Honeywell (Lead Organization)	
Kirk Kessler	Project Manager	EPS (Investigative Organization)	Kirk Kessler
Timmerly Bullman	Quality Assurance Officer & Project Database Manager	EPS (Investigative Organization)	T Bullman
Joe Terry	Field Team Leader	EPS (Investigative Organization)	Joseph Terry
Natalie Luciano	Laboratory Project Manager	Eurofins Lancaster Laboratories Environmental LLC	

* Signatures indicate personnel have read and agree to implement this QAPP as written.

Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Driver	Responsible Entity, Organization	Name/Contact	Procedure (timing, pathway, documentation, etc.)
Regulatory agency interface	Project Coordinator ("PC"), Honeywell	Prashant Gupta 973-722-1656	All information about the project will be sent to Federal Coordinator (FC) by PC.
Project management and technical direction	Project Manager ("PM"), EPS	Kirk Kessler 404-315-9113	Interface between project team and PC.
Manage field tasks	Field Team Leader ("FTL"), EPS	Joe Terry 404-315-9113	Act as liaison to PM concerning investigation activities. Daily communication with PM. Communicate implementation issues to PM.
Data management planning	Quality Assurance Officer ("QAO"), EPS	Timmerly Bullman 404-315-9113	Provide sample location, sample ID, and analysis information prior to sample collection to FTL. Coordinate with Laboratory Project Managers (LPMs) concerning timing and analytical requirements, and bottle orders.
Field data management	FTL, EPS	Timmerly Bullman 404-315-9113	Provide information of sample collection (e.g. chain-of-custodies) to QAO.
Site Health and Safety Issues	Health and Safety Officer ("HSO"), EPS	Alex Testoff 404-315-9113	Conduct daily H&S meetings, make decisions regarding H&S issues and upgrading Personal Protective Equipment (PPE). Communicate to PM, FTL and field staff as appropriate.
QAPP changes during project execution	FTL, EPS	Joe Terry 404-315-9113	Notify PM immediately and complete a Field Change Request (FCR) form and/or corrected worksheets. Send to PM and QAO.
	QAO, EPS	Timmerly Bullman 404-315-9113	Notify LPM of delays or changes to field work, as necessary.
	PM, EPS	Kirk Kessler 404-315-9113	Notify FC and PC of delays or changes to field work.
Field corrective actions	FTL, EPS	Joe Terry 404-315-9113	Initiates corrective action on identified field issues within reasonable timeframe.
Sample receipt variances	LPM, Eurofins Frontier	Natalie Luciano 717-556-7258	Notify QAO and PM of any sample receipt issues.
Notification of analytical issues	LPM, Eurofins ELLE	Natalie Luciano 717-556-7258	Notify QAO and PM of any sample collection or shipment issues.
Data verification	QAO, EPS	Timmerly Bullman 404-315-9113	Communicate any issues with the PM.
Data validation	Validator, Validata, LLC	Christina Jensen 206-361-8249	Validate data and report to PM.

Worksheet #9: Project Planning Session Summary
(UEF-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

This worksheet or a modified version of this worksheet will be filled out and made available as-needed for each project planning session. A template is provided here for reference.

Date of planning session:
Location:
Purpose:

Participants:

Name	Organization	Title/Role	Email/Phone

Notes/Comments:

Consensus decisions made:

Action Items:

Action	Responsible Party	Due Date

Worksheet #10 & 11 (continued)

Worksheet #10 and #11: Conceptual Site Model and Project/Data Quality Objectives (UFP-QAPP Manual Section 2.5.2, 2.6.1) (EPA 2106-G-05 Section 2.2.5, 2.2.6)

Conceptual Site Model ("CSM")

ARCO operated the Site as a petroleum refinery from 1919 to the early 1930s. At one time, over 100 process and storage tanks were present on the upland portion of the Site. In 1955, Allied Chemical and Dye established and operated a chlor-alkali facility at the Site. The facility used the mercury cell process, which involved passing a concentrated brine solution between stationary graphite or metal anodes and a liquid mercury cathode to produce chlorine gas, sodium hydroxide (caustic) solution, and hydrogen gas. The mercury cell process was performed in two adjacent buildings separated by a salt plant (herein referred to as the Cell Building Area ("CBA"). During plant operations, release of mercury to the subsurface either in metallic form or as a solute in process liquids (brine or caustic) occurred. Prior investigations into the occurrence of mercury in CBA were performed as part of the groundwater RI Report (Geosyntec, 1997)[5] and two CBA-specific investigations (detailed herein).

On January 29, 2018, the EPA determined after reviewing a summary of mercury test results for soils beneath the CBA that a data gap may exist in the delineation of the deep soil mercury condition. Specifically, the EPA requested additional subsurface characterization be performed in the northeast and southeast quadrants of Cell Building 1, and areas of Cell Building 2. EPS on behalf of the Responsible Parties has been tasked with designing and implementing a field work scope to address this data gap as well as assessment of Mercury partitioning within the CBA.

The release of mercury to the subsurface occurred in the CBA in metallic form. A comingled release of process liquids (caustic and brine) from the chlor-alkali operations has been termed the caustic brine pool ("CBP") during the early Site investigation work and is operationally defined as groundwater that exhibits a pH more than 10.5 Standard Units, with other general indicators including elevated salinity, elevated metals concentrations due to enhanced solubility, and reduced oxidation-reduction potential ("ORP"). The Satilla Formation ("Fm.") underlies the CBA extending to a depth of approximately 50 feet below ground surface ("ft bgs"). The Satilla is comprised of layered sequences of downward coarsening unconsolidated sands, which terminate at a sandstone aquitard layer (upper member of the Ebenezer Fm.).

[5] GeoSyntec Consultants, 1997. Remedial Investigation Report, Groundwater Operable Unit, LCP Chemicals, Brunswick, Georgia - Volumes I and II September 1997.

Worksheet #10 & 11 (continued)

Metallic mercury is recognized as the primary source of mercury to groundwater. Full detail of mercury fate and transport in the CBA is detailed in the groundwater RI Report (Geosyntec, 1997)[3]. In summary, mercury released in metallic form acts as a dense non-aqueous phase liquid (DNAPL) in that it is heavier than water. Downward migration of mercury was evaluated in prior CBA soil cores and found to reside in subsurface layers comprised of well sorted coarse grains overlying finer grained and less permeable lithologic layers. The solubility and dissolution of metallic mercury in the subsurface is enhanced by two primary factors as a consequence of the caustic brine release. First, the dissolution and solubility of mercury is enhanced through complexation of mercury by chloride and hydroxyl groups shifting the equilibrium from metallic mercury to Hg^{2+} complexes. Second, the caustic condition solubilizes natural humic material in the aquifer to which mercury readily complexes, thus acting as a secondary mobilization pathway. Concentrations of mercury in groundwater are well correlated to pH, a condition that also describes the defined profile of the CBP and concentration gradient of the dissolved mercury plume originating from the CBA. Just as the geochemical conditions imparted by the caustic mobilizes mercury, as the caustic condition is moderated by interaction with meteoric groundwater and buffered by the aquifer matrix, the concentration of mercury in groundwater quickly decreases along the path of groundwater flow away from the CBA, a condition further detailed in the groundwater RI Report based on chemical equilibrium modeling, chemical partitioning study and empirical data.

Investigation of the CBA Between 1994 and 1995, two investigations under the direction of the EPA targeted shallow soil across the footprint of the CBA including soil beneath the cell building foundations. The preliminary investigation work, targeted areas of the CBA that exhibited settlement as observed through cracked or stressed concrete, but also investigated the entirety of the shallow soil surrounding the CBA. The initial investigation collected shallow soil with a hand auger, either in soil adjacent to each cell building or beneath the building after coring through the concrete foundation slab. Approximately 50 locations were assessed during the initial assessment work with the hand auger with two depth intervals tested within the upper 3 to 4 feet of hand auger boring. In 1995, the soil study was expanded to include mechanical excavation (i.e., test pits) in areas of interest to allow for a more thorough assessment of the sub-foundation soil condition. In total, seven test pits were excavated in the CBA, five beneath Cell Building 1 and two beneath Cell Building 2. The test pit program included a visual assessment of the soil for metallic mercury and analytical testing for mercury.

Additional characterization of the CBA was performed under the direction of the EPA in 1996-1997 under the Cell Building Area Subsurface Investigation ("CBASI") program, designated at the time to be the final phase of groundwater characterization under the OU2 RI (Geosyntec, 1997)[3]. The CBASI was designed to address the following objectives:

Worksheet #10 & 11 (continued)

- Characterize the nature and extent of metallic mercury in subsurface soils beneath the cell buildings;
- Map the three-dimensional extent of the caustic brine pool ("CBP");
- Map in further detail the stratigraphy of the CBA, including geotechnical properties of the soil; and
- Assess the unique geochemical properties of the CBP, including its relationship to colloidal transport of mercury and to mercury partitioning between soil and groundwater.

The CBASI work scope involved multiple field assessment approaches including the use of cone-penetrometer testing, deep soil borings with continuous soil coring, collection of paired aquifer matrix and groundwater samples (for a site-specific soil-water partition coefficient ("K_d") study), and additional deep monitoring well installation and sampling. The deep soil coring targeted locations of potential metallic mercury in subsurface soils, with emphasis on the settlement area beneath Cell Building 1 where alteration of the geologic medium by the caustic release was most evident. The deep soil assessment was performed at 14 locations: ten borings beneath Cell Building 1, one boring south of Cell Building 2, one boring at the mercury retort, and two borings in the caustic storage and rail loading area. These borings were advanced to the semi-confining layer (*i.e.*, the sandstone). The soil core from each boring was visually assessed through the splitting of the core to examine for metallic mercy and through the collection and analytical testing for mercury.

Data Quality objectives are based on the following Seven Steps

1. State the Problem

A data gap exists regarding characterization of surficial soil (*i.e.*, the top 2 feet of the soil horizon) in the CBA due to the existence of a constructed soil cover. The surface soil data gap precludes a quantitative assessment of potential risk for the CBA area.

2. Identify the Goals of the Study

The overall objective of the CBA surface soil investigation is to:

A. Evaluate the CBA surface soil (0 to 2 feet) for potential occurrence of Target Analyte List ("TAL") metals, mercury, volatile organic compounds ("VOCs"), polycyclic aromatic hydrocarbons ("PAH"), and PCB Aroclors ("PCB").

3. Identify Information Input

To support the above objective, the following data will be collected.

- Objective A

Worksheet #10 & 11 (continued)

a. During hand auger activity (0 to 2 ft-bgs), soil will be visually characterized to determine if soil cover fill can be discerned from native soil.

b. Soil collected from each 0-2 ft-bgs hand auger boring will be sampled for the prescribed analytical testing.

c. Soil samples will be tested for the following to support the risk assessment:

   i. TAL metals

   ii. Mercury

   iii. PAHs

   iv. VOCs

   v. PCBs

d. All soil samples will be tested for total solids (i.e. percent moisture)

4. Define the Boundaries of the Study

Spatial Boundaries:

The study area encompasses surface soil (0 to 2 ft-bgs) in the CBA soil cover where the soil cover is estimated to be less than 2 ft thick. The soil cover encompasses an area of approximately 5 acres.

Temporal Boundaries:

The study will represent soil conditions approximately 27 years after facility operations ceased. A sampling schedule is included in the Work Plan (EPS, 2021a)[6].

Practical Constrains on Data Collection:

Scheduling adjustments will be made if inclement weather, safety considerations, or unforeseen circumstances delay data collection.

5. Develop the Analytical Approach

Samples will be collected from locations designated on Figure A1. At each location, a hand auger will be used to collect soil from 0 to 2 ft-bgs. The soil will be visually characterized during auger activity with respect to depth to determine if a transition from soil cover material to native soil can be discerned. Soil from the 0-2 ft-bgs interval will be composited and sampled for the prescribed

[6] EPS (2021a). Revised Supplemental Site Characterization Work Plan for Operable Unit 2: Cell Building Area Surface Soil. LCP Chemicals, Brunswick, Georgia.

Worksheet #10 & 11 (continued)

analytical program. See Field Sampling Plan ("FSP") for specific details on this sampling protocol (EPS, 2021b)[7].

6. Specify Performance or Acceptance Criteria

All data will be reviewed and verified to ensure that they are acceptable for the intended use. All data will be validated in accordance with the procedures specified in Worksheet #36. QC criteria for analytical data are listed in Worksheet #28.

Decision errors will be limited to the extent practicable by following approved EPA methods and applicable standard operating procedures ("SOP") listed in Worksheet #21. Any deviation from the SOP/QAPP will be documented.

7. Develop the Detailed Plan for Obtaining Data

Soil samples will be collected at locations designated on Figure A1. Worksheets #17, #18, #20, and #21 present the sampling design and procedures.

Worksheets #19, #20, #24-#28 and #30 specify analytical requirements. Data from the laboratories will be delivered in an electronic data deliverable ("EDD") and an Adobe pdf file. The data will be documented in the site activities report. Project data records and data management is detailed in Worksheet #29.

Data Use

Data will be used to support the CBA surface soil risk assessment (and to update the CSM as needed).

Data Quality

The project-specific action limits and quantification limits are specified on Worksheets #15-1 through #15-6. Data quality is to meet the data quality objectives ("DQOs") that have been specified for the site and the measurement quality objectives presented in Worksheets #12-1 through #12-6 and Worksheets #28-1 through #28-8.

Data Collection

EPS personnel will collect the soil samples. SOPs for sample collection are provided on Worksheet #21.

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[7] EPS (2021b). Supplemental Field Sampling Plan for Operable Unit 2: Cell Building Area Surface Soil. LCP Chemicals, Brunswick, Georgia.

Worksheet #10 & 11 (continued)

Data Reporting

Eurofins Lancaster Laboratories Environmental LLC ("Eurofins") and Eurofins Frontier Global Sciences LLC ("Frontier") will analyze the samples for the hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), including TAL metals, mercury, VOCs, PAHs, and PCBs. Eurofins will be the primary laboratory managing the project and will be responsible for sending electronic reports to EPS, as described. EPS will provide the full laboratory reports to Validata, LLC ("Validata") to validate these sample results in accordance with Worksheet #36. Following completion of all laboratory analyses and specific data validation, the analytical data will be uploaded to a site-specific Microsoft Access database and to the EPA's EQuIS database. Database queries will be used to create project data to be included in reports that will be submitted to the EPA and EPD for review. EPS will use Geographic Information System ("GIS") and other software to facilitate spatial analysis of the data and to generate figures for reports and presentations.

Data Archive

Eurofins and Frontier maintain respective data archives. EPS will also archive the data both in its original electronic format and in the project database. The EPA will also have the raw data in EQuIS. Field data and field logs will be archived in the electronic project files at EPS.

Worksheet #12-1: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: TAL metals, EPA Method 6020
Concentration Level: Medium in the CBA

Sampling Procedure	Analytical Method / SOP[h]	Data Quality Indicator (DQI)	Quality Control (QC) Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code[i]
SOP-F11; Refer to Worksheet #21	EPA Method 6020; Refer to SOP-A01 and SOP-A06 in Appendix B	Precision	Field duplicates (FD), matrix spike (MS) / matrix spike duplicates (MSD)	Relative percent difference (RPD), Worksheet #28-1.	S+A
		Accuracy/Bias	Laboratory control sample (LCS), MS, surrogates, internal standards, instrument performance checks	+/- Percent Recovery, See Worksheet #28-1.	A
		Representativeness	Evaluate target analyte holding times, preservation, and quantitation. Evaluation of method blank (MB).	Sample holding times and preservation requirements. Target analyte identification and quantitation. Contamination of sample with target analyte. See Worksheet #28-1.	S+A
		Comparability	Review of analytical methods applied to analysis.	Qualitative evaluation of compliance with industry standard methods and reporting units.	A
		Sensitivity	Calibrations within method criteria. Quantitation limits (QLs) and minimum detection limits (MDLs) meet QAPP requirements.	See Worksheet #15-1.	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

[h] Standard operating procedure
[i] Key: (S) – sampling error; (A) – analytical error; (S+A) – both sampling and analytical errors

Worksheet #12-2: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: PAHs, EPA Method 8270D-SIM
Concentration Level: Medium to high in the CBA

Sampling Procedure	Analytical Method / SOP	DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code
SOP-F11; Refer to Worksheet #21	EPA Method 8270D SIM; Refer to SOP-A02 in Appendix B	Precision	FD, MS/MSD	RPD, Worksheet #28-2.	S+A
		Accuracy/Bias	LCS, MS, surrogates, internal standards, instrument performance checks	+/- Percent Recovery, See Worksheet #28-2.	A
		Representativeness	Evaluate target analyte holding times, preservation, and quantitation. Evaluation of MB.	Sample holding times and preservation requirements. Target analyte identification and quantitation. Contamination of sample with target analyte. See Worksheet #28-2.	S+A
		Comparability	Review of analytical methods applied to analysis.	Qualitative evaluation of compliance with industry standard methods and reporting units.	A
		Sensitivity	Calibrations within method criteria. QLs and MDLs meet QAPP requirements.	See Worksheet #15-2.	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

Worksheet #12-3: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: Total mercury, 1631B
Concentration Level: Medium to high in the CBA

Sampling Procedure	Analytical Method / SOP	DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code
SOP-F11; Refer to Worksheet #21	EPA Method 1631B; Refer to SOP-A03 and SOP-A04 in Appendix B	Precision	FDs, MS/MSD	RPD, See Worksheet #28-3.	S+A
		Accuracy/Bias	LCS, MS, surrogates, internal standards, instrument performance checks	+/- Percent Recovery, See Worksheet #28-3.	A
		Representativeness	Evaluate target analyte holding times, preservation, and quantitation. Evaluation of MB.	Sample holding times and preservation requirements. Target analyte identification and quantitation. Contamination of sample with target analyte. See Worksheet #28-3.	S+A
		Comparability	Review of analytical methods applied to analysis.	Qualitative evaluation of compliance with industry standard methods and reporting units.	A
		Sensitivity	Calibrations within method criteria. QLs and MDLs meet QAPP requirements.	See Worksheet #15-3.	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

Worksheet #12-4: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: VOCs, Method 8260C
Concentration Level: Low in the CBA

Sampling Procedure	Analytical Method / SOP	DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code
SOP-F11; Refer to Worksheet #21	Method 8260C; Refer to SOP-A07 and SOP-A10 Appendix B	Precision	FDs	RPD, See Worksheet #28-7.	S+A
		Accuracy/Bias	Surrogates, internal standards, instrument performance checks	+/- Percent Recovery, See Worksheet #28-7.	A
		Representativeness	Evaluate target analyte holding times, preservation, and quantitation. Evaluation BS/BSD.	Sample holding times and preservation requirements. Target analyte identification and quantitation. Contamination of sample with target analyte. See Worksheet #28-7.	S+A
		Comparability	Review of analytical methods applied to analysis.	Qualitative evaluation of compliance with industry standard methods and reporting units.	A
		Sensitivity	Calibrations within method criteria. QLs and MDLs meet QAPP requirements.	See Worksheet #15-4.	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

Worksheet #12-5: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: PCB Aroclors, Method 8082A
Concentration Level: Low to medium in the CBA

Sampling Procedure	Analytical Method / SOP	DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code
SOP-F11; Refer to Worksheet #21	Method 8082A; Refer to SOP-A08 and SOP-A11 Appendix B	Precision	FDs	RPD, See Worksheet #28-8.	S+A
		Accuracy/Bias	Surrogates, internal standards, instrument performance checks	+/- Percent Recovery, See Worksheet #28-8.	A
		Representativeness	Evaluate target analyte holding times, preservation, and quantitation. Evaluation BS/BSD.	Sample holding times and preservation requirements. Target analyte identification and quantitation. Contamination of sample with target analyte. See Worksheet #28-14.	S+A
		Comparability	Review of analytical methods applied to analysis.	Qualitative evaluation of compliance with industry standard methods and reporting units.	A
		Sensitivity	Calibrations within method criteria. QLs and MDLs meet QAPP requirements.	See Worksheet #15-5.	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

Worksheet #12-6: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil
Analytical Group or Method: Percent solids, Method SM2540B
Concentration Level: Not applicable (N/A)

Sampling Procedure	Analytical Method / SOP	DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria	QC Sample Error Assessment Code
SOP-F11; Refer to Worksheet #21	Method SM2540B; Refer to SOP-A05 Appendix B	Precision	FDs	RPD, See Worksheet #28-6.	S+A
		Accuracy/Bias	N/A	N/A, See Worksheet #28-6.	A
		Representativeness	N/A	N/A, See Worksheet #28-6	S+A
		Comparability	N/A	N/A, See Worksheet #28-6	A
		Sensitivity	N/A	N/A, See Worksheet #28-6	A
		Completeness	Data usability check	> 95% of the laboratory analyses must provide for data usable for project objectives; See Worksheet #37.	S+A

Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

Data Type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Historical Media Testing Data	Project Specific Database	Assessment of current condition and data trends (*i.e.*, time series data).	Historical analytical detection limits may be elevated in comparison to current standards.
Historical Investigation Reports	Historical Records, Previous Investigations	Supplemental background information on historical site conditions, and previous investigations.	No limitations identified
Soil Boring Logs	Historical Records, Previous Investigations	Assessment of sample design and support subsurface interpretation of contaminant distribution.	No limitations identified

Worksheet #14 & 16: Project Tasks & Schedule
(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
Mobilization / demobilization	EPS	Day 1	Day 2	field notes	Day 10
Sample collection	EPS	Day 3	Day 4	field notes	Day 35
Sample analysis	Frontier, Eurofins	Day 4	Day 60	Report of analyses / data package	Day 60
Validation	Validata	Day 60	Day 90	Validation Summary Report	Day 90
Summarize data	EPS	Day 90	Day 150	Draft Report	Day 150

Worksheet #15-1 (continued)

Worksheet #15-1: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Laboratory: Eurofins
Matrix: Soil
Analytical Method: TAL metals, EPA Method 6020A
Concentration level: Medium in the CBA

Analyte	CAS #	RSL[j] for Resident Soil (mg/kg[k])	PAL[l]/PQL[m] Goal[n] (mg/kg)	MRL[o] (mg/kg)	MDL[p] (mg/kg)
Aluminum	7429-90-5	77000	77000	10.0	4.37
Antimony	7440-36-0	31	31	0.100	0.0632
Arsenic	7440-38-2	0.68	0.68	0.200	0.0669
Barium	7440-39-3	15000	15000	0.200	0.0915
Beryllium	7440-41-7	160	160	0.0500	0.0119
Cadmium	7440-43-9	71	71	0.0500	0.0252
Calcium	7440-70-2	N/A	N/A	20.0	7.49
Chromium	7440-47-3	N/A	N/A	0.200	0.0769
Cobalt	7440-48-4	23	23	0.100	0.0292
Copper	7440-50-8	3100	3100	0.200	0.0878
Iron	7439-89-6	55000	55000	10.0	3.75

[j] RSL – EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[k] mg/kg – milligrams per kilogram
[l] PAL – Project Action Limit
[m] PQL – Project Quantitation Limit
[n] Equal to the RSL, or N/A if no RSL exists
[o] MRL – Method Reporting Limit, laboratory-specific; values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[p] MDL – Method Detection Limit, laboratory-specific; values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-1 (continued)

Analyte	CAS #	RSL[j] for Resident Soil (mg/kg[k])	PAL[l]/PQL[m] Goal[n] (mg/kg)	MRL[o] (mg/kg)	MDL[p] (mg/kg)
Lead	7439-92-1	400	400	0.100	0.0252
Magnesium	7439-95-4	N/A	N/A	5.00	1.57
Manganese	7439-96-5	N/A	N/A	0.200	0.106
Nickel	7440-02-0	1500	1500	0.200	0.0814
Potassium	7440-09-7	N/A	N/A	20.0	9.52
Selenium	7782-49-2	390	390	0.200	0.0652
Silver	7440-22-4	390	390	0.0500	0.0203
Sodium	7440-23-5	N/A	N/A	25.0	13.4
Thallium	7440-28-0	0.78	0.78	0.0500	0.0196
Vanadium	7440-62-2	390	390	0.400	0.0429
Zinc	7440-66-6	23000	23000	15.0	0.535

[a] RSL – EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[a] mg/kg – milligrams per kilogram
[a] PAL – Project Action Limit
[a] PQL – Project Quantitation Limit
[a] Equal to the RSL, or N/A if no RSL exists
[a] MRL – Method Reporting Limit, laboratory-specific; values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[a] MDL – Method Detection Limit, laboratory-specific; values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-2 (continued)

Worksheet #15-2: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Laboratory: Eurofins
Matrix: Soil
Analytical Method: PAHs, EPA Method 8270D-SIM
Concentration level: Medium to high in the CBA

Analyte	CAS #	RSL[q] for Resident Soil (mg/kg)	PAL/PQL Goal[r] (mg/kg)	MRL[s] (mg/kg)	MDL[t] (mg/kg)
1-Methylnaphthalene	90-12-0	18	18	0.00333	0.000667
2-Methylnaphthalene	91-57-6	240	240	0.00333	0.00133
Acenaphthene	83-32-9	3600	3600	0.00167	0.000667
Acenaphthylene	208-96-8	N/A	N/A	0.00167	0.000333
Anthracene	120-12-7	18000	18000	0.00167	0.000667
Benzo[a]anthracene	56-55-3	1.1	1.1	0.00167	0.000667
Benzo[a]pyrene	50-32-8	0.11	0.11	0.00167	0.000667
Benzo[b]fluoranthene	205-99-2	1.1	1.1	0.00167	0.000667
Benzo[g,h,i]perylene	191-24-2	N/A	N/A	0.00167	0.000667
Benzo[k]fluoranthene	207-08-9	11	11	0.00167	0.000667
Chrysene	218-01-9	110	110	0.00167	0.000333
Dibenz(a,h)anthracene	53-70-3	0.11	0.11	0.00167	0.000667

[q] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[r] Equal to the RSL, or N/A if no RSL exists
[s] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[t] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-2 (continued)

Analyte	CAS #	RSL[q] for Resident Soil (mg/kg)	PAL/PQL Goal[r] (mg/kg)	MRL[s] (mg/kg)	MDL[t] (mg/kg)
Dibenzofuran	132-64-9	78	78	0.00167	0.000667
Fluoranthene	206-44-0	2400	2400	0.00167	0.000667
Fluorene	86-73-7	2400	2400	0.00167	0.000667
Indeno[1,2,3-cd]pyrene	193-39-5	1.1	1.1	0.00167	0.000667
Naphthalene	91-20-3	2	2	0.00333	0.00133
Phenanthrene	85-01-8	N/A	N/A	0.00233	0.001
Pyrene	129-00-0	1800	1800	0.00167	0.000667

[a] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[a] Equal to the RSL, or N/A if no RSL exists
[a] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[a] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-3: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Laboratory: Frontier
Matrix: Soil
Analytical Method: Total mercury, EPA Method 1631B
Concentration level: Medium to high in the CBA

Analyte	CAS #	RSL[u] for Resident Soil (mg/kg)	PAL/PQL Goal[v] (mg/kg)	MRL[w] (mg/kg dry weight)	MDL[x] (mg/kg dry weight)
Total mercury	7439-97-6	11	11	0.0017	0.0005

[u] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[v] Equal to the RSL
[w] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[x] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-4: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Laboratory: Eurofins
Matrix: Soil
Analytical Method: VOCs, Method 8260C
Concentration level: Low in the CBA

Analyte	CAS #	RSL[y] for Resident Soil (mg/kg)	PAL/PQL Goal[z] (mg/kg)	MRL[aa] (mg/kg dry weight)	MDL[bb] (mg/kg dry weight)
4-Methyl-2-pentanone	108-10-1	33000	33000	0.01	0.001
Acetone	67-64-1	N/A	N/A	0.02	0.006
Benzene	71-43-2	1.2	1.2	0.005	0.0005
Bromodichloromethane	75-27-4	0.29	0.29	0.005	0.0004
Bromoform	75-25-2	19	19	0.01	0.005
Bromomethane	74-83-9	6.8	6.8	0.005	0.0007
Carbon disulfide	75-15-0	770	770	0.005	0.0006
Carbon tetrachloride	56-23-5	0.65	0.65	0.005	0.0005
Chlorobenzene	108-90-7	280	280	0.005	0.0005
Chloroethane	75-00-3	14000	14000	0.005	0.001
Chloroform	67-66-3	0.32	0.32	0.005	0.0006
Chloromethane	74-87-3	110	110	0.005	0.0006
cis-1,2-Dichloroethene	156-59-2	160	160	0.005	0.0005
cis-1,3-Dichloropropene	10061-01-5	N/A	N/A	0.005	0.0004
Cyclohexane	110-82-7	6500	6500	0.005	0.0005

[y] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[z] Equal to the RSL, or N/A if no RSL exists
[aa] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[bb] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Analyte	CAS #	RSL[y] for Resident Soil (mg/kg)	PAL/PQL Goal[z] (mg/kg)	MRL[aa] (mg/kg dry weight)	MDL[bb] (mg/kg dry weight)
Dibromochloromethane	124-48-1	8.3	8.3	0.005	0.0005
Dichlorodifluoromethane	75-71-8	87	87	0.005	0.0006
Ethylbenzene	100-41-4	5.8	5.8	0.005	0.0004
Freon 113	76-13-1	6700	6700	0.01	0.0006
Isopropylbenzene	98-82-8	1900	1900	0.005	0.0004
Methyl acetate	79-20-9	78000	78000	0.005	0.001
Methyl tertiary butyl ether	1634-04-4	47	47	0.005	0.0005
Methylcyclohexane	108-87-2	N/A	N/A	0.005	0.0006
Methylene Chloride	75-09-2	57	57	0.005	0.002
Styrene	100-42-5	6000	6000	0.005	0.0004
Tetrachloroethene	127-18-4	24	24	0.005	0.0005
Toluene	108-88-3	4900	4900	0.005	0.0006
trans-1,2-Dichloroethene	156-60-5	70	70	0.005	0.0005
trans-1,3-Dichloropropene	10061-02-6	N/A	N/A	0.005	0.0005
Trichloroethene	79-01-6	0.94	0.94	0.005	0.0005
Trichlorofluoromethane	75-69-4	23000	23000	0.005	0.0007
Vinyl chloride	75-01-4	0.059	0.059	0.005	0.0006
Xylenes, Total	1330-20-7	580	580	0.01	0.0014

[a] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[a] Equal to the RSL, or N/A if no RSL exists
[a] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[a] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-5: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Laboratory: Eurofins
Matrix: Soil
Analytical Method: PCB Aroclors, Method 8082A
Concentration level: Low to medium in the CBA

Analyte	CAS #	RSL[cc] for Resident Soil (mg/kg)	PAL/PQL Goal[dd] (mg/kg)	MRL[ee] (mg/kg dry weight)	MDL[ff] (mg/kg dry weight)
PCB-1016	12674-11-2	4.1	4.1	0.017	0.0056
PCB-1221	11104-28-2	0.2	0.2	0.017	0.0046
PCB-1232	11141-16-5	0.17	0.17	0.017	0.008
PCB-1242	53469-21-9	0.23	0.23	0.017	0.0033
PCB-1248	12672-29-6	0.23	0.23	0.017	0.0033
PCB-1254	11097-69-1	0.24	0.24	0.017	0.0033
PCB-1260	11096-82-5	0.24	0.24	0.017	0.0064

[cc] EPA Regional Screening Level, (TR=1E-06, HQ=1), May 2021
[dd] Equal to the RSL
[ee] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria
[ff] Values are based upon a clean sample matrix, dilutions will be performed as required which may increase limits beyond the stated regulatory criteria

Worksheet #15-6: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

Laboratory: Eurofins
Matrix: Soil
Analytical Method: Percent solids, Method SM2540B
Concentration level: N/A

Analyte	MCL	RSL	PAL/PQL Goal	MRL (%)	MDL (%)
Percent solids	N/A	N/A	N/A	0.10	0.10

Worksheet #17: Sampling Design and Rationale
(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

Sample Design and Rationale

The objective of the soil sampling design is to characterize the surface soil where the CBA soil cover may be less than 2 feet thick. This work will supplement the existing dataset according to the following rationale:

- Insufficient surface soil data is presently available to assess potential risk to future site workers.

The sample design calls for each hand auger soil boring to be visually characterized to determine of native soil can be discerned from the existing soil cover material. Each soil boring will be completed from 0 to 2 ft-bgs.

Process to Address Sample Design Limits

In the event a sample cannot be collected as or where planned, a field-based decision on the need for a corrective action (*e.g.*, alternate sample location, replacement of soil boring) will be determined by the RP contractor and the Agency oversight contractor based on multiple factors including: field observations, field conditions, field data review and determined relevance of the planned sample location based on data collected. The field-based decision and basis of the decision will be documented in the field log book.

Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

Table A1 lists soil sampling locations and associated analyses. Figure A1 shows the locations for characterization of the CBA. Complete field SOPs are provided in Appendix A and listed as follows:

SOP-F01: Logbooks

SOP-F02: Field Equipment Cleaning and Decontamination Procedures

SOP-F03: Sample and Evidence Management

SOP-F04: Packing, Marking, Labeling and Shipping of Environmental and Waste Sampled

SOP-F05: Management of Investigation Derived Waste

SOP-F06: Environmental Data Submission

SOP-F07: Equipment Inventory and Management

SOP-F08: Field Sampling Quality Control

SOP-F09: Soil Sampling

Soil sampling forms are also included in Appendix C.

Sample nomenclature and detail in provided below.

Sample ID	Matrix	Type	Analyte / Analytical Group	Sampling SOP
JULIAN DATE_WELL#	Soil/GW	field sample	Per Table A1	SOP-F11
JULIAN DATE_DUP#	Soil/GW	field duplicate	Per Table A1	SOP-F11
JULIAN DATE_EB#	Water	equipment blank	Per Table A1	N/A

Example soil boring ID for sample SB-501 collected on May 1, 2021:
21121-SB-501

Field samples collected for laboratory analysis will be placed in the containers specified in the QAPP. Disposable gloves will be worn during sampling and discarded after each sample is collected. Containers will be double-bagged with both bags sealed completely to avoid potential cross contamination.

Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times
(UFP-QAPP Manual Section 3.1.2.2)
(EPA 2106-G-05 Section 2.3.2)

Laboratory (Name, sample receipt address, POC, e-mail, and phone numbers):

Eurofins ELLE
Attn: Natalie Luciano
2425 New Holland Pike
Lancaster, PA 17601
Phone: 7176562300
Natalie.Luciano @eurofinset.com
425-686-1996

List any accreditations/certifications: Including but not limited to National Environmental Laboratory Approval Program (NELAP), Department of Defense (DoD-ELAP), ISO-17025-L17-540 PJLA, TNI L17-541 PJLA (see details below and Appendix E)

Back-up Laboratory: N/A

Sample Delivery Method: Courier/FedEx

Analyte / Analyte Group	Matrix	Method	Laboratory	Accreditation Expiration Date	Sample container details	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Total mercury (soil characterization)	Soil	EPA Method 1631B	Eurofins Frontier	NELAP (LA) 6/30/2021	(1) 125 mL HDPE	Frozen to <10°C	None	6 Months	20 days Level II, 20 days Level IV
TAL metals – no Hg (soil characterization)	Soil	EPA Method 6020	Eurofins ELLE	NELAP (PA) 1/31/2022	(1) 4 oz PP jar - packed	None	180 days	180 days	10 days Level II, 20 days Level IV
PAHs (soil characterization)	Soil	EPA Method 8270D SIM	Eurofins ELLE	NELAP (PA) 1/31/2022	(1) 4 oz PP jar - packed	Cool to 4°C	14 days	40 days	10 days Level II, 20 days Level IV
VOCs (soil characterization)	Soil	EPA Method	Eurofins ELLE	NELAP (PA) 1/31/2022	(2) 40 ml VOC vials	$NaHSO_4$ or methanol. Cool to 0-6 °C	48 hours/14 days	14 days	28 days Level II, 28 days Level IV
PCBs (soil characterization)	Soil	EPA Method	Eurofins ELLE	NELAP (PA) 1/31/2022	(1) 8 oz wide-mouth amber glass container with Teflon-lines cap	Cool to 0-6 °C	1 Year	40 days from extraction	28 days Level II, 28 days Level IV

Worksheet #20: Field QC Summary
(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

Analyte / Analytical Group	Matrix	Field Samples	Field (Blind) Duplicates	MS/MSD	Field Blanks	Equipment Blanks	Trip Blanks	Total # Analyses
Soil Characterization								
TAL Metals	Soil	12	2	2	N/A	2	N/A	18
Total mercury	Soil	12	2	2	N/A	2	N/A	18
PCBs	Soil	12	2	2	N/A	2	N/A	18
PAHs	Soil	12	2	2	N/A	2	N/A	18
VOCs	Soil	12	2	2	N/A	2	1	19

Worksheet #21: Field SOPs
(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

Field SOPs are presented in Appendix A.

SOP #	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type	Modified for Project? Y/N	Comments
SOP-F01	Logbooks SESDPROC-1002-R0 10/01/2017 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	Dedicated bound logbooks	N	The purpose of this SOP is to describe protocols for recording field survey and sampling information in a field logbook.
SOP-F02	Field Equipment Cleaning and Decontamination LSASDPROC-205-R4 06/22/2020 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	Deionized (DI) water, low phosphate detergent (e.g., Alconox™)	N	This SOP describes the procedures to be followed for decontaminating sampling equipment used during field activities.
SOP-F03	Sample and Evidence Management SESDPROC-005-R3 05/25/2016 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	N/A	N	The purpose of this SOP is to describe protocols for sample and evidence handling, including the chain-of-custody (COC).
SOP-F04	Packing, Marking, Labeling and Shipping of Environmental and Waste Samples LSASDPROC-209-R4 02/23/2020 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	Cooler, ice, packing tape, shipping paper work (labels, custody seals)	N	The purpose of this SOP is to describe protocols for the packing and shipping of samples to the laboratory for analysis.
SOP-F05	Management of Investigation Derived Waste LSASDPROC-202-R4 05/08/2020 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	N/A	N	The purpose of this SOP is to describe the acceptable means of disposing of investigation derived waste.

SOP #	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type	Modified for Project? Y/N	Comments
SOP-F06	Environmental Data Submission SFDPROC-009-R0 01/27/17	EPA, Region 4	EQuIS data management	N	The purpose of this SOP is to describe the acceptable means of submitting analytical data.
SOP-F07	Equipment Inventory and Management LSASDPROC-1009-R1 02/28/2020 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	N/A	N	The purpose of this SOP is to describe the procedures necessary to demonstrate operational status and inventory of equipment used during field activities.
SOP-F08	Field Sampling Quality Control SESDPROC-011-R5 04/26/17 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	N/A	N	This SOP describes the procedures established to ensure the quality of field sampling activities.
SOP-F09	Soil Sampling LSASDPROC-300-R4 06/11/2020 https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches	EPA, Region 4	Hand Auger, Encore or equivalent sampler	N	This SOP describes general and specific procedures, methods, and considerations to be used when collecting soil samples.

Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

NOT APPLICABLE TO CURRENT WORK SCOPE

Field Equipment	Inspection	Calibration / Testing	Acceptance Criteria	Corrective Action	Maintenance	SOP Reference	Responsible Person
Flow-through cell	Inspect equipment condition upon receipt and prior to each use. Verify successful operation during use.	Calibrate using NIST[gg] calibration solutions at the beginning of the day and verify calibration at end of the day.	pH: ±0.05 units Temperature: ± 0.3 °C Specific conductance: ±5 µS Dissolved oxygen: ±0.02 ppm	Recalibrate or service as necessary. Replace if needed.	Performed by manufacturer or rental company before shipment and as needed	Manufacturer's specifications	Field Crew Chief
Water level meter	Inspect prior to usage and verify successful operation.	Manufacture calibration only. Test daily prior to use.	Pass/Fail	Send for service and replace unit.	Clean and decontaminate after usage, proper storage	Manufacturer's specifications	Field Crew Chief
Waterloo APS profiling tool	Inspect prior to usage and verify successful operation.	Manufacture calibration only. Test daily prior to use.	Manufacturer's specifications	Send for service and replace unit.	Clean and decontaminate after usage, proper storage	Manufacturer's specifications	Drilling contractor/operator

[gg] National Institute for Standards Technology

Worksheet #23: Analytical SOPs
(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

Analytical SOPs are presented in Appendix B.

SOP #	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix / Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
SOP-A01	EPA 6020, Inductively Couple Plasma - Mass Spectrometry (ICP-MS) Eurofins Lancaster Laboratories Environmental LLC. T-MET_WI1933, Revision 11 12/20/2020	Definitive	Soil / TAL metals (no Hg)	ICP/MS	N
SOP-A02	EPA 8270D SIM, by GC/MS Eurofins Lancaster Laboratories Environmental LLC. T-SVOA-WI9995, Revision 18 07/07/2020	Definitive	Soil / PAHs	GC/MS	N
SOP-A03	Preparation of Solids Samples for Total Mercury Analysis by Modified Cold Aqua-Regia Digestion Eurofins Frontier Global Sciences EFAFS-T-AFS-SOP2807, Revision 12 04/11/2020	N/A – digest	Soil / Total mercury	Digestion Vials, Analytical Balance, Centrifuge	N
SOP-A04	Determination of Total Mercury in Various Matrices by Cold Vapor Atomic Fluorescence Spectrometry Eurofins Frontier Global Sciences EFAFS-T-AFS-SOP2822, Revision 7 11/06/2020	Definitive	Soil / Total mercury	Soils method; Analytical balance, Atomic Fluorescence Spectrophotometer	N

Worksheet #23 (continued)

SOP #	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix / Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
SOP-A05	Total Solids and Density Determination Eurofins EFAFS-T-AFS-SOP5133, Version 9 12/22/16	Definitive	Soil / Percent solids	Microwave Digestion Oven. Analytical balance	N
SOP-A06	Preparation of sediment, sludges, soils, and tissue by SW846 3050B for ICP and ICP-MS Eurofins Lancaster Laboratories Environmental LLC. T-MET-WI8636, Revision 25 03/08/2019	N/A – digest	Soil / Metals	Digestion Vials, Analytical Balance	N
SOP-A07	Determination of VOCs by GC/MS by EPA Method 8260C Eurofins Lancaster Laboratories Environmental LLC. T-VOA-WI8236, Revision 8 03/26/2020	Definitive	Soil / VOCs	GC/MS	N
SOP-A08	Microwave extraction method 3546 for PCBs in a solid matrix Eurofins Lancaster Laboratories Environmental LLC. T-OE-PEST-WI10927, Revision 9 10/31/2019	N/A - Extraction	Soil / PCBs	Extraction Vials, Analytical Balance, Microwave	N
SOP-A09	Microwave Extraction by Method 3546 for semi-volatiles/PAHs Eurofins Lancaster Laboratories Environmental LLC. T-OE-SVOA-WI10928, Revision 13 03/20/2019	N/A - Extraction	Soil / PAHs	Extraction Vials, Analytical Balance, Microwave	N
SOP-A10	Preparation of soil for volatile analysis by EPA SW-846 Method 5035 and Method 5035A Eurofins Lancaster Laboratories Environmental LLC.	N/A - Extraction	Soil / VOCs	Encore or equivalent sampling devise	N

Worksheet #23 (continued)

	T-VOA-WI11170, Revision 20 04/09/2021				
SOP-A11	PCBs in solid sample by 8082A using GC-ECD Eurofins Lancaster Laboratories Environmental LLC. T-PEST-WI10004, Revision 10 03/20/2021	Definitive	Soil / PCBs	GC-ECD	N

Worksheet #24: Analytical Instrument Calibration
(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

Refer to the SOPs cited below for analytical instrument calibration information. All analytical instruments used in the laboratory are the responsibility of Eurofins Frontier, Eurofins Calscience, or Eurofins Lancaster and the laboratory analyst performing the analysis. Calibration details are provided in the SOPs in Appendix B.

Instrument	Title / position responsible for Corrective Action	SOP Reference
Inductively Coupled Plasma - Mass Spectrometer (ICP-MS)	Laboratory analyst	SOP-A01, SOP-A06
Gas Chromatograph / Mass Spectrometer (GC/MS)	Laboratory analyst	SOP-A02, SOP-A07, SOP-A08
Centrifuge	Laboratory analyst	SOP-A03
Analytical balance	Laboratory analyst	SOP-A03, SOP-A04, SOP-A05, SOP-A06, SOP-A07, SOP-A08, SOP-A09, SOP-A10
Atomic Fluorescence Spectrophotometer (AFS)	Laboratory analyst	SOP-A04
Gas Chromatograph / Electron Capture Detector (GC-ECD)	Laboratory Analyst	SOP-A11

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

Refer to the Quality Assurance Manuals cited below for the Eurofins Frontier and Eurofins Lancaster laboratories for analytical instrument and equipment maintenance, testing, and inspection information. These manuals are included in Appendix D.

Eurofins Frontier Global Sciences, Quality Manual, Document EFQA-Q-QM-QM5805, Version 6, 01/11/2021

Eurofins Lancaster Laboratories Environmental, Environmental Quality Policy Manual, Document 1-P-QM-GDL-9015377, Version 18, 09/17/20

Worksheet #26 & 27: Sample Handling, Custody, and Disposal
(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Section 2.3.3)

Sampling Organization: EPS

Receiving Laboratory: Eurofins ELLE

Method of sample delivery (shipper/carrier): Courier/FedEx

Number of days from reporting until sample disposal: 60 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	EPS, FTL	SOP-F03
Chain-of-custody form completion	EPS, FTL and QAO	SOP-F03
Packaging	EPS, FTL	SOP-F04
Shipping coordination	EPS, FTL; Eurofins ELLE	SOP-F04
Sample receipt, inspection, & log-in	Eurofins ELLE Eurofins Frontier	Laboratory specifications
Sample custody and storage	Eurofins ELLE Eurofins Frontier	Laboratory specifications
Sample disposal	Eurofins ELLE Eurofins Frontier	Laboratory specifications

Worksheet #28-1: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: TAL metals
Analytical Method (SOP #): EPA Method 6020 (SOP-A01)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Method Blank	1 per prep batch of up to 10 samples	No analytes detected > 1/2 RL or >1/20 the amount measured in any sample	Reanalyze blank to confirm detections. If detects confirm, redigest samples that are not ND or not >20x the blank value.	Laboratory analyst	No analytes detected > 1/2 RL or >1/20 the amount measured in any sample
MS/MSD	1 per prep batch of up to 10 samples	Laboratory Statistical; RPD ≤20%	Analyze post digestion spike and serial dilution	Laboratory analyst	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to 10 samples	Laboratory Statistical; RPD ≤20%	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-digested and reanalyzed.	Laboratory analyst	Results within acceptance limits
Duplicate	1 per prep batch of up to 10 samples	RPD must be ≤20%	Flag data	Laboratory analyst	Results within acceptance limits

Worksheet #28-1 (continued)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Serial Dilutions	Must be prepared with each background sample, evaluated only when analyte concentrations are >50x the MDL	The percent difference must be ≤10%	Flag data	Laboratory analyst	Results within acceptance limits
Post Digestion Spike (PDS)	Prepare with each background sample	± 15% True Value	No specific action needed unless required by the project. PDS is reported in data package	Laboratory analyst	Results within acceptance criteria
Internal Standard	Every sample and QC	6020: Must be 30%-120% for samples, 80-120% for ICV, CCVs, ICB, and CCBs; 30-120% for LLC, ICSA, ICSAB. 6020A/B: 70-130% for samples	Reanalyze at a dilution	Laboratory analyst	Results within acceptance criteria

Worksheet #28-2: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: PAHs
Analytical Method (SOP #): EPA Method 8270C SIM (SOP-A02)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	Laboratory statistical limits	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	Laboratory analyst	Results within acceptance limits
Method blanks	1 per prep batch of up to 10 samples	No analytes detected > RL or >1/10 the amount measured in any sample	Reanalyze to confirm detections. If detects confirm reextract samples that are not ND or not >10x the blank value	Laboratory analyst	No analytes detected > RL or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 10 samples	Laboratory statistical limits, RPD ≤30%	Flag outliers	Laboratory analyst	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to 10 samples	Laboratory statistical limits, RPD ≤30%	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	Laboratory analyst	Results within acceptance limits
Internal standards	Per sample (including MS/MSD, LCS, and blanks)	-50% to +100% of internal standard area of 12 hour STD. RT change ≤30 sec. of associated reference standard	Reanalyze, document if confirmed.	Laboratory analyst	Results within acceptance limits

Worksheet #28-3: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: Total mercury
Analytical Method (SOP #): EPA Method 1631B (SOP-A03 and SOP-A04)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Field duplicate	As required by project. Reference Table A1 and Worksheet #20.	N/A	Flag result and document in case narrative.	QAO	≤ 20% RPD
MS/MSD	As required by project. Reference Table A1 and Worksheet #20.	71-125% Recovery, <24% RPD	Analyze post-digestion/post-distillation spike. If necessary, re-digest the sample batch.	Laboratory analyst	Laboratory control limits.
Method blank	3 per batch	N/A	Re-prep and reanalyze the method blank and all samples processed with the contaminated blank.	Laboratory analyst	No analytes detected greater than ½ RL, 1/10 the amount measured in any sample, whichever is greater.
LCS	One per preparatory batch, up to 20 samples	75-125% Recovery, RSD<24%	Correct problem, re-prep and reanalyze LCS and all samples in associated batch for failed analytes. If problem persists, call PM.	Laboratory analyst	All analytes in samples found to be within ± 20% of the PAL's on Worksheet #15 MUST pass method/SOP criteria.

Worksheet #28-4: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: Percent solids
Analytical Method (SOP): Method SM2540B (SOP-A05)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Field duplicate	As required by project. Reference Table A1 and Worksheet #20.	N/A	Flag result and document in case narrative.	QAO	≤ 20% RPD

Worksheet #28-5: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: VOCs
Analytical Method (SOP): Method 8260C (SOP-A07)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	Laboratory statistical limits	If obvious matrix interference report data with a comment. Otherwise, re-analyze.	Laboratory analyst	Results within acceptance limits
Method blanks	1 per prep batch of up to 10 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample	Reanalyze to confirm detections. If detects confirm reanalyze samples that are not ND or not >10x the blank value	Laboratory analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 10 samples	Laboratory statistical limits; RPD ≤30%	Flag outliers	Laboratory analyst	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to10 samples	Laboratory statistical limits; RPD ≤30%	Analytes in the LCS that fail high and are ND in the samples can be reported. For all others reanalyze LCS and samples. If it still fails, perform instrument maintenance, restart the tune period and	Laboratory analyst	Results within acceptance limits

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
			reanalyze all QC and samples.		
Internal standards	Per sample (including MS/MSD, LCS, and blanks)	Peak areas within -50% to + 100% of the area in the associated reference standard. RT within 30 seconds of RT for associated reference standard	Check the instrument for possible problems and then reanalyze samples. If reinject confirms, report with a comment.	Laboratory analyst	Results within acceptance limits

Worksheet #28-6: Analytical Quality Control and Corrective Action (UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil
Analytical Group: PCBs
Analytical Method (SOP): Method 8082A (SOP-A11)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	Laboratory statistical limits	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	Laboratory analyst	Results within acceptance limits
Method blanks	1 per prep batch of up to 10 samples	No analytes detected > RL or >1/10 the amount measured in any sample	Reanalyze to confirm detections. If detects confirm reextract samples that are not ND or not >10x the blank value	Laboratory analyst	No analytes detected > RL or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 10 samples	Laboratory statistical limits	Flag outliers	Laboratory analyst	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to 10 samples	Laboratory statistical limits	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	Laboratory analyst	Results within acceptance limits

Worksheet #29: Project Documents and Records
(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Field logbook or data collection sheets	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Chain-of-Custody Forms	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Air Bills	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Contractor Daily QC Reports	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Deviations	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Corrective Action Reports	FTL (Joe Terry)	PM (Kirk Kessler)	File server at EPS
Correspondence	FTL (Joe Terry)	PM (Kirk Kessler)	File server at EPS
Project Assessments			
Record	**Generation**	**Verification**	**Storage location/archival**
Field audit checklists	FTL (Joe Terry)	QAO (Timmerly Bullman)	File server at EPS
Data verification checklists	QAO (Timmerly Bullman)	PM (Kirk Kessler)	File server at EPS
Data validation report	QAO (Timmerly Bullman)	PM (Kirk Kessler)	File server at EPS
Data usability assessment report	QAO (Timmerly Bullman)	PM (Kirk Kessler)	File server at EPS
Laboratory Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Analytical data	Eurofins ELLE and Eurofins Frontier (Laboratory Technician)	Eurofins PM (Natalie Luciano)	File server at Eurofins and Frontier

Laboratory Data Deliverables						
Record	**TAL Metals**	**PAHs**	**Total Hg**	**VOCs**	**PCB Aroclors**	**% Solids**
Narrative	X	X	X	X	X	X
COC	X	X	X	X	X	X
Summary Results	X	X	X	X	X	X
QC Results	X	X	X	X	X	X
Prep Sheets & Raw Instrument Data	X	X	X	X	X	X

Worksheets #31, 32 & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA 2106-G-05 Section 2.4 and 2.5.5)

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Field audit checklists	FTL (EPS)	Once	TBD	Checklist	TBD
Data verification checklists	QAO (EPS)	Once	TBD	Checklist	TBD
Data validation report	QAO (EPS)	Once	TBD	Checklist	TBD
Data usability assessment report	QAO (EPS)	Once	TBD	Checklist	TBD
Laboratory Technical System Audit (TSA)	Laboratory QA Manager	As needed	TBD	Analytical TSA Memorandum and Checklist	TBD

TBD: To be determined, subject to field activity and data collection dates.

Worksheet #34: Data Verification and Validation Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	X
2	Field SOPs	X	
3	Laboratory SOPs	X	
Field Records			
4	Field logbooks	X	
5	Equipment calibration records	X	X
6	Chain-of-Custody Forms	X	X
7	Change orders/deviations	X	
8	Field audit reports	X	
9	Field corrective action reports	X	
Analytical Data Package			
10	Cover sheet (laboratory identifying information)	X	
11	Case narrative	X	
12	Internal laboratory chain-of-custody	X	X
13	Sample receipt records	X	X
14	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
15	Communication records	X	X
16	Project-specific PT sample results		
17	MDL / RL establishment and verification	X	X
18	Standards Traceability	X	X
19	Instrument calibration records	X	X
20	Definition of laboratory qualifiers	X	X
21	Results reporting forms	X	X
22	QC sample results	X	X
23	Corrective action reports	X	
24	Raw data	X	
25	Electronic data deliverable	X	X

Worksheet #35: Data Verification Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook	QAPP, SOP-F01	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Daily – FTL or QAO At conclusion of field activities – QAO
Chain-of-custody forms	QAPP, SOP-F03	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD), if applicable. Verify that all required signatures and dates are present. Check for transcription errors.	Daily – FTL or QAO At conclusion of field activities –QAO
Laboratory Deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the COCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – LPM Upon receipt – QAO

Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Data Validator: Validata, LLC

	TAL metals	PAHs	Total mercury	VOCs	PCB Aroclors
Analytical Method:	Method 6020	Method 8270C SIM	Method 1631B	Method 8260C	Method 8082A
Matrix:	Soil	Soil	Soil	Soil	Soil
Data deliverable requirements:	Full package	Full package	Full package	Full package	Full package
Analytical specifications:	Worksheet #28-1; SOP-A01	Worksheet #28-2; SOP-A02	Worksheet #28-3; SOP-A03 and SOP-A04	Worksheet #28-7; SOP-A18	Worksheet #28-8; SOP-A22
Measurement performance criteria:	Worksheet #12-1	Worksheet #12-2	Worksheet #12-3	Worksheet #12-4	Worksheet #12-5
Percent of data packages to be validated:	100%	100%	100%	100%	100%
Percent of raw data reviewed:	0%	0%	0%	0%	0%
Percent of results to be recalculated:	0%	0%	0%	0%	0%
Validation procedure[hh]:	Superfund CLP National Functional Guidelines for Data Review	Superfund CLP National Functional Guidelines for Data Review	Superfund CLP National Functional Guidelines for Data Review	Superfund CLP National Functional Guidelines for Data Review	Superfund CLP National Functional Guidelines for Data Review
Validation code[ii]:	S3VM	S3VM	S3VM	S3VM	S3VM
Electronic validation program/version:	N/A	N/A	N/A	N/A	N/A

Glossary of Qualifier Used in Validation:
U = The analyte was analyzed for, but was not detected above the level of the associated value. The associated value is raised to the reporting limit for inorganics analyses.
J = The associated value is an estimated quantity.
R = The data are unusable. Analyte may or may not be present in the sample.
UJ = The analyte was analyzed for, but not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.

[hh] https://www.epa.gov/clp/superfund-clp-national-functional-guidelines-data-review (The lab is not required to provide formal CLP forms; however, they must provide "CLP-like" data as described on Worksheet #29 and Worksheet #34)
[ii] S3VM – Stage 3 Validation Manual

Worksheet #37: Data Usability Assessment
(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:

PM: Kirk Kessler, EPS
QAO: Timmerly Bullman, EPS
FTL: Joe Terry, EPS

Describe how the usability assessment will be documented: The summary report for the soil characterization will discuss the usability assessment.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data: The data will be evaluated using database queries and GIS applications.

Step 1	**Review the project's objectives and sampling design** *Review the key outputs defined during systematic planning to make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps.*
Step 2	**Review the data verification and data validation outputs** *Review available QA reports, including the data verification and data validation reports. Perform basic calculations and summarize the data (using graphs, maps, tables, etc.). Look for patterns, trends, and anomalies (i.e., unexpected results). Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, and SOP deviations) and determine their impacts on the data usability. Evaluate implications of unacceptable QC sample results.*
Step 3	**Document data usability and draw conclusions** *Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and identify limitations on data use. Prepare the data usability summary to be included in the soil characterization assessment report.*

Tables

Table 1. Sample Locations and Constituents
QAPP for Operable Unit 2 Site Characterization
LCP Chemicals Site
Brunswick, Georgia

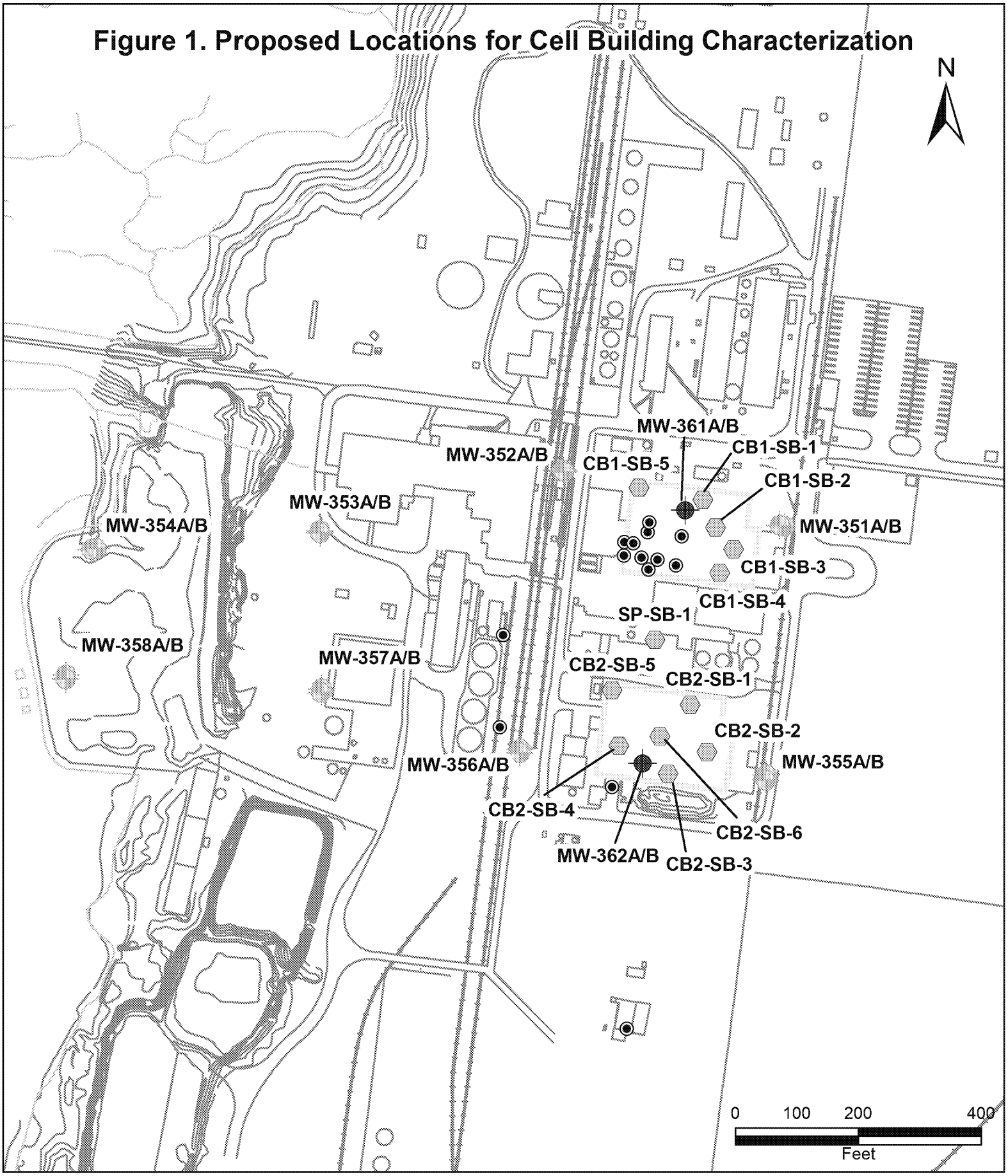
Location	Total Mercury	TAL Metals	PAHs	Mercury fractions (F-0 thru F-5)	Methyl Mercury	% Solids	Elemental Mercury	Total Dissolved Solids	Silica	Total Organic Carbon	Ferrous Iron	Sulfate	Sulfide	Chloride
Soil Characterization														
CB1-SB-1	13	≤ 2	≥ 2			±17								
CB1-SB-2	13	≤ 2	≥ 2			±17								
CB1-SB-3	13	≤ 2	≥ 2			±17								
CB1-SB-4	13	≤ 2	≥ 2			±17								
CB1-SB-5	13	≤ 2	≥ 2			±17								
CB2-SB-1	13	≤ 2	≥ 2			±17								
CB2-SB-2	13	≤ 2	≥ 2			±17								
CB2-SB-3	13	≤ 2	≥ 2			±17								
CB2-SB-4	13	≤ 2	≥ 2			±17								
CB2-SB-5	13	≤ 2	≥ 2			±17								
CB2-SB-6	13	≤ 2	≥ 2			±17								
SP-SB-1	13	≤ 2	≥ 2			±17								
Mercury Kd Study (Soil)														
MW-361A	1			1	1	1								
MW-361B	1			1	1	1								
MW-362A	1			1	1	1								
MW-362B	1			1	1	1								
Duplicate	1			1	1	1								
Mercury Kd Study (Groundwater)														
MW-361A	1				1		1							
MW-361B	1				1		1							
MW-361A	1				1		1							
MW-361B	1				1		1							
Duplicate	1				1		1							
CBP Profiling (Groundwater)														
CB1-GW-1	3							3	3					
CB1-GW-2	3							3	3					
CB1-GW-3	3							3	3					
CB1-GW-4	3							3	3					
CB1-GW-5	3							3	3					
CB2-GW-1	3							3	3					
CB2-GW-2	3							3	3					
CB2-GW-3	3							3	3					
CB2-GW-4	3							3	3					
CB2-GW-5	3							3	3					
CB2-GW-6	3							3	3					
SP-GW-1	3							3	3					
Additional Groundwater Sampling														
MW-351A									1	1	1	1	1	1
MW-351B									1	1	1	1	1	1
MW-352A									1	1	1	1	1	1
MW-352B									1	1	1	1	1	1
MW-353A									1	1	1	1	1	1
MW-353B									1	1	1	1	1	1
MW-354A									1	1	1	1	1	1
MW-354B									1	1	1	1	1	1
MW-355A									1	1	1	1	1	1
MW-355B									1	1	1	1	1	1
MW-356A									1	1	1	1	1	1
MW-356B									1	1	1	1	1	1
MW-357A									1	1	1	1	1	1
MW-357B									1	1	1	1	1	1
MW-358A									1	1	1	1	1	1
MW-358B									1	1	1	1	1	1
MW-361A									1	1	1	1	1	1
MW-361B									1	1	1	1	1	1
MW-362A									1	1	1	1	1	1
MW-362B									1	1	1	1	1	1
MW-506A					1									
MW-506B					1									
MW-507A					1									
MW-507B					1									

Table A1. CBA Surface Soil Locations and Constituents
QAPP for Operable Unit 2 Site Characterization
LCP Chemicals Site
Brunswick, Georgia

Location	Total Mercury	TAL Metals	SVOCs	VOCs	PCB Aroclors	% Solids
Soil Characterization						
SB-500	1	1	1	1	1	1
SB-501	1	1	1	1	1	1
SB-502	1	1	1	1	1	1
SB-503	1	1	1	1	1	1
SB-504	1	1	1	1	1	1
SB-505	1	1	1	1	1	1
SB-506	1	1	1	1	1	1
SB-507	1	1	1	1	1	1
SB-508	1	1	1	1	1	1
SB-509	1	1	1	1	1	1
SB-510	1	1	1	1	1	1
SB-511	1	1	1	1	1	1

Figures

Figure 1. Proposed Locations for Cell Building Characterization



Dec '96-Jan '97 Deep Soil Coring Program

Cell Building Outlines

Existing Groundwater Monitoring Wells

Proposed 2018 Monitoring Well Locations

Proposed 2018 Boring Locations

Proposed Sample Locations

Est. Soil Cover Thickness Contours

- 0
- 0.5 ft
- 1 ft
- 1.5 ft
- 2 ft
- CBA Risk Evaluation Area
- Cell Building Outlines

Estimated Soil Cover Thickness

- < 0.5 ft
- 0.5 - 0.75 ft
- 0.75 - 1 ft
- 1 - 1.25 ft
- 1.25 - 1.5 ft
- 1.5 - 1.75 ft
- 1.75 - 2 ft
- 2 - 2.25 ft
- 2.25 - 2.5 ft
- > 2.5 ft

Proposed Surface Soil Sample Locations
LCP Chemicals Site
Brunswick, GA

MONTROSE ENVIRONMENTAL

Figure No. A1

Appendix A

Field SOPs

Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Groundwater Level and Well Depth Measurement	ID: LSASDPROC-105-R4
Issuing Authority: LSASD Field Branch Chief	
Effective Date: May 15, 2020	Review Date: May 15, 2024

Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when determining water levels and depths of wells.

Scope/Application

The procedures contained in this document are to be used by field investigators to measure water levels and depths of wells. On the occasion that LSASD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used for water level or depth determination, the variant procedure(s) will be documented in the field log book and the subsequent investigation report, along with a description of the circumstances requiring its use

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1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD Local Area Network. The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.2 General Precautions

1.2.1 Safety

Proper safety precautions must be observed when measuring water levels in wells and determining their depths. Refer to the LSASD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.2.2 Procedural Precautions

The following precautions should be considered when measuring water levels and depths of wells:

- Special care must be taken to minimize the risk of cross-contamination between wells when conducting water level and depth measurements. This is accomplished primarily by decontaminating the sounders or other measuring devices between wells, according to LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, (LSASDPROC-205) and maintaining the sounders in clean environment while in transit between wells.
- Water levels and well depths measured according to these procedures should be recorded in a bound logbook dedicated to the project as per LSASD Operating Procedure for Logbooks (LSASDPROC-010). Serial numbers, property numbers or other unique identification for the water level indicator or sounder must also be recorded.

2 Quality Control Issues

There are several specific quality control issues pertinent to conducting water level and depth measurements at wells. These are:

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- Devices used to measure groundwater levels should be verified annually against a National Institute of Standards and Technology (NIST) traceable measuring tape. These devices should check to within 0.01 feet per 10 feet of length with an allowable error of 0.03 feet in the first 30 feet. Before each use, these devices should be prepared according to the manufacturer's instructions (if appropriate) and checked for obvious damage. All verification and maintenance data should be documented electronically or recorded in a logbook maintained at the Field Equipment Center (FEC) as per the LSASD Operating Procedure for Equipment Inventory and Management (LSASDPROC-108). The functional check and tape length verification should be performed according to the instructions included in LSASDFORM-043, *Well Sounder Function Check and Verification,* which also includes the form for recording the required information.

- These devices should be decontaminated according to the procedures specified in LSASD Operating Procedure for Field Equipment Cleaning and Decontamination (LSASDPROC-205) prior to use at the next well.

3 Water Level and Depth Measurement Procedures

3.1 General

The measurement of the groundwater level in a well is frequently conducted in conjunction with ground water sampling to determine the phreatic water surface. This potentiometric surface measurement can be used to establish ground water direction and gradients. Groundwater level and well depth measurements are needed to determine the volume of water or drawdown in the well casing for proper purging.

All groundwater level and well depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. This reference point is usually identified by the well installer using a permanent marker for PVC wells, or by notching the top of casing with a chisel for stainless steel wells. By convention, this marking is usually placed on the north side of the top of casing. If no mark is apparent, the person performing the measurements should take both water level and depth measurements from the north side of the top of casing and note this procedure in the field log book.

To be useful for establishing groundwater gradient, the reference point should be tied in with the NAVD88 (North American Vertical Datum of 1988) or a local datum. For an isolated group of wells, it is acceptable to use an arbitrary datum common to all wells in that group.

Water levels should be allowed to equilibrate prior to measurement after removing sealing caps. There are no set guidelines and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives.

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3.2 Specific Groundwater Level Measurement Techniques

Measuring the depth to the phreatic ground water surface can be accomplished by the following methods. Method accuracies are noted for each of the specific methods described below.

- Electronic Water Level Indicators – These types of instruments consist of a spool of dual conductor wire, a probe attached to the end and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or audible buzzer attached to the spool will signal contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.

- Other Methods – There are other types of water level indicators and recorders available on the market, such as weighted steel tape, chalked tape, sliding float method, air line pressure method and automatic recording methods. These methods are primarily used for closed systems or permanent monitoring wells. Acoustic water level indicators are also available which measure water levels based on the measured return of an emitted acoustical impulse. Accuracies for these methods vary and should be evaluated before selection. Any method not capable of providing measurements to within 0.1 foot should not be used.

3.3 Special Considerations for Water Level Measurements at Sites with Shallow Groundwater Gradient

Groundwater gradients at some sites can be very shallow and if gradient and groundwater flow pattern (gradient direction) determination are part of the project objectives, it is critical that groundwater level measurements obtained from wells are as accurate as possible. Special care should be taken to allow the water level to equilibrate after removing sealing caps and the same sounder should be used for all measurements, if possible. The sounding activity should be coordinated to allow all wells to be sounded within the minimum possible time. This is particularly important in areas with potential tidal influences.

3.4 Total Well Depth Measurement Techniques

The well sounder, weighted tape or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well and sediment in the bottom of the well can also make it difficult to determine total depth. Care must be taken in these situations to ensure accurate measurements. The operator may find it easier to allow the weight to touch bottom and then detect the 'tug' on the tape while lifting the weight off the well bottom. All total depth measurements must be made and recorded to the nearest 0.1 foot. As a cautionary note, when measuring well depths with the electronic water level indicators, the person performing the measurement must measure and add the length of the probe beneath the circuit closing electrodes to the depth measured to obtain the true depth. This is necessary because the tape distance markings are referenced to the electrodes, rather than the end of the probe. For electronic sounders maintained at the LSASD FEC, the sounder reel will be marked with the appropriate additional length identified as the 'TD adder'.

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3.5 Equipment Available

The following equipment is available for ground water level and total depth measurements:

- Weighted steel measuring tapes
- Electronic water level indicators

4 Establishment of Top of Casing Elevations

To establish groundwater surface elevations, the measured distance from the top of casing to the water surface is subtracted from the well top of casing (TOC) elevation. Obtaining accurate TOC elevations is crucial to developing an accurate groundwater surface elevation map and determination of groundwater flow direction.

The only acceptable means of surveying well TOC elevations is differential leveling conducted to third order standards. Third order differential leveling has allowable error defined by the following formula:

$$Allowable\ Error\ (ft) = 0.05 \times \sqrt{Survey\ loop\ length\ (miles)}$$

This work must be conducted with an auto level as the leveling instrument. Surveying TOC elevations with a total station or survey-grade GPS will not provide the requisite accuracy.

When adding wells to a monitoring network, it is permissible to tie the new well elevations to the known TOC elevations of existing wells in the network. The elevations of several wells in the existing network should be checked to assure that the relative differences in elevation match the recorded elevation data.

Generally, the ground surface elevations at each well should be surveyed at the same time.

5 References

LSASD Operating Procedure for Equipment Inventory and Management, LSASDPROC-108, Most Recent Version

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, LSASDPROC-205, Most Recent Version

LSASD Operating Procedure for Logbooks, LSASDPROC-010, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region LSASD, Athens, GA, Most Recent Version

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6 Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the LSASD Document Control Coordinator on the LSASD local area network (LAN).

History	Effective Date
LSASDPROC-105-R4, *Groundwater Level and Well Depth Measurement*, replaces SESDPROC-105-R3 **General:** Corrected any typographical, grammatical, and/or editorial errors. Updated document template and naming convention. Changed references to SESD to LSASD and FSB to ASB due to organizational name changes from Agency re-alignment. Reformatted and updated naming convention.	May 15, 2020
SESDPROC-105-R3, *Groundwater Level and Well Depth Measurement*, replaces SESDPROC-105-R2 **General:** Corrected any typographical, grammatical, and/or editorial errors. **Title Page:** Author changed from Tim Simpson to Brian Striggow. Changed the Field Quality Manager from Bobby Lewis to Hunter Johnson. Updated cover page to represent LSASD reorganization. John Deatrick was not listed as the Chief of the Applied Services Branch **Section 4:** Added section on the Establishment of Well Top of Casing Elevations.	November 3, 2016
SESDPROC-105-R2, *Groundwater Level and Well Depth Measurement*, replaces SESDPROC-105-R1	January 29, 2013
SESDPROC-105-R1, *Groundwater Level and Well Depth Measurement*, replaces SESDPROC-105-R0	November 1, 2007
SESDPROC-105-R0, Groundwater Level and Well Depth Measurement, Original Issue	February 05, 2007

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Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Athens, Georgia	
Operating Procedure	
Title: **Logbooks**	ID: **SESDPROC-1002-R0**
Issuing Authority: Deputy Director, SESD	
Effective Date: October 1, 2017	

Purpose

This procedure is specific to the Region 4 Science and Ecosystem Support Division (SESD) to maintain conformance to technical and quality system requirements. This procedure defines the process for documenting direct observations in logbooks or other record formats related to laboratory analyses, field investigations, or assessments of field sampling processes and laboratory operations of external entities.

Scope/Application

The requirements of this procedure apply to all personnel who perform work under SESD's quality system. This procedure contains requirements for documenting activities related to laboratory analyses, field investigations, or assessments of field sampling processes and laboratory operations of external entities and serves as a supplement to the overarching requirements for SESD records, outlined in the SESD Operating Procedure for Control of Records (SESDPROC-1001). While this SOP may be informative, it is not intended for and may not be directly applicable to operations in other organizations. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

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1.0 Procedure

1.1 General Requirements

General requirements for SESD logbook or other record format entries related to laboratory analyses, field investigations, or assessments of field sampling processes and laboratory operations of external entities:

1. Observations, data and calculations will be recorded at the time they are made.
2. Dedicated bound logbooks will be used.
3. Entries will be legible, containing pertinent, accurate, and inclusive documentation of project activities, free of personal feelings or other terminology which might prove inappropriate.
4. Unless prohibited by environmental conditions, pens with permanent ink will be used to record all data. When environmental conditions do not make it feasible to use permanent ink, entries should be made using a non-smear lead pencil (e.g., 2H or 3H). Upon returning from the field, the project leader will photocopy the penciled section of the logbook and certify, in writing, that the photocopied record is a true copy of the original logbook entry. The photocopy will be included in the project file.
5. Entries in logbooks shall be dated and signed or initialed by staff.
6. Data or other information that has been entered incorrectly shall only be corrected using a single strike-through, date and initials of the person making the correction. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.
7. To demonstrate continuity of the work and maintain the integrity of the data collection process, pages should not be removed from any bound logbook.
8. Blank pages or spaces should not be present in logbooks. Blank areas should be lined through and initialed and dated to prevent the opportunity for back-filling.
9. Logbook pages and books shall be numbered. The numbering format will consist of "page x of y", where "x" is the current page number and "y" is the total number of pages of the logbook.
10. To facilitate accurate and complete documentation of activities, SESD-generated forms may be used. In order to be utilized, SESD-generated forms must be bound prior to use and adhere to all requirements outlined in this procedure. In cases where unbound pages/forms are necessary due to project requirements or practicality, the appropriate Section Chief and System Manager will determine the best course of action.
11. If pre-printed adhesive labels are used in logbooks or bound forms to facilitate organization of information entry, the SESD staff responsible for taking notes will sign the label with the signature beginning on the label and ending on the page of the logbook such that the label cannot be removed without detection.

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1.2 Laboratory Logbooks

The following are requirements for laboratory logbooks, in addition to those established in Section 1.1. Each sample preparation, analysis or equipment check is maintained using logbooks in the appropriate laboratory. Active logbooks are maintained within the laboratory where the instrument or equipment is located and should be maintained with the instrument throughout its useful life. At such time the instrument is removed from service, the logbook is transferred with the appropriate form to the LQM, and then to the SESD Records Room.

1.2.1 Instrument Maintenance Logbooks

Each major instrument shall have a maintenance logbook. At a minimum the following information will be included:

1. Instrument serial number
2. Instrument's unique name
3. Software version
4. In-service date (if known)

In addition, maintenance, service and repair records are maintained in these logbooks. Preventive maintenance schedules should be noted in the log, or in a separate maintenance log. When a service or maintenance call is completed by the vendor, the analyst should place a copy of the documentation or transcribe the details for the work that was performed on the instrument in the logbook. The original work order invoice should be provided to the Office of Program Support for payment. Instrument Maintenance logbooks are purchased as bound record books that contain pre-numbered pages. The numbering convention does not account for the number of pages per book.

1.2.2 Instrument Logbooks

Instrument logs shall include:

1. Instrument serial number
2. Date of analysis
3. Analyst and samples which have been analyzed
4. A reference or a record of which options or analytical conditions were used for analysis
5. Where appropriate, instrument acceptance criteria (e.g., tune criteria, sensitivity checks)

1.2.3 Preparation Logbooks

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Preparation logs shall document all information to reconstruct the preparation of samples, reagents, and standards, and should include, but not limited to:

1. Analyst's name
2. Weights
3. Volumes
4. Lot number of digestion tubes
5. ID of any preparation equipment used
6. Certification dates of equipment, if applicable
7. Reagents/standards used
8. Preservation checks
9. Units
10. Any cleanup procedures used
11. Project Number/Name and Workorder Number will be included on each page.

Electronic traceability via Element® is an acceptable option for documenting standard preparation. If Element® is used as the standard prep log, it is subject to all the requirements of this section.

1.2.4 Analysis Logbooks

Electronic records, including spreadsheets which contain original measurements, may be used to create logbooks if all the required information can be captured by the instrumental software; however, a sequential analysis log must still be created and maintained. This is accomplished by printing a copy of the electronic record and including it in a notebook. These sequential logs must also include failed runs, or sequences which were abandoned prior to completion. When a pre-determined number of pages has been accumulated (e.g., 50 pages), the individual records are combined into a single bound logbook and retained as specified in the SESD Operating Procedure for Records Management (SESDPROC-1001). Any electronic records must accurately reflect actual analytical information. For analyses with holding times < 72 hours, or when time-critical or method-specified times are included in the analysis, the time of analysis must also be recorded.

1.2.5 Laboratory Equipment Logbooks

Equipment Logbooks, such as balance logs, are maintained in the lab in close proximity to the equipment. At a minimum the following information must be included:

1. Equipment serial number
2. Equipment unique name
3. Vendor name
4. In-service date (if known)

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In addition, calibration check, maintenance, service and repair information may also be recorded and/or maintained in the logbook.

1.3 Field Operation Logbooks

The following are requirements for field logbooks, in addition to those established in Section **1.1**

1.3.1 General Information Required in All Field Operations Logbooks

The following information shall be included either on the front cover or the first page of all field logbooks:

1. Project name
2. Project location
3. Project identification number
4. Project leader (full name)
5. Sample team leader (full name) and initials
6. Sample team member(s) (full names) and initials

In addition, the project's unique identifier (unique identification number(s)) will be included on each page.

Any deviations from the quality assurance project plan (QAPP) that occur while in the field shall be noted in the logbook(s). Field logbook entries that may be considered privileged or confidential information shall be handled in accordance with the relevant sections of SESD Operating Procedure for Control of Records (SESDPROC-1001). The logbooks will be placed in the SESD project file upon transmittal of the final report to the project requestor.

1.3.2 Information Required for Sample Collection

In addition to previously listed requirements, the following information will be included in all field logbooks when **samples** are collected:

1. Applicable SESD Operating Procedures for field sampling.
2. Date and time of collection.
3. Station identification, including GPS coordinates (non-logging GPS units), if applicable.
4. Sample identification.
5. Method of collection.
6. Number and type of containers (describe, as needed).
7. Sample collection equipment.

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8. SESD equipment identification number, if applicable.
9. Matrix sampled.
10. Physical description of sample.
11. Sample team member duties (calibration, collection, deployment, etc.).
12. Sample preservation method (e.g., indirect contact with ice), if applicable.
13. Environmental conditions such as rain, wind, smoke, dust, extreme temperature, etc., which may adversely impact quality of samples, if applicable.
14. Location of electronic data file backups, if applicable.
15. Monitoring of condition of ice in coolers or sampler, if applicable.
16. Date and time of sample arrival to SESD. Storage room for samples, even if it is for initial, temporary purposes.
17. Sample team member duties (e.g., calibration, equipment deployment, collection, sample preservation, sample preservation monitoring, etc.).
18. Other pertinent information.

1.3.3 Information Required for Field Measurements

In addition to previously listed requirements, the following information will be included in all logbooks when **measurements** are conducted:

1. Applicable SESD Operating Procedures for field measurement.
2. Date and time of measurement or instrument/equipment deployment.
3. Sample identification, if appropriate.
4. Station identification, including GPS coordinates (non-logging GPS units), if applicable.
5. Sample measurement equipment.
6. SESD sample measurement equipment identification number.
7. Manufacturer name, lot number and expiration date of all pH buffers and chemical standards.*
8. Calibration information, including before and after calibration readings.*
9. Meter and check information.
10. Equipment deployment depth and total depth, if applicable.
11. Pinger identification number and frequency for deployed equipment, if applicable.
12. Date and time of retrieval for deployed equipment, if applicable.
13. Matrix measured.
14. Physical description of matrix.
15. Measurement values for non-logging equipment.
16. Ambient air temperature, where applicable.

17. Environmental conditions that may adversely impact quality of measurement (e.g., rain, wind, smoke, dust, extreme temperatures), if applicable.
18. Equipment or instrument maintenance performed, if applicable.
19. Meter malfunctions, troubleshooting efforts and final status, if applicable.
20. Location of electronic data file backups, if applicable.
21. Measurement team member duties (e.g., calibration, equipment deployment, measurement, maintenance, troubleshooting, etc.).
22. Other pertinent information.

* Entry of calibration information in logbooks is only required for calibrations conducted in the field. All calibrations conducted at the SESD Field Equipment Center or laboratory will be recorded in the appropriate equipment tracking logbook.

1.3.4 Additional Information for Inclusion in Field Activity Logbooks

The following visual information may be included in field logbooks, as appropriate:

1. Maps/sketches.
2. Photographic or video-graphic log.
3. Process diagrams.

1.4 Quality Assurance Field Documentation

The following are requirements for Quality Assurance (QA) field documentation, in addition to those established in Section 1.1. The following information shall be included either on the front cover or the first page of all QA field documentation:

1. Audit/facility name
2. Audit/facility location
3. Audit leader
4. Audit team members
5. Audit dates
6. Audit Identification Number

In addition to logbooks, QA uses checklists to document audits of methods and procedures during the onsite evaluation of laboratories and facilities. These checklists are printed and/or used electronically to document field observations. These electronic checklists are located on the SESD LAN and updated periodically as changes are needed.

1.5 Other Logbooks and Documentation

Some methods and measurements do not use instrumentation to generate a result. For these methods, SESD relies on spreadsheets or other calculating software for recording/documenting original observations made (e.g., weights). All spreadsheets or other calculating software used as logbooks or used in support of data generation will be validated and controlled. All cells, except informational input cells, will be locked to prevent alteration of a formula or essential static information, such as the unique identifier. All calculations in electronic spreadsheets and calculating software files will be hand-validated by the responsible party and submitted through the Section Chief to the appropriate System Manager for approval and posting. The entire spreadsheet or software-generated electronic file will be password protected, which will be assigned by the System Manager at the time of posting on the LAN.

2.0 Definitions

None

3.0 Related Documents and Forms

U.S. EPA, Region 4, SESD, Analytical Services Branch, Logbook Transfer Form.

4.0 References

U.S. EPA, Region 4, SESD, SESD Field Branches Quality Management Plan, SESDPLAN-001, most recent version.

U.S. EPA, Region 4, SESD, ASB, Laboratory Operations and Quality Assurance Manual, most recent version.

U.S. EPA, Region 4, SESD, Records Management Standard Operating Procedures, most recent version.

U.S. EPA, Region 4, SESD, Quality Management Plan, most recent version.

U.S. EPA, Region 4, SESD, SESD Operating Procedure for Control of Records, SESDPROC-002, most recent version.

ISO/IEC 17025: General Testing for the Competence of Testing and Calibration Laboratories, 2nd Ed., 2005, 05/15/2015, Switzerland.

Uncontrolled When Printed

ANAB, ISO/IEC 17025: Accreditation Requirements for Forensic Testing Laboratories, pp. 49, Document Number MA 3011, Effective Date: 02/02/2015.

5.0 Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-1002-R0, Logbooks, Original Issue	October 1, 2017

ED_006371_00001599-00090

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Groundwater Sampling**

Effective Date: April 26, 2017	**Number:** SESDPROC-301-R4

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-301-R4, Groundwater Sampling, replaces SESDPROC-301-R3. **General:** Corrected any typographical, grammatical, and/or editorial errors. **General:** An extensive rewrite and reorganization of material. Stronger support of low-flow methods while maintaining cautious view of minimal/no purge methods.	April 26, 2017
SESDPROC-301-R3, Groundwater Sampling, replaces SESDPROC-301-R2.	**March 6, 2013**
SESDPROC-301-R2, Groundwater Sampling, replaces SESDPROC-301-R1.	**October 28, 2011**
SESDPROC-301-R1, Groundwater Sampling, replaces SESDPROC-301-R0.	**November 1, 2007**
SESDPROC-301-R0, Groundwater Sampling, Original Issue	**February 05, 2007**

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting groundwater samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling groundwater samples in the field. On the occasion that SESD field personnel determine that any of the procedures described are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a groundwater sample, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

Interstate Technology & Regulatory Council, Technology Overview of Passive Sampler Technologies, Prepared by The Interstate Technology & Regulatory Council Diffusion Sampler Team, March 2006.

Nielsen, David. *Practical Handbook of Environmental Site Characterization and Ground-Water Monitoring*. 2nd ed. Boca Raton, FL: Taylor&Francis, 2006. Print.

Puls, Robert W., and Michael J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analysis. Hazardous Waste and Hazardous Materials 6(4), pp.385-393.

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Puls, Robert W., Don A. Clark, and Bert Bledsoe. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. Hazardous Waste and Hazardous Materials 9(2), pp. 149-162.

SESD Guidance Document, Design and Installation of Monitoring Wells, SESDGUID-001, Most Recent Version

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field pH Measurement, SESDPROC-100, Most Recent Version

SESD Operating Procedure for Field Specific Conductance Measurement, SESDPROC-101, Most Recent Version

SESD Operating Procedure for Field Temperature Measurement, SESDPROC-102, Most Recent Version

SESD Operating Procedure for Field Turbidity Measurement, SESDPROC-103, Most Recent Version

SESD Operating Procedure for Groundwater Level and Well Depth Measurement, SESDPROC-105, Most Recent Version

SESD Operating Procedure for Management of Investigation Derived Waste, SESDROC-202, Most Recent Version

SESD Operating Procedure for Pump Operation, SESDPROC-203, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

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SESD Operating Procedure for Potable Water Supply Sampling, SESDPROC-305, Most Recent Version

United States Environmental Protection Agency (US EPA). 1975. Handbook for Evaluating Water Bacteriological Laboratories. Office of Research and Development (ORD), Municipal Environmental Research Laboratory, Cincinnati, Ohio.

US EPA. 1977. Sampling for Organic Chemicals and Microorganisms in the Subsurface. EPA-600/2-77/176.

US EPA. 1978. Microbiological Methods for Monitoring the Environment, Water and Wastes. ORD, Municipal Environmental Research Laboratory, Cincinnati, Ohio.

US EPA. 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 1995. Ground Water Sampling - A Workshop Summary. Proceedings from the Dallas, Texas November 30 – December 2, 1993 Workshop. ORD, Robert S. Kerr Environmental Research Laboratory. EPA/600/R-94/205, January 1995.

US EPA 1996. Ground Water Issue. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. ORD, Robert W. Puls and Micael Barcelona. EPA/540/S-95/504, April 1996

US EPA. Analytical Services Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

Varljen, M., Barcelona, M., Obereiner, J., & Kaminski, D. (2006). Numerical simulations to assess the monitoring zone achieved during low-flow purging and sampling. *Ground Water Monitoring and Remediation*, 26(1), 44-52.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting groundwater samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. The reader should address chemicals that pose specific toxicity or safety concerns

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and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting groundwater samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Always sample from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location. This minimizes the opportunity for cross-contamination to occur during sampling.
- Collected samples must remain in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done legibly, completely, and neatly in a bound logbook.

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2 Special Sampling Considerations

2.1 Volatile Organic Compounds (VOC) Analysis

Groundwater samples for VOC analysis must be collected in 40 ml glass vials with Teflon® septa. The vial may be either pre-preserved with concentrated hydrochloric acid or they may be unpreserved. Preserved samples have a two-week holding time, whereas unpreserved samples have only a seven-day holding time. In the majority of cases, the preserved vials are used to take advantage of the extended holding time. In some situations, however, it may be necessary to use the unpreserved vials. For example, if the groundwater has a high amount of dissolved limestone, i.e., is highly calcareous, there will likely be an effervescent reaction between the hydrochloric acid and the water, producing large numbers of fine bubbles and rendering the sample unacceptable. In this case, unpreserved vials should be used and arrangements confirmed with the laboratory to ensure that they can accept the unpreserved vials and meet the shorter sample holding times.

The samples should be collected with as little agitation or disturbance as possible. The vial should be filled so that there is a meniscus at the top of the vial and no bubbles or headspace should be present in the vial after it is capped. After the cap is securely tightened, the vial should be inverted and tapped on the palm or knuckle to check if any undetected bubbles are dislodged. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken not to flush any preservative out of the vial during topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected. While the 8260 method allows for bubbles up to 6 mm at the time of analysis, dissolved or entrained gases can coalesce during shipment. Collecting VOC vials absent of bubbles is generally feasible and is a reasonable precaution.

2.2 Special Precautions for Trace Contaminant Groundwater Sampling

- Sampling equipment must be constructed of Teflon® or stainless steel materials. Bailers and pumps should be of Teflon® and stainless steel construction throughout.
- New Teflon® tubing should be used at each well, although tubing dedicated to a particular well may be reused, either after decontamination or storage in the well between sampling events. Caution is appropriate in reusing tubing where early sampling events report high concentrations of contaminants.
- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.

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- Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if purging and sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same cooler as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Clean plastic sheeting will be placed on the ground at each sample location to prevent or minimize contaminating sampling equipment by accidental contact with the ground surface.
- Samplers must use new, verified certified-clean disposable or non-disposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compound analyses.

2.3 Sample Handling and Preservation Requirements

1. Groundwater samples will typically be collected from the discharge line of a pump or from a bailer. Efforts should be made to reduce the flow from either the pump discharge line or the bailer during sample collection to minimize sample agitation.

2. During sample collection, make sure that the pump discharge line or the bailer does not contact the sample container.

3. Place the sample into appropriate, labeled containers. Samples collected for VOC, and alkalinity analysis must be collected without headspace. All other sample containers must be filled with an allowance for ullage.

4. All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection. If pre-preserved VOC vials are used, these will be preserved with concentrated hydrochloric acid by Analytical Services Branch (ASB) personnel prior to departure for the field investigation. For all other chemical preservatives, SESD will use the appropriate chemical preservative generally stored in an individual single-use vial as described in the SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011). The adequacy of sample preservation will be checked after the addition of the preservative for all samples except for the samples collected for VOC analysis. If additional preservative is needed, it should be added to achieve adequate preservation. Preservation requirements for groundwater samples are found in the USEPA Region 4 Analytical Services Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), most recent version.

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5. Sample containers should be placed in an ice-filled cooler as soon as possible after filling. Ice in coolers should be in bags with minimal pooled water and the cooler should be periodically checked and replenished to maintain sample storage temperature.

2.4 Quality Control

Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by pumps, bailers, tubing, or other sampling equipment.

Where appropriate, a background sample upgradient of all known influences or a control sample upgradient of site influences may be indicated. Background and control samples should be collected as close to the sampled area as possible and from the same water-bearing formation as the site samples.

2.5 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in SESD Operating Procedure for Control of Records, SESDPROC-002. Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation in accordance with SESD Operating Procedure for Logbooks, SESDPROC-010 and SESD Procedure for Sample and Evidence Management, SESDPROC-005.

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3 Groundwater Purging and Sampling

3.1 Overview of Purging and Sampling Strategies

Purging is the process of removing stagnant water from a well, immediately prior to sampling, causing its replacement by groundwater from the adjacent formation that is representative of aquifer conditions. Sampling is the process of obtaining, containerizing, and preserving (when required) a ground water sample after the purging process is complete. There are several approaches to well purging and sampling that may be appropriate in various circumstances or for various combinations of available equipment. They are briefly summarized below and in *Table 1, Purge and Sample Strategies with Equipment Considerations.*

The M**ultiple-Volume Purge** method involves removing a minimum of three well volumes of water from the top of the water column and then sampling when the well has achieved stability of water quality parameters and adequately low turbidity. This is a traditional method and consistent results are generally obtained with samplers of varying skill. A drawback is that large volumes of purge water may be produced for large diameter or deep wells.

The **Low-Flow** method involves purging the well at a relatively low flow rate that minimizes drawdown, with the pump or tubing inlet located within the screened interval of the well. The well is sampled when water quality parameters are stable, adequately low turbidity is achieved, and the water level has achieved a stable drawdown (an unchanging water level). This method is often faster than Multiple-Volume Purge and generates less purge water. The method requires more skill and judgment on the part of the samplers.

The **Multiple-Volume Purge** method and the **Low-Flow** method can be considered equivalent for conventionally screened and filter-packed wells in that they both sample a flow-weighted average of water entering the well during pumping. However, other variables can result in differences between results with the two methods. In repeat sampling events, the sampling design should not change from one method to the other without appropriate cause. The transition should be noted in the report.

Minimum-Purge and **No-Purge** methods are based on the assumption that water within the screened interval of the well is at equilibrium with the water in the surrounding aquifer. This assumption should be carefully considered in the use of these methods and various cautions are discussed in sections below. The minimal-purge and no-purge methods are most useful for long-term monitoring and are generally inappropriate for the early stages of investigation. In some cases the methods might be used to gather screening-level data from wells that are too large to practically purge or have other sampling complications.

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The **Minimum-Purge** and **No-Purge** methods collect water in the vicinity of the device under near-static conditions and are not equivalent to the multiple-volume purge and Low-Flow methods. Stratification of horizontal flow or vertical flow conditions within the well can result in non-intuitive and deceptive results. A comparison study should be conducted before transitioning a sampling program to the minimal-purge or no-purge methods.

3.2 Purging

Wells are purged to eliminate stagnant water residing in the casing and/or screen that has undergone geochemical changes or loss of VOCs. At the conclusion of purging, the desired flow-weighted average of water entering the well under pumping conditions will be available for sampling. Turbidity is often elevated during purging by the disturbance of formation materials at the borehole walls. As many contaminants (metals and many organics) will sorb to the formation particles, a sample including these particles will not represent the dissolved concentrations of the contaminants. Thus, a secondary goal of purging is to reduce the turbidity to the point that the sample will represent the dissolved concentration of contaminants.

In order to determine when a well has been adequately purged, field investigators should monitor, at a minimum, the pH, specific conductance and turbidity of the groundwater removed and the volume of water removed during purging. The measurements should be recorded in a purge table in the field logbook that includes the start time of purging, the parameter measurements at intervals during purging, estimated pumped volumes, depths to water for Low-Flow sampling, and any notes of unusual conditions. A typical purge table used for Low-Flow sampling is reproduced below.

Continuation of sample GW65-0713

INITIAL 22.33ft

TIME	pH (S.U.s)	Spec. Cond. (us/cm)	Temp. (Deg. C)	D.O. (mg/L)	D.O. (% sat.)	ORP (mV)	Turbidity (NTUs)	Water Level (Ft.)	Purge Vol. (gallons)
0930								Pump On	
0935	5.71	1065	19.6	0.77	8.7	43.9	210	24.83	1/4
1004	5.64	988	20.0	0.36	3.9	222.5	17.8	25.22	2
1026	5.63	959	20.5	0.25	2.7	98	9.95	25.18	3 1/2
1038	5.62	950	20.5	0.21	2.4	75	9.85	25.18	4
1046	5.61	946	20.8	0.21	2.4	73	6.07	25.18	4 1/2
1047								Sample Collection Time	

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3.3 Parameter Stabilization Criteria

With respect to the ground water chemistry, an adequate purge is achieved when the pH and specific conductance of the ground water have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs) (twice the Secondary Drinking Water Standard of 5 NTUs).

Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU) and specific conductance varies no more than 5 percent. Other parameters, such as dissolved oxygen (DO) or oxidation-reduction potential (ORP), may also be used as a purge adequacy parameter. Normal stability goals for DO are 0.2 mg/L or 10% change in saturation, whichever is greater. DO and ORP measurements must be conducted using either a flow-through cell or an over-topping cell to minimize oxygenation of the sample during measurement. A reasonable ORP stability goal is a range of 20 mV, although ORP is rarely at equilibrium in environmental media and often will not demonstrate enough stability to be used as a purge stabilization parameter. Determining the frequency of measurements has generally been left to 'Best Professional Judgement'. Care is in order, as measurements recorded at frequent intervals with low flow rates can falsely indicate stability of parameters. Several measurements should be made early in the well purge to establish the direction and magnitude of trends, which can then inform the stability decision. Stability parameters should either be not trending, or approaching an asymptote, when a stability determination is made. As a matter of practice, parameter measurements are generally made at 5-10 minute intervals.

Because the measured groundwater temperature during purging is subject to changes related to surface ambient conditions and pumping rates, its usefulness is subject to question for the purpose of determining parameter stability. As such, it has been removed from SESD's list of parameters used for stability determination. Even though temperature is not used to determine stability, it is still advisable to record the temperature of purge water as it is often used in the interpretation of other parameters.

Information on conducting the stability parameter measurements is available in the SESD Operating Procedures for Field pH Measurement (SESDPROC-100), Field Specific Conductance Measurement (SESDPROC-101), Field Temperature Measurement (SESDPROC-102), Field Turbidity Measurement (SESDPROC-103), Field Measurement of Dissolved Oxygen (SESDPROC-106) and Field Measurement of Oxidation-Reduction Potential (SESDPROC-113).

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Table 1, Purge and Sample Strategies with Equipment Considerations

Purging Strategy	Purge Eqpt	Sample Eqpt	Comments
Multi-Volume Purge	----------	----------	Overall Method Comments- Advantages: Consistent results can be achieved with minimal skill level required. Common, simple equipment can be used. Disadvantages: Can result in large volumes of purge water. Can take extended periods of time with large diameter wells or long water columns.
In this traditional method, 3-5 well volumes of water are removed from the top of the water column while verifying the stability of water quality parameters. Following the well purge, the well is sampled from the top of the water column.	Bailer	Bailer	Bailers are rarely used for purging due to the effort required, the difficulty of lowering turbidity adequately, and the possibility of aerating the upper water column.
	Electric Submersible Pump	Bailer	Common multiple-volume setup when depth to water exceeds 25 feet. Abbreviated pump decontamination procedure can be used between wells.
	Electric Submersible Pump	Electric Submersible Pump	Requires full pump decontamination and new tubing at each well. In most cases the pump would be deployed to the screened interval instead to perform Low-Flow sampling.
	Peristaltic Pump	Peristaltic Pump	Common, multi-volume setup when depth to water is less than 25 feet. Special sampling techniques are required for the collection of SVOCs and VOCs.
Low-Flow methods	----------	----------	Overall Method Comments- Advantages: Lower volumes of purge water. May be faster, especially with longer water columns. Disadvantages: Requires greater skill for consistent results. Higher tubing costs than multi-volume method.
The pump or tubing inlet is placed within the screened interval and the well is purged to stable water quality parameters while maintaining stable drawdown of the water level.	Electric Submersible Pump	Electric Submersible Pump	Commonly used when depth to water exceeds 25 feet. Pump is cleaned to sample equipment standards prior to sampling each well and new or dedicated tubing used for each well. Concerns have been raised concerning VOC loss from agitation in the turbine section or from sample heating.
	Peristaltic Pump	Peristaltic Pump	Commonly used where depth to water is less than 25 feet. Special sampling techniques required for the collection of SVOCs and VOCs. Concerns have been raised concerning VOC loss from vacuum created in sample tubing.
	Bladder Pump	Bladder Pump	Least danger of VOC loss as entire sample train is under positive pressure and little sample heating occurs. Difficult to remove large volumes of water in reasonable time. Mild surging effect may keep turbidity elevated in sensitive wells.
Minimum-Purge, No-Purge Methods	----------	----------	Overall Method Comments- Advantages: Very little or no waste water. Well suited to repeat sampling events. Likely faster with lower costs. Disadvantages: Not directly equivalent to other methods. Vertical stratification or vertical flow conditions in the screened interval can result in deceptive or non-intuitive analytical results.
Predicated on the assumption that aquifer flow through the well maintains the water in the screened interval in a state equivalent to that in the aquifer. This assumption should be proven or the data qualified. Sampling is conducted with little or no purge, or by equilibrating a sampler in screened interval.	Pumps, various	Pumps, various	In the minimum-purge method, the internal volume of the sample tubing and pump is calculated. One volume of the pump and tubing is purged to flush the equipment and the well is then sampled.
	na	Passive Diffusion Bags	In most common form, a sealed water-filled polyethylene bag is allowed to equilibrate in the water column. Suitable primarily for VOCs. Generally require 2 week minimum in-situ residence time.
	na	Hydrasleeves	Collect a fixed volume of water from a specific interval. Requires duplicate samplers or redeployment for larger volumes. Sorbtion issues may bias results.
	na	Snap sampler	Deploys a sample container in the sampling interval where it is allowed to equilibrate (commonly for two weeks) before being sealed insitu by the sampler mechanism and retrieved. Limited to specific containers.

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3.4 Multiple-Volume Purge

In the traditional Multiple-Volume Purge method, water is removed from the top of the water column, causing water to enter the screen and flush stagnant casing water upward to be subsequently removed. In recognition of the mixing of fresh and stagnant water in the casing section, a minimum of three well volumes is removed, at which time purging can be terminated upon parameter stabilization. Wells can be assumed to be adequately purged when five well volumes have been removed, although further purging may be conducted to meet specific goals, such as further reduction of turbidity.

3.4.1 Purge Volume Determination

Prior to initiating the purge, the amount of water standing in the water column (water inside the well riser and screen) should be determined The diameter of the well is determined and the water level and total depth of the well measured and recorded prior to inserting a pump or tubing into the well. The water level is subtracted from the total depth, providing the length of the water column. Specific methodology for obtaining these measurements is found in SESD Operating Procedure for Groundwater Level and Well Depth Measurement (SESDPROC-105).

Once this information is obtained, the volume of water to be purged can be determined using one of several methods. The well volume can be calculated using the equation:

$$V = 0.041\ d^2h$$

Where:
h = length of water column in feet
d = diameter of well in inches
V = one well volume in gallons

Alternatively, the volume of standing water in the well and the volume of three water columns may be determined using a casing volume per foot factor for the appropriate diameter well, such as *Table 2 Well Casing Diameter Volume Factors*. The water column length is multiplied by the appropriate factor in the Table 2 to determine the single well volume, three well volumes, or five well volumes for the well in question. Other acceptable methods include the use of nomographs or other equations or formulae.

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TABLE 2, WELL CASING DIAMETER VOLUME FACTORS

Well Casing Diameter (in)	Reference 1 Well Volume (gallons/ft)	Minimum purge 3 Well Volumes (gallons/ft)	Maximum purge* 5 Well Volumes (gallons/ft)
0.5	0.01	0.03	0.05
0.75	0.02	0.07	0.11
1	0.04	0.12	0.20
2	0.16	0.49	0.82
3	0.37	1.1	1.8
4	0.65	2.0	3.3
5	1.0	3.1	5.1
6	1.5	4.4	7.3
7	2.0	6.0	10.0
8	2.6	7.8	13.1
9	3.3	9.9	16.5
10	4.1	12.2	20.4
11	4.9	14.8	24.7
12	5.9	17.6	29.4
13	6.9	20.7	34.5
14	8.0	24.0	40.0
15	9.2	27.5	45.9
16	10.4	31.3	52.2
18	13.2	39.7	66.1
24	23.5	70.5	118
36	52.9	159	264
48	94.0	282	470

*** See text for discussion on terminating purge at five well volumes**

An adequate purge is normally achieved when three to five well volumes have been removed. The field notes should reflect the single well volume calculations or determinations, according to one of the above methods, and a reference to the appropriate multiplication of that volume, i.e., a minimum three well volumes, clearly identified as an initial purge volume goal.

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3.4.2 Pumping Conditions

The pump or tubing inlet should be located at the top of the water column. If the pump is placed deep into the water column, the water above the pump may not be removed, and the subsequent samples, particularly if collected with a bailer, may not be representative of the aquifer conditions. If the recovery rate of the well is faster than the pump rate and no observable draw down occurs, the pump should be raised until the intake is as close as possible to the top of the water column for the duration of purging. If the pump rate exceeds the recovery rate of the well, the pump or tubing will have to be lowered to accommodate the drawdown.

3.4.3 Stability of Chemical Parameters

In the multiple-volume purge method, a stability determination may be made after three well volumes have been removed. If the chemical parameters have not stabilized according to the above criteria, additional well volumes (up to a total of five well volumes) should be removed. If the parameters have not stabilized after the removal of five well volumes, it is at the discretion of the project leader whether or not to collect a sample or to continue purging. If, after five well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible.

3.4.4 Sample Collection

There are several means by which sampling can proceed after adequate volume has been purged and water quality parameters have stabilized. If a submersible pump and tubing are of suitable material and cleanliness for sample collection, sampling can proceed immediately by directly filling bottles from the tubing outlet. Commonly with the multiple-volume purge method, the pump is set up and cleaned in a manner suitable only for purging. In these cases, the pump is stopped and removed from the well and sampling proceeds with a bailer per the procedure described in Section 3.6.3. The pump should have a check valve to prevent water in the pump tubing from discharging back into the well when the pump is stopped. If a peristaltic pump is used, sampling can proceed as described in Section 3.6.1.

3.5 Low-Flow Method

This method involves placing the pump or tubing inlet within the screened interval of the well and purging at a low enough rate to achieve stable drawdown and minimal depression of the water level. The well is sampled without interruption after field parameters are stable and low turbidity is achieved. In general, only water in the screened interval of the well is pumped and the stagnant water in the well casing above the screen is not removed. Wells can generally be sampled in less time with less purge volume than with the multi-volume purge method. More attention is required in the assessment of stability criteria than the multi-volume method.

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3.5.1 Nomenclature

A variety of terminology has been used to describe this method by SESD and others, including: 'low flow', 'low-flow/low-volume', 'tubing-in-screen method', 'low flow/ minimal drawdown', and 'micropurge'. The current preferred SESD terminology for this method is 'Low-Flow'. As the term 'micropurge' is sometimes used to refer to minimal-purge methods and has been trademarked by a vendor, the use of 'micropurge' to describe the Low-Flow method generally introduces ambiguity and confusion and thus the use of the term is discouraged.

3.5.2 Placement of Pump Tubing or Intake

The inlet of the pump tubing or intake of the submersible pump is placed in the approximate mid-portion of the screened interval of the well. While it is often thought that particular aquifer zones can be targeted by specific pump or intake placement, for conventionally constructed screened and filter-packed monitoring wells the zone monitored is only weakly dependent on the intake placement (Varljen, Barcelona, Obereiner & Kaminski, 2006).

The pump or tubing can be placed by carefully lowering them to the bottom of the well and then withdrawing half of the screen length, plus the length of any sump sections at the bottom of the well. A drawback of this approach is that it may stir up sediment at the well bottom. An alternate approach is to lower the pump or tubing a measured distance to place it at mid-screen without touching the bottom of the well. In the case of pumps, special care should be used in lowering them slowly, especially in the screened interval, to prevent elevating turbidity needlessly by the surging action of the pump.

3.5.3 Conditions of Pumping

Prior to initiation of pumping, a properly decontaminated well sounder should be lowered into the well to measure the water level prior to and during the purging process. Ideally, there should be only a slight and stable drawdown of the water column after pumping begins. In some cases, it will be necessary for the well to drawdown a considerable distance (10 ft or more in extreme cases) to maintain a minimal usable pumping rate for sampling (100-200 ml/min). Excessive pump rates and drawdown can result in increased turbidity, or aeration of the sample if the screen is exposed. Stable drawdown is an essential condition of the Low-Flow method. If the stable drawdown condition cannot be met, then one of the other methods should be employed.

3.5.4 Stability of Chemical Parameters

As with the Multiple-Volume Purging method described, it is important that all chemical parameters be stable prior to sampling. It is common for wells to require the removal of one of more screened-interval volumes (~2 gal for a 10 ft screen in a 2" dia. well) to achieve stability. Although it is possible for wells to achieve stability with lower purge volumes, the sampler should exercise caution in making an early stability determination.

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3.5.5 Sample Collection

Low-Flow sampling is implemented using a pump and tubing suitable for sampling. After making the determination of parameter stability with stable drawdown, sampling can proceed immediately. Where submersible or bladder pumps are used, sampling can proceed by directly filling bottles from the tubing outlet. Where peristaltic pumps are used, sampling can proceed per the procedure described in Section 3.6.3.

3.6 Minimum-Purge and No-Purge Sampling

The Minimum-Purge and No-Purge sampling methods are employed when it is necessary to keep purge volumes to an absolute minimum, where it is desirable to reduce long-term monitoring costs, or where large wells or other limitations prevent well purging. The underlying assumption when employing these methods is that the water within the well screen is equilibrated with the groundwater in the associated formation. This assumption should be demonstrated prior to use of these methods or the results suitably qualified. These methods are generally impractical for SESD to implement because of the common lack of hydrogeological information in early investigative phases and the necessity with some methods that the samplers be pre-deployed to allow equilibration.

Vertical flow conditions and stratification of the water column have also been known to result in deceptive and non-intuitive analytical results. The use of these methods in the early phases of investigation can easily result in misinterpretation of site conditions and plume boundaries.

Particular caution is in order in the use of these methods when any of the following conditions exist:

- Low hydraulic conductivity ($K<10^{-5}$ cm/sec)
- Low groundwater surface gradients
- Fractured bedrock
- Wells with long screened intervals
- Wells screened in materials of varying hydraulic conductivities

If it is desired to transition a long-term monitoring program to Minimum-Purge or No-Purge sampling, a pilot study should be conducted where the Minimum-Purge or No-Purge sample results are compared to the conventional methods in use. Multiple samplers may be deployed in the screened interval to help establish appropriate monitoring intervals.

These methods are in common use and for the purposes of the SESD quality system they can be considered standard, but unaccredited, procedures. Several Minimum-Purge or No-Purge procedures that might be employed are shown below. It is not the intention to recommend particular equipment or vendors, and other equipment that can accomplish the same goals may be suitable.

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3.6.1 Minimum Purge Sampling

The pump or tubing inlet is deployed in the screened interval. A volume of water equal to the internal pump and tubing volume is pumped to flush the equipment. Sampling then proceeds immediately. While superficially similar to Low-Flow sampling, the results obtained in this method will be sensitive to the vertical pump or tubing inlet placement and are subject to the limitations described above.

3.6.2 Passive Diffusion Bags

The no-purge Passive Diffusion Bag (PDB) typically consists of a sealed low-density polyethylene (LDPE) bag containing deionized water. They are deployed in the screened interval of a well and allowed to equilibrate, commonly for two weeks, prior to retrieval and decanting of the water into sample containers. Many volatile organic compounds will reach equilibrium across the LDPE material, including BTEX compounds and many chlorinated solvents. Compounds showing poor equilibration across LDPE include acetone, MTBE, MIBK, and styrene. PDBs have been constructed of other materials for sampling other analytes, but the vast majority of PDB samplers are of the LDPE material. Various vendors and the Interstate Technology and Regulatory Council (ITRC) can provide additional information on these devices.

3.6.3 HydraSleevesTM

HydraSleeeves™ are no-purge grab sampling devices consisting of a closed-bottom sleeve of low-density polyethylene with a reed valve at the top. They are deployed in a collapsed state to the desired interval and fill themselves through the reed valve when pulled upward through the sampling interval. The following is a summary of their operation:

Sampler placement – A reusable weight is attached to the bottom of the sampler or the sampler is clipped to a weighted line. The HydraSleeve™ is lowered on the weighted line and placed with the top of the sampler at the bottom of the desired sampling interval. In-situ water pressure keeps the reed valve closed, preventing water from entering the sampler. The well is allowed to return to equilibrium.

Sample collection - The reed valve opens to allow filling when the sampler is moved upward faster than 1 foot per second, either in one continuous upward pull or by cycling the sampler up and down to sample a shorter interval. There is no change in water level and only minimal agitation during collection.

Sample retrieval - When the flexible sleeve is full, the reed valve closes and the sampler can be recovered without entry of extraneous overlying fluids. Samples are removed by puncturing the sleeve with the pointed discharge tube and draining the contents into containers for sampling or field parameter measurements.

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Because the HydraSleeve™ is retrieved before equilibration can occur and they are constructed of non-Teflon® materials, there may be issues with sorbtion of contaminants in the use of this sampler.

3.6.4 Snap Samplers

The Snap Sampler is a patented no-purge groundwater sampling device that employs a double-end-opening bottle with "Snap" sealing end caps. The dedicated, device is deployed at the desired position in the screened interval with up to six Snap Samplers and six individual sampling bottles. The device is allowed to equilibrate in the screened interval and retrieved between 3 and 14 days after deployment. Longer deployments are possible to accommodate sampling schedules.

To operate, Snap Samplers are loaded with Snap Sampler bottles and the "Snap" caps are set into an open position. Samplers are deployed downhole with an attachment/trigger line and left to equilibrate downhole. To collect samples, the Snap Sampler bottles seal under the water surface by pulling a mechanical trigger line, or using an electric or pneumatic trigger system. The trigger releases Teflon® "Snap Caps" that seal the double-ended bottles. The end caps are designed to seal the water sample within the bottles with no headspace vapor. After the closed vial is retrieved from the well, the bottles are prepared with standard septa screw caps and labeled for laboratory submittal.

The manufacturer of the Snap Sampler provides considerable additional information on the validation and use of the device.

3.7 Equipment Considerations

Equipment choices are dictated by the purging and sampling method used, the depth to water, the quantity of water to be pumped, and quality considerations. The advantages and disadvantages of various commonly used pumps are discussed in the sections below and summarized in *Table 1, Purge and Sample Strategies with Equipment Considerations*. Additional information on the use of individual pumps is available in SESD Operating Procedure for Pump Operation, SESDPROC-203.

3.7.1 Use of Peristaltic Pumps

Peristaltic pumps are simple, inexpensive, and reliable equipment for purging and sampling where the limit of suction is not exceeded (approximately 25-30 vertical feet from the groundwater surface to the pump). When used for sampling, they should be equipped with new Teflon® tubing for each well. The flexible peristaltic pump-head tubing should also be changed between wells.

Samples for organic analyses cannot be exposed to the flexible peristaltic pump-head tubing, both due to the risk that the tubing would sorb contaminants and the propensity of this tubing to contribute organic compounds to the sample. Samples can be collected without contact with the pump-head tubing by the use of vacuum transfer caps for

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analyses requiring 1 liter glass containers and the use of the 'soda-straw' method for the filling of VOC vials.

The sample containers for the more turbidity-sensitive analyses are filled first, as filling the VOC vials (and to a lesser extent the glass bottles) may disturb the well and increase turbidity. The most appropriate order of sampling with a peristaltic pump is generally to fill poly containers for metals and classical analyses, followed by glass bottles for SVOCs and associated analyses, and finally to fill 40 ml VOC vials.

The following step-by-step procedure assumes that the pump has been set up per SESD Operating Procedure for Pump Operation (SESDPROC-203) and that containers for a typical full suite of analyses will be filled. The procedure is suitable for use with either multi-volume Purge and Low-Flow methods with minor differences in the collection of VOCs:

1. Deploy the lower end of the tubing to the desired point in the well. This would be the top-of-water for the multi-volume purge method or to the mid-screen for the Low-Flow method. Connect the well tubing to the flexible pump-head tubing and connect a short piece of tubing from the pump-head tubing to a measuring bucket.

2. Turn on the pump and establish a suitable pumping rate. For the multi-volume purge method, the rate will generally be a relatively fast rate that the well will sustain without elevating turbidity. For the low-flow method the pump rate is established at a slower rate to maintain a minimal and stable drawdown level.

3. Proceed with the measurement of water quality parameters and adjust the pump rate as needed to achieve low turbidity and stable drawdown.

4. When the well purge has been determined to be sufficient, fill containers for metals and classical analyses directly from the pump outlet. There is no need to interrupt pumping. The tubing should be held at the opening of the container and should not touch the container during filling. Protect caps from dust and debris during filling.

5. After filling the containers for metals and classical analyses stop the pump. Make sure that the tubing leading into the well is secured against movement during the following operations.

6. Create a crimp in the well tubing approximately one foot from the pump and grasp the crimped tubing in one hand. It is generally most effective to create a double 'Z' crimp.

7. Cut the sample tubing between the crimp and the pump. The tightly-held crimped tubing should keep water from running back into the well. In lieu of

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cutting the tubing, the well tubing can be disconnected from the pump and a short piece of tubing connected in its place.

8. Insert both free ends of the tubing into the ferrule-nut fittings of a pre-cleaned Teflon® transfer cap assembly and tighten the nuts. Attach the transfer cap assembly to the first glass container for semi-volatile analysis and securely tighten the threaded ring.

9. Turn the pump on. Very slowly release the 'Z' crimp in the sample tubing. As vacuum builds up in the sample container, water should begin to move up the sample tubing instead of back into the well. If after several minutes water has not begun moving up the tubing, check the tightness of fittings and the attachment of the cap to the bottle. Allowing water to rush back down the tubing from the 'Z' crimp can surge the well and elevate turbidity.

10. Fill the container to about halfway between the shoulder and the neck. Crimp the well tubing. Move the transfer cap to any additional bottles and repeat the filling process.

11. When finished filling bottles with the transfer cap, again crimp the tubing. Remove the well tubing from the transfer cap and reattach it to the pump. Slowly run the pump and release the crimp until water is approaching the flexible peristaltic tubing.

12. Make a kink or otherwise mark the tubing at the top of the casing in case the tubing needs to be reinserted for additional sample volume. Slowly remove the tubing from the well and coil it in one hand in loose coils. With the top end of the tubing blocked, water is retained in the tubing as it is withdrawn, much as in a capped soda straw, hence the name for this method.

13. Remove the top from a 40 ml VOC vial and position the end of the sample tubing near the top of the vial. Reverse the pump direction and turn the speed knob to its slowest position. Turn on the pump and slowly increase speed until water slowly fills the vial. Fill the vial with a slow laminar flow that does not agitate the water in the vial or entrain bubbles. Continue to fill the vial until a convex meniscus forms on the top of the vial and turn off the pump.

14. Carefully screw the septum-lid to the vial and fasten firmly. Invert the vial and tap on your knuckles to check for bubbles. Carefully add additional volume to the vial if necessary. Small bubbles are undesirable but may be unavoidable with some media, especially when using pre-preserved vials.

15. Repeat the filling process for additional vials. Avoid partially filling vials as the available water in the tubing is used. If more volume is required than that contained in the tubing, purge the remaining water from the tubing and reinsert

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the tubing in the well to the level marked previously. Run the pump to refill the tubing. If performing Low-Flow sampling, run additional volume through the pump to purge any water that may have been collected from the stagnant water column.

16. Fill additional vials as needed. Be sure that any water that has contacted the flexible peristaltic tubing is not pumped into a vial.

3.7.2 Use of Submersible Centrifugal Pumps

Submersible centrifugal pumps are used in wells of 2" diameter and larger. They are especially useful where large volumes of water are to be removed or when the groundwater surface is a large distance below ground surface. Commonly used pumps are the Grundfos® Redi-Flo2, the Geotech GeoSub, and the various 'Monsoon' style pumps. Other pumps are acceptable if constructed of suitable materials.

When used with the Multiple-Volume Purge method, the pump is generally used only to purge, with sampling performed with a bailer. In this use, the pump can be used with polyethylene or other tubing or hose that will not contribute contaminants to the well. The pump and tubing is decontaminated between wells per the relevant provisions of SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205). When used in this application the pump should be equipped with a check valve to prevent water in the discharge tubing or hose from running back down into the well.

When used for Low-Flow purging and sampling the pump must be constructed of stainless steel and Teflon®. Pump cleaning at each well follows the more stringent procedures described in SESD Operating Procedure for Field Equipment Cleaning and Decontamination SESDPROC-205) for this application. The sample tubing should be either new Teflon® tubing, or tubing dedicated to each well. Dedicated tubing would ideally be cleaned between uses, but tubing stored in the well casing between uses is acceptable, although caution should be exercised where very high concentrations of contaminants have been sampled in a well.

3.7.3 Use of Bailers

Bailers are a common means of sampling when the Multiple-Volume Purge method is used. They are occasionally used for purging when other equipment is not available or has failed. As bailers surge the well on each withdrawal, it is very difficult to lower turbidity adequately during a well purge, and when used for sampling they can elevate turbidity in a well before all sample volume is collected. If not lowered carefully into the top of the water column, the agitation may strip volatile compounds. Due to the difficulties and limitations inherent in their use, other sampling or purging means should generally be given preference.

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Bailers should be closed-top Teflon® bailers with Teflon® coated stainless steel leaders used with new nylon haul rope. They are lowered gently into the top of the water column, allowed to fill, and removed slowly. It is critical that bailers be slowly and gently immersed into the top of the water column, particularly during final stages of purging and during sampling, to minimize turbidity and loss of volatile organic constituents.

If the well has previously been purged with a pump, there is likely stagnant water at the top of the well that was above the pump or tubing inlet. Several bailers of water should be retrieved and discarded to assure the upper stagnant water has been removed.

When sampling, containers are filled directly by pouring from the outlet at the top of the bailer. Containers for metals analysis should be filled first in case the bailing process increases well turbidity. VOC vials should be filled carefully and slowly with a laminar flow to reduce agitation and the stripping of VOCs.

3.7.4 Use of Bladder Pumps

Bladder pumps use a source of compressed gas to compress and release a bladder straddled by check valves within the pump body. As the bladder is compressed, water is expelled out the upper check valve to the surface. When gas pressure is released, the bladder refills as well water enters the lower pump inlet. A control unit is used to control the pressure and timing of the bladder inflation gas flow.

Bladder pumps are capable of pumping from moderate depths to water, but are not capable of high flow rates. As they operate cyclically, the well is surged slightly on each cycle and it may be difficult to lower turbidity in sensitive or poorly developed wells. As the entire sample train is under positive pressure and the pumps develop little heat, they are ideal for sampling VOCs.

Prior to sampling and between each well the pumps are cleaned internally and externally per the provisions of SESD Operating Procedure for Field Decontamination (SESDPROC-205) and a new Teflon® bladder installed. New (or dedicated) Teflon® sample tubing is used at each well, although polyethylene tubing can be used for the compressed gas drive line and cleaned between each well.

3.7.5 Use of Inertial Pumps

Inertial pumps consist of a check valve which is affixed to the lower end of semi-rigid tubing. The tubing and valve are cycled up and down, allowing water to alternately be drawn into the check valve inlet and then pulled up towards the surface. Two commonly used inertial pumps are the Waterrra® pump for wells larger than 1" and the Geoprobe® Tubing Check Valve for small diameter wells. The primary use of these pumps is in well development where their near-immunity to silt is an advantage. Inertial pumps should not be used for the final well purge or for sampling as there is a low likelihood of

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reducing turbidity to appropriate levels and they have the potential to strip volatiles from the water column through agitation.

To set up the pump, the check valve is screwed onto the discharge tubing where it will cut its own threads. In the case of the Waterra® pump, a surge block can also be pressed onto the check valve. The pump is lowered into the well to the screened interval and rapidly cycled up and down a distance of 3" -12". The stroke length and speed are adjusted for pumping effect. Electric actuators can be used to reduce the effort involved. The pump should be moved to different levels in the screen to surge the entire screen. The pump can occasionally be lowered to the bottom of the well to vacuum out silt. Any silt that clogs the valve is usually quickly rinsed out by the pump cycling and if the clog remains the pump is easily retrieved and redeployed.

The surging activity is usually continued until turbidity is lowered to a measurable range and cannot easily be lowered further. Further development or purging is then conducted with other pumps.

3.8 Wells With In-Place Plumbing

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, and in other applications. Many permanent monitoring wells at active facilities are also equipped with dedicated, in-place pumps.

A permanent monitoring well with an in-place pump may be treated as other monitoring wells without pumps. Since the in-place pump is generally "hard" mounted at a pre-selected depth, it cannot be moved up or down during purging and sampling. If the pump inlet is above the screened interval, the well should be sampled using the Multiple-Volume Purge method. If the pump intake is located within the screened interval, the well can be sampled using Low-Flow procedures. Known details of pump type and construction, tubing types, pump setting depths, and any other available information about the system should be recorded in the field logbook.

In the case of the other types of wells, e.g., municipal, industrial and residential supply wells, there is typically not enough known about the construction aspects of the wells to apply the same criteria as used for monitoring wells. The volume to be purged in these situations therefore depends on several factors: whether the pumps are running continuously or intermittently and whether or not any storage/pressure tanks are located between the sampling point and the pump. The following considerations and procedures should be followed when purging wells with in-place plumbing under the conditions described.

3.8.1 Continuously Running Pumps

If the pump runs more or less continuously, no purge (other than opening a valve and allowing it to flush for a few minutes) is necessary. If a storage tank is present, a spigot,

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valve or other sampling point should be found located between the pump and the storage tank. If no valve is present, locate and use the valve closest to the tank. Measurements of field parameters are recorded immediately prior to the time of sampling.

3.8.2 Intermittently or Infrequently Running Pumps

If the pump runs intermittently or infrequently, best judgment should be utilized to remove enough water from the plumbing to flush standing water from the piping and any storage tanks that might be present. Often under these conditions, 15 to 30 minutes of purging will be adequate. Measurements of pH, specific conductance, temperature and turbidity should be made and recorded at intervals during the purge and the final measurements made at the time of sampling should be considered the measurements of record for the event.

3.9 Temporary Monitoring Wells

3.9.1 General Considerations

As temporary wells are installed for immediate sample acquisition, the procedures used to purge temporary ground water monitoring wells may differ from those for permanent wells. Temporary wells include standard well screen and riser placed in boreholes created by hand augering or drilling, or they may consist of a drive rod and screen such as a direct-push Geoprobe® Screen Point that is driven into place at the desired sampling interval. As aquifer water enters the sampler immediately upon deployment, the requirement to remove several volumes of water to replace stagnant water does not necessarily apply. In practice, developing and purging the well to usable turbidity levels will remove many times the water that would be removed in a Multiple-Volume Purge with calculated well volumes. It is important to note, however, that the longer a temporary well is in place and not sampled, the more stagnant the water column becomes and the more appropriate it becomes to apply standard permanent monitoring well purging criteria to achieve representative aquifer conditions in the sample.

3.9.2 Development of Temporary Wells

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well installation procedures disturb the existing aquifer conditions, causing extreme turbidity. The goal of purging is to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure.

The following procedure has been found to be effective in developing and sampling small diameter temporary wells where a peristaltic pump can be used. Turbidity can generally be lowered to 50 NTU at the time of sampling and turbidity less than 10 NTU is often achieved.

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1. Cut peristaltic tubing to reach to the bottom of the well. Connect to a peristaltic pump and begin pumping at a high rate.

2. Use the tubing to vacuum out sediment at the bottom of the well.

3. Aggressively surge the end of the tubing in the screened interval by cycling the tubing rapidly up and down. Periodically repeat vacuuming of the well bottom.

4. When a visible 'break' to a lower turbidity is observed, cease surging the well and begin lowering the pumping rate.

5. When the water clears (turbidity < 100-200 NTU) begin raising the end of the tubing to the top of the water column.

6. Continue purging from the top of the water column, lowering the pump speed as required to lower turbidity. When adequately low turbidity and stable water quality parameters have been achieved, sampling can proceed.

Where the water level is below the limit of suction in a small diameter temporary well, a Geoprobe® mechanical bladder pump can be used for purging and sampling. The well should first be developed with an inertial pump to remove the bulk of silt and suspended particles that could clog the check valves of the bladder pump. The inertial pump is used to vacuum out the bottom of the well and surged in the screened interval until a 'break' to lower turbidity is observed prior to deployment of the bladder pump. Since the mechanical bladder pump requires cumbersome redeployment to change its pumping level, it should be deployed low enough in the water column that the water level will not be lowered below the pump during purging and sampling. The mechanical bladder pump is generally deployed above the screened interval to facilitate the settling of particles, but below the top of the water column to alleviate the need to reset the pump. Detailed instructions on the deployment of the pump can be found in SESDPROC203, Pump Operation.

3.9.3 Decommissioning of Temporary Wells

After temporary wells have fulfilled their purpose, they should be properly decommissioned similar to permanent wells. In general, the casings and screens can be easily removed and the borehole should then be pressure grouted from the bottom of the original borehole to prevent surface contamination of the aquifer, cross-connection of aquifers, and to remove a potential vapor pathway.

Direct-push screen-point wells may be decommissioned by one of two methods.

1. A disposable screen is used. The sampling sheath is pulled off of the screen and a 30% solids bentonite grout is pumped down the tool string as the rods are withdrawn.

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Grout volumes are measured during pumping to assure that the hole is completely filled. The disposable screen is left behind at the bottom of the borehole.

2. The screen is removed with the sampler sheath and tool string. The hole is immediately re-entered with an empty sample sheath with disposable point. Upon reaching the original total depth of the temporary well, 30% solids bentonite grout is pumped down the tool string with the pumped volume monitored during tool string withdrawal to assure that the hole is completely filled.

A system is available to insert a small diameter grouting tube down through the screen-point screen. Grout is pumped through the grouting tube while the tools are withdrawn. SESD does not use this system as grout denser than 20% solids cannot reliably be installed with this system.

Additional guidance on decommissioning may be found in SESDGUID-101, Design and Installation of Monitoring Wells.

3.9.4 Other Considerations for Direct-Push Groundwater Sampling

With certain direct push sampling techniques, such as the Hydropunch™ and other discrete samplers used with cone-penetrometer rigs, purging is either not practical or not possible. The sampling device is simply pushed or driven to the desired depth and opened, whereupon the sample is collected and retrieved. As a result, some samples collected in this way may not be satisfactory or acceptable for certain analyses, i.e., the sampler may collect a turbid sample inappropriate for metals analyses or the sample may have inadequate volume to achieve desired reporting levels.

3.10 Wells Purged to Dryness

In some situations, even with slow purge rates, a well may be purged dry in the Multiple-Volume Purge method or stable drawdown cannot be maintained in the Low-Flow method. In these cases, the well should be purged to dryness (evacuated) and sampled upon recovery of adequate volume for sampling. Sampling should occur as soon as adequate volume has recovered. The field parameters should be measured and recorded at the time of sample collection as the measurements of record for the sampling event.

Sampling under these conditions is not ideal and suitable qualifications of the data should be included in the report. Water cascading down the screen into the well may strip volatile compounds and elevate turbidity. Although suffering from other limitations, No-Purge methods may prove useful for these wells.

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4 Additional Purging and Sampling Considerations

4.1 Field Care of Purging Equipment

New plastic sheeting should be placed on the ground surface around the well casing to prevent contamination of the pumps, hoses, ropes, etc., in the event they accidentally come into contact with the ground surface or, for some reason, they need to be placed on the ground during the purging event. It is preferable that hoses used in purging that come into contact with the ground water be kept on a spool or contained in a large wash tub lined with plastic sheeting, both during transportation and during field use, to further minimize contamination by the transporting vehicle or the ground surface.

Careful consideration shall be given to using submersible centrifugal or bladder pumps to purge wells which are excessively contaminated with oily compounds as it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells of this type are encountered, alternative equipment, such as bailers or peristaltic pumps, should be considered.

4.2 Investigation Derived Waste

Purging and field cleaning of equipment generates liquid investigation derived waste (IDW), the disposition of which must be considered. See SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for guidance on management or disposal of this waste.

4.3 Sample Preservation

After sample collection, all samples requiring preservation must be preserved as soon as practical. Consult the Analytical Services Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM) for the correct preservative for the particular analytes of interest. All samples preserved using a pH adjustment (except VOCs) must be checked, using pH strips, to ensure that they were adequately preserved. This is done by pouring a small volume of sample over the strip. Do not place the strip in the sample. Samples requiring reduced temperature storage should be placed on ice immediately.

4.4 Special Sample Collection Procedures

4.4.1 Trace Organic Compounds and Metals

Special sample handling procedures should be instituted when trace contaminant samples are being collected. All sampling equipment, including pumps, bailers, water level measurement equipment, etc., which contacts the water in the well must be cleaned in accordance with the cleaning procedures described in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-

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206). Pumps should not be used for sampling unless the interior and exterior portions of the pump and the discharge hoses are thoroughly cleaned. Rinse blank samples should be collected to verify the adequacy of cleaning when using a sampling pump other than a peristaltic pump.

4.4.2 Order of Sampling with Respect to Analytes

In many situations when sampling permanent or temporary monitoring wells, sufficiently low turbidity is difficult to achieve and maintain. Removal and insertion of equipment after the purge or during sampling may negate the low turbidities achieved during purging and elevate turbidity back to unacceptable levels. For this reason, it is important that special efforts be used to minimize any disturbance of the water column after purging and to fill sample containers for metals analysis first. The preferred order of sampling is metals first, followed by other inorganic analytes, extractable organic compounds, and finally volatile organic compounds.

4.5 Filtering

As many contaminants are known to sorb to soil particles, the normal goal of sampling is to reduce the presence of these particles (measured by turbidity) in order that the dissolved concentration of contaminants can be obtained. However, transport of sorbed contamination on colloidal particles can be a means of contaminant transport on some sites. For this reason, the SESD approach is to reduce turbidity through the careful purging of wells, rather than through filtering of samples, in order that the colloidal particles would be included in the sample.

As a standard practice, ground water samples will not be filtered for routine analysis. Filtering will usually only be performed to determine the fraction of major ions and trace metals passing the filter and used for flow system analysis and for the purpose of geochemical speciation modeling. Filtration is not acceptable to correct for improperly designed or constructed monitoring wells, inadequate well development, inappropriate sampling methods, or poor sampling technique.

When samples are collected for routine analyses and are filtered, both filtered and non-filtered samples will be submitted for analyses. Samples for organic compounds analysis should not be filtered. Prior to filtration of the ground water sample for any reason other than geochemical speciation modeling, the following criteria must be demonstrated to justify the use of filtered samples for inorganic analysis:

1. The monitoring wells, whether temporary or permanent, have been constructed and developed in accordance with the SESD Guidance Document, Design and Installation of Monitoring Wells (SESDGUID-001).

2. The ground water samples were collected using sampling techniques in accordance with this section, and the ground water samples were analyzed in accordance with USEPA approved methods.

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3. Efforts have been undertaken to minimize any persistent sample turbidity problems. These efforts may consist of the redevelopment or re-installation of permanent ground water monitoring wells or the implementation of carefully conducted low flow rate sampling techniques.

If filtration is necessary for purposes of geochemical modeling or other **pre-approved** cases, the following procedures are suggested:

1. Accomplish in-line filtration through the use of disposable, high capacity filter cartridges (barrel-type) or membrane filters in an in-line filter apparatus. The high capacity, barrel-type filter is preferred due to the higher surface area associated with this configuration. If a membrane filter is utilized, a minimum diameter of 142 mm is suggested.

2. When using pumps for sampling, the filter can generally be attached directly to the pump outlet. When sampling with a bailer or when otherwise required, an initial unfiltered sample with extra volume will be collected, and a peristaltic pump with filter used to decant and filter the sample to the final sample container.

3. Use a 0.45 µm pore-size filter to remove most non-dissolved particles. A 5 µm or 10 µm pore-size filter should be used for the purpose of determining colloidal constituent concentrations.

4. Fill the filter and rinse with approximately one additional filter volume prior to filling sample bottles

Potential differences can result from variations in filtration procedures used to process water samples for the determination of trace element concentrations. A number of factors associated with filtration can substantially alter "dissolved" trace element concentrations; these include filter pore size, filter type, filter diameter, filtration method, volume of sample processed, suspended sediment concentration, suspended sediment grain-size distribution, concentration of colloids and colloidally-associated trace elements, and concentration of organic matter. Therefore, consistency is critical in the comparison of short-term and long-term results. Further guidance on filtration may be obtained from the following: 1) Metals in Ground Water: Sampling Artifacts and Reproducibility; 2) Filtration of Ground Water Samples for Metals Analysis; and 3) Ground Water Sampling - A Workshop Summary. See Section 1.4, References, for complete citation for these documents.

4.6 Bacterial Sampling

Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in the following: 1) Sampling for Organic Chemicals and Microorganisms in

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the Subsurface; 2) Handbook for Evaluating Water Bacteriological Laboratories; and 3) Microbiological Methods for Monitoring the Environment, Water and Wastes. See Section 1.4, References, for complete citation for these documents.

4.7 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect ground water samples shall be cleaned as outlined in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206). Malfunctioning equipment should be labeled in the field and repaired, before being stored at the conclusion of field studies. Cleaning procedures utilized in the field or field repairs shall be thoroughly documented in field records.

4.8 Auxiliary Data Collection

During ground water sample collection, it is important to record a variety of ground water related data. Included in the category of auxiliary data are water levels measured according to the SESD Operating Procedure for Groundwater Level and Well Depth Measurement (SESDPROC-105), well volume determinations, pumping rates during purging, and, driller or boring logs. This information should be documented in the field records.

4.9 Well Development

Wells may be encountered that are difficult to sample effectively due to inadequate initial development or the need for redevelopment due to scaling, sedimentation, corrosion, or biofouling. These wells may produce water only at low flow rates or water with chronically elevated turbidity. Redevelopment of these wells should be considered as the process can improve sample quality and speed field operations. Well development procedures are described in Design and Installation of Monitoring Wells (SESDGUID-101).

Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Field Equipment Cleaning and Decontamination	ID: LSASDPROC-205-R4
Issuing Authority: LSASD Field Branch Chief	
Effective Date: June 22, 2020	Review Due Date: June 22, 2023

Purpose

This procedure is to be used by Region 4 Laboratory Services and Applied Science Division staff . This document describes general and specific procedures, methods and considerations to be used and observed when cleaning and decontaminating sampling equipment during the course of field investigations. This procedure is to be used by all Region 4 Laboratory Services and Applied Science Division (LSASD) staff.

Scope/Application

The procedures contained in this document are to be followed when field cleaning sampling equipment, for both re-use in the field, as well as used equipment being returned to the Field Equipment Center (FEC). On the occasion that LSASD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that other procedures must be used to clean or decontaminate sampling equipment at a particular site, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

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1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on LAN and for maintaining records of review conducted prior to its issuance.

1.2 Definitions

- Decontamination: The process of cleaning dirty sampling equipment to the degree to which it can be re-used, with appropriate QA/QC, in the field.

- Deionized water: Tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. Deionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for deionized water.

- Detergent shall be a standard brand of phosphate-free laboratory detergent such as Liquinox® or Luminox®. Liquinox® is a traditional anionic laboratory detergent and is used for general cleaning and where there is concern for the stability of the cleaned items in harsher cleaners. Luminox® is a specialized detergent with the capability of removing oils and organic contamination. It is used in lieu of a solvent rinse step in cleaning of equipment for trace contaminant sampling. Where not specified in these procedures, either detergent is acceptable.

- Drilling Equipment: All power equipment used to collect surface and sub-surface soil samples or install wells. For purposes of this procedure, direct push is also included in this definition.

- Field Cleaning: The process of cleaning dirty sampling equipment such that it can be returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

- Organic-free water: Tap water that has been treated with activated carbon and deionizing units. At a minimum, the finished water must meet the analytical criteria of deionized water and it should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 4 laboratory for a given set of analyses. Organic-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

- Tap water: Water from any potable water supply. Deionized water or organic-free water may be substituted for tap water.

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1.3 General Precautions

1.3.1 Safety

Proper safety precautions must be observed when field cleaning or decontaminating dirty sampling equipment. Refer to the LSASD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- When conducting field cleaning or decontamination using laboratory detergent, safety glasses with splash shields or goggles, and latex gloves will be worn.

- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

1.3.2 Procedural Precaution

Prior to mobilization to a site, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinses and other waste waters that might be considered RCRA hazardous waste or may require special handling.

2 Introduction to Field Equipment Cleaning and Decontamination

2.1 General

The procedures outlined in this document are intended for use by field investigators for cleaning and decontaminating sampling and other equipment in the field. These procedures should be followed in order that equipment is returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for the Data Quality Objectives (DQOs) of the study or investigation. If deviations from these procedures need to be made during the course of the field investigation, they will be documented in the field logbook along with a description of the circumstances requiring the use of the variant procedure.

Cleaning procedures for use at the Field Equipment Center (FEC) are found in LSASD Operating Procedure for Equipment Cleaning and Decontamination at the FEC (LSASDPROC-206).

2.2 Handling Practices and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

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- Detergent must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.

- Tap water may be kept in tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.

- Deionized water must be stored in clean, glass or plastic containers that can be closed for transport. It can be applied from plastic squeeze bottles.

- Organic-free water must be stored in clean glass or Teflon® containers prior to use. It may be applied using Teflon® squeeze bottles, or with the portable system.

2.3 Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW); including used wash water and rinse water are in LSASD Operating Procedure for Management of Investigation Derived Waste (LSASDPROC-202).

2.4 Sample Collection Equipment Contaminated with Concentrated Materials

Equipment used to collect samples of concentrated materials from investigation sites must be field cleaned before returning from the study. At a minimum, this should consist of washing with detergent and rinsing with tap water. When the above procedure cannot be followed, the following options are acceptable:

- Leave with facility for proper disposal;

- If possible, containerize, seal, and secure the equipment and leave on-site for later disposal;

- Containerize, bag, or seal the equipment so that no odor is detected and return to the Field Equipment Center.

It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.5 Sample Collection Equipment Contaminated with Environmental Media

Equipment used to collect samples of environmental media from investigation sites should be field cleaned before returning from the study. Based on the condition of the sampling equipment, one or more of the following options must be used for field cleaning:

- Wipe the equipment clean;

- Water-rinse the equipment;

- Wash the equipment in detergent and water followed by a tap water rinse.

- For grossly contaminated equipment, the procedures set forth in Section 2.4 must be followed.

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Under extenuating circumstances such as facility limitations, regulatory limitations, or during residential sampling investigations where field cleaning operations are not feasible, equipment can be containerized, bagged or sealed so that no odor is detected and returned to the FEC without being field cleaned. If possible, FEC personnel should be notified that equipment will be returned without being field cleaned. It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.6 Handling of Decontaminated Equipment

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used, it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

3 Field Equipment Decontamination Procedures

3.1 General

Sufficient equipment should be transported to the field so that an entire study can be conducted without the need for decontamination. When equipment must be decontaminated in the field, the following procedures are to be utilized.

Note: Equipment utilized for PFAS sampling will not cleaned in the field.

3.2 Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- The pad should not leak.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.
- Water should be removed from the decontamination pad frequently.
- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

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At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. See LSASD Operating Procedure for Management of Investigation Derived Waste (LSASDPROC-202) for proper handling and disposal of these materials. If the decontamination pad has leaked excessively, soil sampling may be required.

3.3 "Classical Parameter" Sampling Equipment

"Classical Parameters" are analyses such as oxygen demand, nutrients, certain inorganic compounds, sulfide, flow measurements, etc. For routine operations involving classical parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc., may be cleaned with the sample water or tap water between sampling locations as appropriate.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

Note: The procedures described in Section 3.3 are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

3.4 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

For samples undergoing trace organic or inorganic constituent analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

3.4.1 Standard LSASD Method

- An optional Liquinox® detergent wash step may be useful to remove gross dirt and soil.
- Clean with tap water and Luminox® detergent using a brush, if necessary, to remove particulate matter and surface films.
- Rinse thoroughly with tap water.
- Rinse thoroughly with organic-free water and place on a clean foil-wrapped surface to air-dry.
- Wrap the dry equipment with aluminum foil or bag in clean plastic. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

3.4.2 Alternative Solvent Rinse Method

The historical solvent rinse method of cleaning equipment for trace contaminant sampling remains an acceptable method.

- Clean with tap water and Liquinox® detergent using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (Liquinox® detergent and high-pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.

- Rinse thoroughly with tap water.

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- Rinse thoroughly with deionized water.
- Rinse with an appropriate solvent (generally isopropanol).
- Rinse with organic-free water and place on a clean foil-wrapped surface to air-dry.
- Wrap the dry equipment with aluminum foil or plastic. If the equipment is to be stored overnight before it is wrapped, it should be covered and secured with clean, unused plastic sheeting.

3.5 Well Sounders or Tapes

The following procedures are recommended for decontaminating well sounders (water level indicators) and tapes. Unless conditions warrant, it is only necessary to decontaminate the wetted portion of the sounder or tape.

- Wash with Liquinox® detergent and tap water.
- Rinse with tap water.
- Rinse with deionized water.

3.6 Redi-Flo2® Pump

CAUTION – Do not wet the controller. Always disconnect power from the pump when handling the pump body.

The Redi-Flo2® pump and any associated connected hardware (e.g., check valve) should be decontaminated between each monitoring well. The following procedures are required, depending on whether the pump is used solely for purging or used for purging and sampling.

3.6.1 Purge Only (Pump and Wetted Portion of Tubing or Hose)

- Disconnect power and wash exterior of pump and wetted portion of the power lead and tubing or hose with Liquinox® detergent and water solution.
- Rinse with tap water.
- Final rinse with deionized water.
- Place pump and reel in a clean plastic bag and keep tubing or hose contained in clean plastic or galvanized tub between uses.

3.6.2 Purge And Sample

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Grundfos Redi-Flo2® pumps are extensively decontaminated and tested at the FEC to prevent contamination from being transmitted between sites. The relevant sections of LSASDPROC-206, *Field Equipment Cleaning and Decontamination at the FEC,* should be implemented in the field where a high risk of cross-contamination exists, such as where NAPL or high-concentration contaminants occur. In most cases, the abbreviated cleaning procedure described below will suffice, provided that sampling proceeds from least to most contaminated areas.

- Disconnect and discard the previously used sample tubing from the pump. Remove the check valve and tubing adapters and clean separately (See Section 3.6.3 for check valve). Wash the pump exterior with detergent and water.

- Prepare and fill three containers with decontamination solutions, consisting of Container #1, a tap water/detergent washing solution. Luminox® is commonly used. An additional pre-wash container of Liquinox® may be used; Container #2, a tap water rinsing solution; and Container #3, a deionized or organic-free water final rinsing solution. Choice of detergent and final rinsing solution for all steps in this procedure is dependent upon project objectives (analytes and compounds of interest). The containers should be large enough to hold the pump and one to two liters of solution. An array of 2' long 2" PVC pipes with bottom caps is a common arrangement. The solutions should be changed at least daily.

- Place the pump in Container #1. Turn the pump on and circulate the detergent and water solution through the pump and then turn the pump off.

- Place the pump in Container #2. Turn the pump on and circulate the tap water through the pump and then turn the pump off.

- Place the pump in Container #3. Turn the pump on and circulate deionized or organic-free water through the pump and then turn the pump off.

- Disconnect power and remove pump from Container #3. Rinse exterior and interior of pump with fresh deionized or organic-free water.

- Decontaminate the power lead by washing with detergent and water, followed by tap water and deionized water rinses. This step may be performed before washing the pump if desired.

- Reassemble check valve and tubing adapters to pump. ALWAYS use Teflon® tape to prevent galling of threads. Firm hand-tightening of fittings or light wrench torque is generally adequate.

- Place the pump and reel in a clean plastic bag.

3.6.3 Redi-Flo2® Ball Check Valve

- Remove the ball check valve from the pump head. Check for wear and/or corrosion, and replace as needed. During decontamination check for free-flow in forward direction and blocking of flow in reverse direction.

- Using a brush, scrub all components with detergent and tap water.

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- Rinse with deionized water.

- Rethread the ball check valve to the Redi-Flo2® pump head.

3.7 Mega-Monsoon® and GeoSub® Electric Submersible Pump

As these pumps have lower velocities in the turbine section and are easier to disassemble in the field than Grundfos pumps, the outer pump housing should be removed to expose the impeller for cleaning prior to use and between each use when used as a sampling pump for trace contaminant sampling.

- Remove check valves and adapter fittings and clean separately.
- Remove the outer motor housing by holding the top of the pump head and unscrewing the outer housing from its O-ring sealed seat.
- Clean all pump components per the provisions of section 3.4. Use a small bottle brush for the pump head passages
- Wet the O-ring(s) on the pump head with organic-free water. Reassemble the outer pump housing to the pump head.
- Clean cable and reel per Section 3.4.
- Conduct final rinse of pump with organic-free water over pump and through pump turbine.

3.8 Bladder Pumps

Bladder pumps are presumed to be intended for use as low flow purge-and-sample pumps. The Geotech® bladder pump and Geoprobe Systems® mechanical bladder pump can be cleaned similarly.

- Discard any tubing returned with the pump.

- Completely disassemble the pump, being careful to note the initial position of and retain any springs and loose ball checks.

- Discard pump bladder.

- Clean all parts as per the standard cleaning procedure in Section 3.4.

- Install a new Teflon® bladder and reassemble pump.

3.9 Downhole Drilling Equipment

While LSASD does not currently operate drilling equipment, LSASD personnel do oversee and specify drilling operations. The following procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

3.9.1 Introduction

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Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section 3.2 of this procedure.

Tap water brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank.

A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam, with a detergent compartment, should be obtained.

3.9.2 Preliminary Cleaning and Inspection

Drilling equipment should be clean of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination. The drilling equipment should not serve as a source of contaminants. Associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (detergent and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.

- Any portion of the drilling equipment that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (detergent and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other sites before being brought on site.

- Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can provide materials without the printing and/or writing if specified when ordered. Items that cannot be cleaned are not acceptable and should be discarded.

- Equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.

3.9.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (detergent and high pressure hot water) between boreholes.

3.9.4 Field Decontamination Procedure for Drilling Equipment

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The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be decontaminated as outlined in Section 3.4 of this procedure.

- Wash with tap water and detergent, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with detergent) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.

- Rinse thoroughly with tap water.

- Remove from the decontamination pad and cover with clean, unused plastic if not used immediately. If stored overnight, the plastic should be secured to ensure that it stays in place.

3.9.5 Field Decontamination Procedure for Direct Push Technology (DPT) Equipment

- Certain specific procedures for the decontamination of DPT tools are described in the various sampling procedures, but the following general guidelines apply:

- Prior to return to the Field Equipment Center, all threaded tool joints should be broken apart and the equipment cleaned per the provisions of *Section 2.5, Sample Collection Equipment Contaminated with Environmental Media* of this procedure.

- Equipment that contacts the sample media and is cleaned in the field for reuse should be cleaned per the provisions of *Section 3.4, Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds* of this procedure. This would include piston sampler points and shoes, screen point sampler screens and sheaths, and the drive rods when used for groundwater sampling.

- Equipment that does not directly contact the sample media and is cleaned in the field for reuse can generally be cleaned per the provisions of Section *3.7.4, Field Decontamination Procedure for Drilling Equipment* of this procedure.

- Stainless steel SP15/16 well screens require special care as the narrow slots are difficult to clean under even controlled circumstances and galvanic corrosion can release chrome from the screen surface. As soon as possible after retrieval, the screen slots should be sprayed from the outside to break loose as much material as possible before it can dry in place. To prevent galvanic corrosion, the screens must be segregated from the sampler sheaths, drive rods, and other carbon steel during return transport from the field.

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3.10 Rental Pumps

Completing a groundwater sampling project may require the use of rental pumps. Rental pumps are acceptable where they are of suitable stainless steel and Teflon® construction. These pumps should be cleaned prior to use using the procedures specified herein and a rinse-blank collected prior to use.

4 References

LSASD Operating Procedure for Management of Investigation Derived Waste, LSASDPROC-202, Most Recent Version

LSASD Operating Procedure for Equipment Cleaning and Decontamination at the FEC, LSASDPROC-206, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 LSASD, Athens, GA, Most Recent Version

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the LSASD Document Control Coordinator on the LSASD local area network (LAN).

History	Effective Date
LSASDPROC-205-R4, *Field Equipment Cleaning and Decontamination,* replaces SESDPROC-205-R3 **General:** Updated format, Division and Branch names and naming conventions post agency re-alignment. Section 3.1: Added note that PFAS sampling equipment will not be cleaned in the field. Clarified in Section 3.9 that LSASD does not performing drilling activities.	June 22, 2020
SESDPROC-205-R3, *Field Equipment Cleaning and Decontamination*, replaces SESDPROC-205-R2. **Cover Page:** The author was changed to Brian Striggow. LSASD's reorganization was reflected in the authorization section by making John Deatrick the Chief of the Field Services Branch. The FQM was changed from Bobby Lewis to Hunter Johnson. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. **General:** Corrected any typographical, grammatical and/or editorial errors. **Section 1.4:** Differentiate between Liquinox® and Luminox® detergents. **Section 3.4:** Restore solvent rinse as alternative cleaning method. **Section 3.7:** Added section on cleaning of 12 Volt electric submersible pumps. **Section 3.8:** Added section on cleaning of bladder pumps. **Section 3.9:** Added language on cleaning and transport of SP15/16 screens **Section 3.10:** Added section on cleaning of rental pumps	December 18, 2015
SESDPROC-205-R2, *Field Equipment Cleaning and Decontamination*, replaces SESDPROC-205-R1.	December 20, 2011
SESDPROC-205-R1, *Field Equipment Cleaning and Decontamination*, replaces SESDPROC-205-R0.	November 1, 2007

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SESDPROC-205-R0, *Field Equipment Cleaning and Decontamination*, Original Issue	February 05, 2007

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Sample and Evidence Management**

Effective Date: May 25, 2016 | **Number:** SESDPROC-005-R3

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-005-R3, *Sample and Evidence Management*, replaces SESDPROC-005-R2 **General:** Corrected any typographical, grammatical, and/or editorial errors. **Cover Page:** SESD's reorganization was reflected in the authorization section by making John Deatrick the Chief of the Field Services Branch. The FQM was changed from Bobby Lewis to Hunter Johnson. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. **Section 2.2.2:** Revised to clarify accreditation and agency requirements for digital images. Also, language was added to accommodate new storage techniques.	May 25, 2016
SESDPROC-005-R2, *Sample and Evidence Management*, replaces SESDPROC-005-R1	January 29, 2013
SESDPROC-005-R1, *Sample and Evidence Management*, replaces SESDPROC-005-R0	November 1, 2007
SESDPROC-005-R0, Sample and Evidence Management, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed by SESD field investigators when handling and managing samples and other types of evidence after their collection and during delivery to the laboratory.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators when handling and managing samples and other evidence collected to support SESD field investigations. On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Packing, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

USEPA Digital Camera Guidance for EPA Civil Inspections and Investigations, July 2006

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2 Sample and Evidence Identification

2.1 Introduction

Sample identification, chain-of-custody records, receipt for sample records and other field records will be legibly recorded with waterproof, non-erasable ink, unless otherwise specified. If errors are made in any of these documents, corrections will be made by crossing a single line through the error and entering the correct information. All corrections must be initialed and dated. If possible, all corrections should be made by the individual making the error.

Following are definitions of terms used in this section:

Field Investigator
Any individual who performs or conducts field sampling, observation and/or measurement activities in support of field investigations

Project Leader
The individual with overall responsibility for conducting a specific field investigation in accordance with this procedure

Field Sample Custodian
Individual responsible for identifying the sample containers and maintaining custody of the samples and the Chain-of-Custody Record

Sample Team Leader
An individual designated by the project leader to be present during and responsible for all activities related to the collection of samples by a specific sampling team

Sampler
The individual responsible for the actual collection of a sample

Transferee
Any individual who receives custody of samples subsequent to release by the field sample custodian

Laboratory Sample Custodian
Individual responsible for accepting custody of samples from the field sample custodian or a transferee

One individual may fulfill more than one of the roles described above.

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2.2 Sample and Evidence Identification Procedures

2.2.1 Sample Identification

The method of sample identification used depends on the type of sample collected. Field measurement samples are those collected for specific field analysis or measurement where the data are recorded directly in bound field logbooks or on the Chain-of-Custody Record. Examples of field measurements and analyses include XRF, pH, temperature, dissolved oxygen and conductivity. Samples collected for laboratory analysis will be identified by using a stick-on label or a tag which is attached to the sample container. In some cases such as biological samples, the label or tag may have to be affixed to a bag containing the sample. If a sample tag is used, the sample should be placed in a bag, then the sample and the tag will be placed in a second bag.

The following information will be included on the sample label or tag using waterproof, non-erasable ink:

- Project number;
- Field identification or sample station number;
- Date and time of sample collection;
- Designation of the sample as a grab or composite;
- Whether the sample is preserved or unpreserved;
- The general types of analyses to be performed.

Other information such as readily detectable or identifiable odor, color, or known toxic properties may be added as deemed necessary by the project leader or sample custodian.

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2.2.2 Digital Images – Photographs and Videos

When digital images, which include but are not limited to photographs, digital still images and videos, are taken for purposes of documenting and supporting a field investigation, a record, containing relevant information, will be kept in a field logbook. The following information will be recorded in the log:

- Digital Image Location or Station Identification
- Description of what the digital image shows
- Date and time the digital image was taken
- Name of the individual that took the digital image
- Digital file name (assigned by camera)
- Orientation, if applicable
- Other pertinent information

When digital images are obtained during a field investigation, the permanent record for the official project file, will be stored on a project dedicated data storage device, which includes but is not limited to Secure Digital (SD) card, Compact Discs (CD), or Flash Drives. A new data storage device will be utilized for each project and once the project is completed the device, containing the unaltered investigation-related images, will be labeled with the project's unique identification number and placed in the official file. Photographs taken for educational or other purposes should be stored on an additional storage device and should not be included in the official project file.
It is SESD's policy that, during a field investigation, official project specific digital images should be obtained using SESD issued electronics but in the event that the only option field personnel have is to utilize their own electronic equipment the following steps should be taken:

- Record all required digital image information, as described above
- Record devices make, model and owner's name
- Transfer all digital images to a project specific data storage device and adhere to requirements outlined in the EPA Records Management Policy (CIO 2155.3).

2.2.3 Identification of Physical Evidence

Physical evidence, other than samples, will be identified, when possible, by recording the necessary information on the evidence. When samples are collected from vessels or containers which can be moved (drums for example), the vessel or container should be marked with the field identification or sample station number for future identification. The vessel or container may be labeled with an indelible marker (e.g., paint stick or spray paint). The vessel or container need not be marked if it already has a unique marking; however, these markings will be recorded in the bound field logbooks. In addition, it is suggested that photographs of any physical evidence (markings, etc.) be taken and the necessary information recorded in the field logbook.

Occasionally, it is necessary to obtain copies of recorder and/or instrument charts from facility owned analytical equipment, flow recorders, etc., during field investigations and inspections. A unique identifier will be recorded on the document with that information as well as the following recorded in the logbook:

- Starting and ending time(s) and date(s) for the chart;
- An instantaneous measurement of the media being measured by the recorder will be taken and entered at the appropriate location on the chart along with the date and time of the measurement; and
- A description of the location being monitored and other information required to interpret the data such as type of flow device, chart units, factors, etc.

The field investigator will indicate who the chart (or copy of the chart) was received from and enter the date and time, as well as the field investigator's initials.

Documents such as technical reports, laboratory reports, etc., should be marked with the field investigator's signature, the date, the number of pages and from whom they were received. Documents that are claimed by a facility to be "confidential" and, therefore, potentially subject to the Confidential Business Information requirements, will be handled in accordance with SESD Operating Procedure for Control of Records (SESDPROC-002).

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3 Chain-of-Custody Procedures

3.1 Introduction

Chain-of-custody procedures are comprised of the following elements: 1) maintaining custody of samples or other evidence, and 2) documentation of the chain-of-custody for evidence. To document chain-of-custody, an accurate record must be maintained to trace the possession of each sample, or other evidence, from the moment of collection to its introduction into evidence.

3.2 Sample Custody

A sample or other physical evidence is in custody if:

- It is in the actual possession of an investigator;
- It is in the view of an investigator, after being in their physical possession;
- It was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- It is placed in a designated secure area.

3.3 Documentation of Chain-of-Custody

The following are used to identify and demonstrate how sample integrity is maintained and custody is ensured.

Sample Identification
A stick-on sample label or a tag should be completed for each sample container using waterproof, non-erasable ink as specified in Section 2.2.1.

Sample Seals
If appropriate, samples should be sealed as soon as possible following collection using a custody seal with EPA identification. The sample custodian or project leader will write the date and their initials on the seal. The use of custody seals may be waived if field investigators keep the samples in their custody as defined in Section 3.2, from the time of collection until the samples are delivered to the laboratory analyzing the samples.

Field Sample Custodian
The field sample custodian is the person designated by the project leader to receive and manage custody of samples while in the field, including labeling and custody sealing.

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Chain-of-Custody Record

The field Chain-Of-Custody record is used to document the custody of all samples or other physical evidence collected and maintained by investigators. All physical evidence or samples will be accompanied by a Chain-Of-Custody Record. This form may be generated by sample custody management software (Section 5) or it may be a pre-printed multi-sheet carbonless form for hand entry of required information. The Chain-Of-Custody Record documents transfer of custody of samples from the sample custodian to another person, to the laboratory or other organizational elements. The Chain-of-Custody Record will not be used to document the collection of split samples where there is a legal requirement to provide a receipt for samples (see Section 4, Receipt for Samples Form (CERCLA/RCRA/TSCA)). The Chain-Of-Custody Record also serves as a sample logging mechanism for the laboratory sample custodian. A separate Chain-of-Custody Record should be used for each final destination or laboratory used during the investigation.

All information necessary to fully and completely document the sample collection and required analyses must be recorded in the appropriate spaces to complete the field Chain-Of-Custody Record. The following requirements apply to Chain-Of-Custody records generated by either sample custody management software or by hand entry on pre-printed forms:

- All sampling team leaders must sign in the designated signature block.
- One sample should be entered on each line and not be split among multiple lines.
- If multiple sampling teams are collecting samples, the sampling team leader's name should be clearly indicated for each sample.
- The total number of sample containers for each sample must be listed in the appropriate column. Required analyses should be entered in the appropriate location on the Chain-of-Custody Record.
- The field sample custodian, project leader or other designee, and subsequent transferee(s) should document the transfer of the samples listed on the Chain-of-Custody Record. Both the person relinquishing the samples and the person receiving them must sign the form. The date and time that this occurs should be documented in the proper space on the Chain-of-Custody Record. The exception to this requirement would be when packaged samples are shipped with a common carrier. Even though the common carrier accepts the samples for shipment, they do not sign the Chain-of-Custody Record as having received the samples.

- The last person receiving the samples or evidence will be the laboratory sample custodian or their designee(s).

The Chain-of-Custody Record is a uniquely identified document. Once the Record is completed, it becomes an accountable document and must be maintained in the project file. The suitability of any other form for chain-of-custody should be evaluated based upon its inclusion of all of the above information in a legible format.

If chain-of-custody is required for documents received during investigations, the documents should be placed in large envelopes, and the contents should be noted on the envelope. The envelope will be sealed and an EPA custody seal placed on the envelope such that it cannot be opened without breaking the seal. A Chain-Of-Custody Record will be maintained for the envelope. Any time the EPA seal is broken, that fact will be noted on the Chain-Of-Custody Record and a new seal affixed, as previously described in this section.

Physical evidence such as video tapes or other small items will be placed in an evidence bag or envelope and an EPA custody seal should be affixed so that they cannot be opened without breaking the seal. A Chain-Of-Custody Record will be maintained for these items. Any time the EPA seal is broken, that fact will be noted on the Chain-of-Custody Record and a new seal affixed.

EPA custody seals can be used to maintain custody of other items when necessary by using similar procedures as those previously outlined in this section.

Samples should not be accepted from other sources unless the sample collection procedures used are known to be acceptable, can be documented and the sample chain-of-custody can be established. If such samples are accepted, a standard sample label containing all relevant information and the Chain-Of-Custody Record will be completed for each set of samples.

3.4 Transfer of Custody with Shipment

Transfer of custody is accomplished by the following:

- Samples will be properly packaged for shipment in accordance with the procedures outlined in SESD Operating Procedure for Packing, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209).

- All samples will be accompanied by the laboratory copy of the Chain-Of-Custody Record. If pre-printed forms are used, the white and pink sheets will be sent. If sample custody management software is used to generate the Chain-Of-Custody Record, the laboratory copy is identified with an "L" in the upper right corner. If multiple coolers are needed for shipment to a particular laboratory, the laboratory

copy of the Chain-Of-Custody Record for the entire shipment is placed in a sealed plastic bag in one of the coolers. When shipping samples via common carrier, the "Relinquished By" box should be filled in; however, the "Received By" box should be left blank. The laboratory sample custodian is responsible for receiving custody of the samples and will fill in the "Received By" section of the Chain-of-Custody Record. One copy of the Record will be provided to and retained by the project leader. After samples have been received and accepted by the laboratory, a copy of the Chain-of-Custody Record, with ASB sample identification numbers, will be transmitted to the project leader. This copy will become a part of the project file.

- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, an Air Bill should be used. The Air Bill number, shipment tracking number or registered mail serial number will be recorded in the remarks section of the Chain-Of-Custody Record.

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4 Receipt for Samples Form (CERCLA/RCRA/TSCA)

4.1 Introduction

Section 3007 of the Resource Conservation and Recovery Act (RCRA) of 1976 and Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) of 1980 require that a "receipt" for all facility samples collected during inspections and investigations be given to the owner/operator of each facility before the field investigator departs the premises. The Toxic Substances Control Act (TSCA) contains similar provisions. The laws do not require that homeowners or other off-site property owners be given this form.

4.2 Receipt for Samples Form

If necessary, a Receipt for Samples form, using either the pre-printed form or one generated by sample custody management software, is to be used to satisfy the receipt for samples provisions of RCRA, CERCLA and TSCA. The form also documents that split samples were offered and either "Received" or "Declined" by the owner/operator of the facility or site being investigated (if a sample is split with a facility, state regulatory agency or other party representative, the recipient should be provided (if enough sample is available) with an equal weight or volume of sample). All information must be supplied in the indicated spaces to complete the Receipt for Samples form.

- The sampler(s) must sign the form in the indicated location

- Each sample collected from the facility or site must be documented in the sample record portion of the form. The sample station number, date and time of sample collection, composite or grab sample designation, whether or not split samples were collected (yes or no should be entered under the split sample column), a brief description of each sampling location and the total number of sample containers for each sample must be entered.

- The bottom of the form is used to document the site operator's acceptance or rejection of split samples. The project leader must sign and complete the information in the "Split Samples Transferred By" section (date and time must be entered). If split samples were not collected, the project leader should initial and place a single line through "Split Samples Transferred By" in this section. The operator of the site must indicate whether split samples were received or declined and sign the form. The operator must give their title, telephone number and the date and time they signed the form. If the operator refuses to sign the form, the sampler(s) should note this fact in the operator's signature block and initial this entry.

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The Receipt for Samples form is an accountable document after it is completed. A copy of the form is to be given to the facility or site owner/operator. The original form must be maintained in the project files.

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5 Sample Custody Management Software

The container labels and the Chain-of-Custody record should be generated using a sample custody management software to streamline the documentation required by SESD and/or the Contract Laboratory Program (CLP) for sample identification and chain-of-custody. When possible, the sample custody management software should be used during all field investigations. Once the appropriate information is entered into the computer, the software will generate stick-on labels for the sample containers and will generate sample receipt forms and chain-of-custody records for the appropriate laboratory. The advantages to this system include faster processing of samples and increased accuracy. Accuracy is increased because the information is entered only once, and consequently, consistent for the bottle labels, sample receipt forms and chain-of-custody records. .

Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples	ID: LSASDPROC-209-R4
Issuing Authority: LSASD Field Branch Chief	
Effective Date: February 23, 2020	Review Due Date: February 23, 2024

Purpose

Regulations for packing, marking, labeling, and shipping of dangerous goods by air transport are promulgated by Department of Transportation under 49 CFR, Subchapter C, Hazardous Materials Regulations, and the International Air Transport Authority (IATA), which is equivalent to United Nations International Civil Aviation Organization (UN/ICAO). Transportation of hazardous materials (dangerous goods) by EPA personnel is covered by EPA Order 1000. This document describes general and specific procedures, methods and considerations to be used and observed by LSASD field investigators when packing, marking, labeling and shipping environmental and waste samples to ensure that all shipments are in compliance with the above regulations and guidance.

Scope/Application

The procedures contained in this document are to be used by field personnel when packing, marking, labeling, and shipping environmental samples and dangerous goods by air transport. Samples collected during field investigations or in response to a hazardous materials incident must be classified prior to shipment, as either environmental or hazardous materials (dangerous goods) samples.

In general, environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials. Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods.

Government employees transporting samples or hazardous materials (i.e., preservatives or waste samples) in government vehicles are not subject to the requirements of this section in accordance with 49 CFR 171.1(d)(5). EPA contractors, however, are not covered by this exemption and may not transport these materials without full compliance with 49 CFR. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

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ED_006371_00001599-00156

1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.2 General Precautions

1.2.1 Safety

Proper safety precautions must be observed when packing, marking, labeling, and shipping environmental or waste samples. Refer to the LSASD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional.

2 Shipment of Dangerous Goods

2.1 The project leader is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, IATA, then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of the waste sample or highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

In addition, the shipment of pre-preserved sample containers or bottles of preservatives (e.g., NaOH pellets, HCL, etc.) which are designated as dangerous goods by IATA is regulated. Shipment of nitric acid is strictly regulated. Consult the IATA Dangerous Goods Regulations for guidance. ***Dangerous goods must not be offered for air transport by any personnel except LSASD's dangerous goods shipment designee or other personnel trained and certified by IATA in dangerous goods shipment.***

3 Shipment of Environmental Samples

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3.1 Guidance for the shipment of environmental laboratory samples by personnel is provided in a memorandum dated March 6, 1981, subject "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples". By this memorandum, the shipment of the following unpreserved samples is not regulated:

3.1.1 Drinking water
3.1.2 Treated effluent
3.1.3 Biological specimens
3.1.4 Sediment
3.1.5 Water treatment plant sludge
3.1.6 POTW sludge

3.2 In addition, the shipment of the following preserved samples is not regulated, provided the amount of preservative used does not exceed the amounts found in 40 CFR 136.3 or the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version. This provision is also discussed in correspondence between DOT and EPA (Department of Transportation, Letter from Edward T. Mazzullo, Director, Office of Hazardous Materials Standards, to Henry L. Longest II, Acting Assistant Administrator, USEPA, Ref No.: 02-0093, February 13, 2003). It is the shippers' (individual signing the air waybill) responsibility to ensure that proper amounts of preservative are used:

3.2.1 Drinking water
3.2.2 Ambient water
3.2.3 Treated effluent
3.2.4 Biological specimens
3.2.5 Sediment
3.2.6 Wastewater treatment plant sludge
3.2.7 Water treatment plant sludge

3.3 Samples determined by the project leader to be in these categories are to be shipped using the following protocol, developed jointly between USEPA, OSHA, and DOT. This procedure is documented in the "Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples."

3.4 Untreated wastewater and sludge from Publicly Owned Treatment Works (POTWs) are considered to be "diagnostic specimens" (not environmental laboratory samples). However, because they are not considered to be etiologic agents (infectious) they are not restricted and may be shipped using the procedures outlined below.

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3.5 Environmental samples should be packed prior to shipment by air using the following procedures:

3.5.1 Allow sufficient headspace (ullage) in all bottles (except VOA containers with a septum seal) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

3.5.2 Ensure that the lids on all bottles are tight (will not leak).

3.5.3 Place bottles in separate and appropriately sized polyethylene bags and seal the bags. If available, the use of Whirl-Pak bags is preferable, if unavailable seal regular bags with tape (plastic electrical tape).

3.5.4 Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape inside and outside. Line the cooler with a large heavy duty plastic bag.

3.5.5 Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

3.5.6 .If required by the method for preservation, put "blue ice" (or ice that has been "double bagged" in heavy duty polyethylene bags and properly sealed) on top of and/or between the containers. Fill all remaining space between the containers with absorbent material.

3.5.7. If the samples are preserved with ice, include a temperature blank for the laboratory to verify that the samples are received at the appropriate temperature.

3.5.8 Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).

3.5.9 Place the Chain-of-Custody Record or the CLP Traffic Report Form (if applicable) into a plastic bag and tape the bag to the inner side of the cooler lid.

3.5.10 Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Chain-of-custody seals should be affixed to the top and sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version.

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Title 40 Code of Federal Regulations (CFR), Pt. 136.3, Identification of Test Procedures, July 1, 2001. See Table II, Footnote 3.

Title 49 CFR, Pt. 171.1(d)(5), Applicability of Hazardous Materials Regulations (HMR) to Persons and Functions.

United States Department of Transportation (US DOT). 2003. Letter from Edward T. Mazzullo, Director, Office of Hazardous Materials Standards, to Henry L. Longest II, Acting Assistant Administrator, USEPA, Ref No. 02-0093, February 13, 2003.

US Environmental Protection Agency (US EPA) Order 1000.18, February 16, 1979.

US EPA. 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (LSASD), Athens, GA.

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 LSASD, Athens, GA, Most Recent Version.

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 LSASD Athens, GA, Most Recent Version.

5 Revision History

This table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the LSASD Quality Assurance Coordinator on the LSASD local area network (LAN).

History	Effective Date
LSASDPROC-209-R4 *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces LSASDPROC-209-R3 Reformatted document to Divisional Format	February 23, 2020
LSASDPROC-209-R3, *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces LSASDPROC-209-R2.	February 4, 2015

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ED_006371_00001599-00160

Cover Page: Changes made to reflect reorganization of LSASD from two field branches to one: John Deatrick listed as the Chief, Field Services Branch. The FQM was changed from Liza Montalvo to Hunter Johnson. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history.	
LSASDPROC-209-R2, *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces LSASDPROC-209-R1.	April 20, 2011
LSASDPROC-209-R1, *Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, replaces LSASDPROC-209-R0.	November 1, 2007
LSASDPROC-209-R0, Packing, Marking, Labeling and Shipping of Environmental and Waste Samples, Original Issue	February 05, 2007

Uncontrolled When Printed

Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Management of Investigation Derived Waste	ID: LSASDPROC-202-R4
Issuing Authority: LSASD Field Branch Chief	
Effective Date: May 8, 2020	Review Date: May 8, 2024

Purpose

This document describes general and specific procedures and considerations to be used and observed when managing investigation derived waste (IDW) generated during the course of hazardous waste site investigations.

Scope/Application

The procedures and management options for the different categories of IDW described in this document are to be used by LSASD field personnel to manage IDW generated during site investigations. On the occasion that LSASD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to manage IDW generated at a particular site, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.2 General Precautions

1.2.1 Safety

Proper safety precautions must be observed when managing IDW. Refer to the LSASD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.2.2 Procedural Precautions

The following precautions should be considered when managing IDW:

- Due to time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation start dates should be identified on all drums, buckets or other containers used to hold IDW so that it can be managed in a timely manner.
- During generation of both non-hazardous and hazardous IDW, keep hazardous IDW segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be properly managed.

2 Types of Investigation Derived Waste

Materials which may become IDW include, but are not limited to:

- Personal protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.

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- Disposable equipment and items - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.

- Soil cuttings from drilling or hand augering.

- Drilling mud or water used for mud or water rotary drilling.

- Groundwater obtained through well development or well purging.

- Cleaning fluids such as spent solvents and wash water.

- Packing and shipping materials.

Table 1, found at the end of this procedure, lists the types of IDW commonly generated during field investigations and the current disposal practices for these materials.

For the purpose of determining the ultimate disposition of IDW, it is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis. This determination and subsequent management is the responsibility of the program site manager.

3 Management of Non-Hazardous IDW

Disposal of non-hazardous IDW should be addressed in the Sampling and Analysis Plan (SAP) or QAPP for the investigation. To reduce the volume of any IDW transported back to the Field Equipment Center (FEC), it may be necessary to compact the waste into a reusable container, such as a 55-gallon drum.

If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard into the facility's dumpsters. If necessary, these materials may be placed into municipal dumpsters, with the permission of the owner. These materials may also be taken to a nearby permitted landfill. On larger studies, waste hauling services may be obtained and a dumpster located at the study site.

Disposal of non-hazardous IDW such as drill cuttings, drilling mud, purge or development water, decontamination wash water, etc., should be specified in the approved SAP or QAPP. It is recommended that these materials be placed into a unit with an environmental permit, such as a landfill or sanitary sewer. These materials must not be placed into dumpsters. If the facility at which the study is being conducted is active, permission should be sought to place these types of IDW into the facility's treatment system. It may be feasible to spread drill cuttings around the borehole, or, if the well is temporary, to place

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the cuttings back into the borehole. Non-hazardous monitoring well purge or development water may also be poured onto the ground down gradient of the monitoring well when site conditions permit. Purge water from private potable wells which are in service may be discharged directly onto the ground surface.

The minimum requirements for this subsection are:

- Non-hazardous liquid and soil/sediment IDW may be placed on the ground or returned to the source if doing so does not endanger human health or the environment or violate federal or state regulations. Under no circumstances, however, should monitoring well purge water be placed back into the well from which it came.
- Soap and water decontamination fluids and rinses of such cannot be placed in any water bodies and must be collected and returned to the FEC for disposition.
- The collection, handling and proposed disposal method must be specified in the approved SAP or QAPP.

4 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW must be specified in the approved SAP or QAPP for the study or investigation. Hazardous IDW must be disposed as specified in USEPA regulations. If appropriate, these wastes may be placed back in an active facility waste treatment system. These wastes may also be disposed in the source area from which they originated if doing so does not endanger human health or the environment.

If on-site disposal is not feasible, and if the wastes are suspected to be hazardous, appropriate tests must be conducted to make that determination. If they are determined to be hazardous wastes, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Generation of hazardous IDW must be anticipated, if possible, to allow arrangements for proper containerization, labeling, transportation and disposal/treatment in accordance with USEPA regulations.

The generation of hazardous IDW should be minimized to conserve Division resources. Most routine studies should not produce any hazardous IDW, with the possible exception of spent solvents and, possibly, purged groundwater. The use of solvents during field cleaning of equipment should be minimized by using solvent-free cleaning procedures for routine cleaning and decontamination (see SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205). If solvents are needed, the volume should be minimized by using only the amount necessary and by capturing the residual solvent separately from the aqueous decontamination fluids (detergent/wash water mixes and water rinses).

At a minimum, the requirements of the management of hazardous IDW are as follows:

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- Spent solvents must be left on-site with the permission of site operator and proper disposal arranged.
- All hazardous IDW must be containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

5 References

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, LSASDPROC-205, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

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6 Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
LSASDPROC-202-R4, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R3 **General:** Corrected typographical, grammatical and/or editorial errors. Updated format and naming convention, updated references from SESD to LSASD and FSB to LSB.	May 8, 2020
SESDPROC-202-R3, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R2. **General:** Corrected typographical, grammatical and/or editorial errors. **Cover Page:** The Enforcement and Investigations Branch Chief was changed from Archie Lee to Acting Chief John Deatrick. The Ecological Assessment Branch Chief was changed from Bill Cosgrove to Acting Chief Mike Bowden. The FQM was changed from Liza Montalvo to Bobby Lewis. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history.	July 3, 2014
SESDPROC-202-R2, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R1.	October 15, 2010
SESDPROC-202-R1, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R0.	November 1, 2007
SESDPROC-202-R0, Management of Investigation Derived Waste, Original Issue	February 05, 2007

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Table 1: Disposal of IDW

TYPE	HAZARDOUS	NON - HAZARDOUS
PPE-Disposable	Containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.
PPE-Reusable	Decontaminate as per SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, if possible. If the equipment cannot be decontaminated, containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Decontaminate as per SESDPROC-205, and return to FEC.
Spent Solvents	Containerize in original containers. Clearly identify contents. Leave on-site with permission of site operator and arrange for proper disposal.	N/A
Soil Cuttings	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in a 55-gallon steel drum with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Groundwater	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Decontamination Water	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. Decontamination water may also be disposed in a sanitary sewer system, with permission from the wastewater treatment plant representative, and if doing so does not endanger human health or the environment, or violate federal or state regulations.
Disposable Equipment	Containerize in DOT-approved container or 5-gallon plastic bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. If unfeasible, return to FEC for disposal in dumpster.
Trash	N/A	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.

**** These materials may be placed on the ground if doing so does not endanger human health or the environment or violate federal or state regulations.**

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

GUIDANCE

Title: **Environmental Data Submission**

Effective Date: December 17, 2010	**Number:** SESDGUID-106-R0

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-106-R0, *Environmental Data Submission,* Original Issue	December 17, 2010

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1 General Information

1.1 Purpose

This document describes the methods to be used in submitting environmental data electronically to US EPA Region 4.

1.2 Scope/Application

The methods described in this document are to be used by all data providers when preparing and submitting environmental data electronically to Region 4, regardless of the originating program.

EQuIS is the name of the database used by SESD Region 4 for storing environmental data. DART and EQuIS Pro are the interfaces to that database (web and desktop, respectively). EQuIS Pro is available on all EPA workstations, DART is available via the EPA intranet. Both require a valid User ID and password.

This document does not cover the use of EQuIS for creating maps or reports. Extensive documentation on the use of the system can be found at http://help.earthsoft.com/display/Dashboard/EQuIS+Documentation+Dashboard. In addition, the DART Support Website (US EPA intranet only) contains many useful features: http://r4esdcf1.r4esd.epa.gov/cfdocs/dms/index.cfm.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the SESD LAN and for maintaining records of review conducted prior to its issuance.

1.4 Acronyms

ANSETS: Analytical Services Tracking System

CLP: Contract Laboratory Program

COC: Chain-of-Custody

DART: Data Archival and ReTrieval

EDD: Electronic Data Deliverable

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EDP: EQuIS Data Processor

LIMS: Laboratory Information Management System

SESD: Science and Ecosystem Support Division

PRP: Potentially Responsible Party

1.5 Definitions

Activity Code (task_type): Descriptive code for the EPA program (Superfund, RCRA, etc.) requiring the investigation. Activity Code values are a controlled vocabulary.

Analytical Data: Data reported by a fixed-base laboratory (analyses performed in a laboratory)

Complex Study: An investigation of multiple waterbodies (or sites) combined into a single lab report. This designation is applicable only to certain SESD led studies.

Controlled Vocabulary: see Valid Values

DART: Web-based interface to the Region 4 EQuIS database

Darter: A collection of software utilities to assist in the creation of EDDs for Region 4. These utilities are designed and supported for EPA lead studies only.

Data Package: A data package is a software archive (.zip format) containing one or more EDDs.

Data Provider: The entity responsible for the electronic submission of environmental data to Region 4. Data providers are identified by a code value that is a controlled vocabulary.

Data Submittal Summary: A summary of the data proposed for submittal by the data provider (non-EPA lead providers only).

Electronic Data Deliverable (EDD): A tab delimited text file containing the environmental data to be submitted.

Element: LIMS system used to report SESD and CLP analytical data.

EPA Laboratories: SESD and CLP laboratories.

EPA Workstation: PC connected to the EPA intranet.

EQuIS Data Processor (EDP): Software that validates EDDs prior to submittal.

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EQuIS Pro: EPA workstation software interface to the EQuIS database.

ESRI: is a software development and services company providing Geographic Information System (GIS) software (ArcMap)

FieldResults Data: Field analytical data such as pH, dissolved oxygen, XRF, etc.

Geology Data: Specialized data relating to geology, such as lithology, well construction, etc.

LIMS (Laboratory Information Management System): Software for managing and reporting laboratory analyses.

Media Code (matrix_code): A two letter code designating the sample matrix, i.e., SW is the media code for Surface Water. Media code values are a controlled vocabulary.

Non EPA Laboratories: All laboratories with data being submitted to Region 4 that do not use the Region 4 LIMS (Element).

Project: A project is defined as the data generated for a report.

Project ID (task_code): Unique ID associated with a project. This value is assigned by Project Log (EPA lead investigations), and manually by SESD for all other investigations.

Project Log: Region 4 software for booking lab space in CLP and ASB. This software tracks all Superfund fund lead and SESD lead projects.

Quality Assurance Project Plan (QAPP): The controlling document for proposed field work. The Project ID number assigned to the QAPP will be used in EDDs generated for that project to uniquely identify the data to that investigation.

QA Tracking System: A software subsystem of the Project Tracking System to log QAPPs and track their approval.

Reference Value (.rvf) File: File containing valid values used in Region 4.

Scribe: EPA software for management of data in the field, including chain-of-custody paperwork.

Shapefiles: Map files used by ESRI GIS software.
Site (or Waterbody): The unique site or waterbody in DART for storing project data.

Station ID (sys_loc_code): Unique designation for a sample location.

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Valid Values: All allowable values for the field have been pre-determined, and are available as a drop-down pick list. The data provider must select one of the available choices, or request a new valid value be added.

Waterbody (or Site): The unique site or waterbody in DART for storing project data.

Extended Markup Language (.xml) file: File format of the FORMS II Lite and Scribe chain-of-custody EDD.

1.6 References

United States Environmental Protection Agency (US EPA), Region 4 Electronic Data Deliverables Reference Guide (most recent version).

The Region 4 EDD Reference Guide provides detailed information for the creation of the EDD files that are required to be submitted.
http://www.epa.gov/region4/waste/sf/edd/edd.html

United States Environmental Protection Agency (US EPA), Region 4 EQuIS Data Processor Reference Manual (most recent version).

The Region 4 EDP Reference Manual provides the information needed to download, install and maintain the EDP software, as well as how to use the software to proof EDDs and create data packages. http://www.epa.gov/region4/waste/sf/edd/edd.html

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2 Introduction

2.1 Data Sources

Data is submitted electronically to Region 4 from two sources: EPA lead environmental projects and PRP (Potentially Responsible Party) lead environmental projects. It should be emphasized that the differences between the two processes for data submittal arise solely from the inherent efficiencies afforded to EPA lead investigations because the work is being done 'in-house'. There is **no** difference in the types of data submitted, or the format of the files being submitted. Regardless of how EDD files are created (or what organization led the investigation), the files must meet the specifications of the Region 4 EDD Reference Guide.

2.2 Overview

The following summary provides a general outline of the process for submitting environmental data to Region 4.

Create the site or waterbody: If the site or waterbody does not exist in DART, it must be created. Creating the site or waterbody is the responsibility of Region 4.

Create the project: Before data can be accepted into DART, a receiving project must be created in Project Log (currently Superfund fund lead and SESD lead only). Creating the project is the responsibility of Region 4.

COC or Data Submittal Summary: A summary of the data must be submitted to provide a check that all data is received. The data provider (or EPA SESD project leader) is responsible for this task.

DART Reports: Automated reports for the specific EDDs required are sent out automatically after the COC information is uploaded to Element (EPA lead investigations). The data provider (or EPA SESD project leader) is responsible for responding to these reports.

Create EDD(s): Create EDDs to match the Data Submittal Summary. The data provider (or EPA SESD project leader) is responsible for this task. See the Region 4 Electronic Data Deliverables Reference Guide for details.

Check EDD(s) with EDP: All EDDs must be checked with EDP prior to submittal to Region 4. The data provider (or EPA SESD project leader) is responsible for this task. See the Region 4 EQuIS Data Processor for details.

Submit EDD(s): PRP lead projects should submit all EDDs to r4dartcoordinator@epa.gov. EPA lead projects should submit all EDDs to

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r4dart@epa.gov. Attach the EDD(s) to the requesting email. The data provider (or EPA SESD project leader) is responsible for this task.

Proof and correct reports as needed: It is EPA Region 4's responsibility to provide these reports to the data provider. It is then the responsibility of the data provider (or EPA SESD project leader) to proof the data for accuracy and submit any needed corrections. PRP lead data providers should notify r4dartcoordinator@epa.gov of any needed corrections. EPA lead data providers should notify r4dart@epa.gov of any needed corrections.

The system is designed for data to be submitted once, i.e., sample coordinates for a monitoring well are submitted one time.

The details for successfully completing the above steps can be found below in Section 3 for EPA lead data submittals and Section 4 for Potentially Responsible Party (PRP) lead data submittals.

2.3 EQuIS Data Processor (Standalone)

If you are a data provider to Region 4 and do not have access to an EPA workstation, you will need to download and install the EQuIS Data Processor (EDP) software. There is no charge to the user for this software. If you are a data provider with access to an EPA workstation and need EDP installed, email r4dart@epa.gov.

2.3.1 Obtaining Standalone EDP

Instructions for obtaining, installing, registering, maintaining, and using standalone EDP can be found in the Region 4 EDP Reference Manual.

2.3.2 Using Standalone EDP

EDP can be used to create smaller EDD files, but its primary function is to check EDDs for errors and create data packages for submittal.

The structure of the Region 4 EDD files is determined by the format file. If the format of any of the EDDs must be changed (rarely), it will then be necessary for users of the standalone version of EDP to obtain the updated format file. Instructions for downloading and installing updated format files can be found in the Region 4 EDP Reference Manual.

Likewise, if the valid values used by Region 4 are updated, it will then be necessary for users of the standalone version of EDP to obtain the updated reference value (.rvf) file. This file is updated periodically. The file is available at: http://www.epa.gov/region4/waste/sf/edd/edd.html

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Region 4 will notify all data providers currently in the database when it is necessary to update these files, but it is the responsibility of the data provider to ensure that the most current version is being used. See the Region 4 EQuIS Data Processor Reference Manual for details.

2.3.3 Valid Values in EDP

Region 4 valid values can be viewed in EDP by starting EDP then clicking on the Reference Values tab in the lower left corner.

If you need a valid value that is not in the list (rare analyte, new analytical method, etc.), you may request it be added as outlined in the Region 4 Electronic Data Deliverables Reference Guide.

2.3.4 Data Package

A data package is created by EDP when the 'sign and submit' function is used. This creates an archive file (.zip) containing all EDDs that were loaded into EDP. The data package must be properly named and attached to an email request before submittal to Region 4. See the Region 4 EQuIS Data Processor Reference Manual for details.

2.4 Information Required

An Electronic Data Deliverable (EDD) is a tab-delimited text file containing environmental data in the Region 4 format. Detailed information on all EDD formats may be found in the Region 4 EDD Reference Guide. A summary of the more commonly used formats follows:

Location EDDs: These files provide coordinates for sampling locations, along with a simple indication of the quality of the information. Because all other EDDs rely upon this information, the Location EDD is the first EDD that is submitted.

FieldResults EDDs: These EDDs provide the results of field analyses, for example XRF, pH, temperature, turbidity, etc.

Water Level EDDs: Provide groundwater elevation data. If a water level EDD is submitted, a Location EDD with the surface elevation (measured to top of casing for wells) is required. In addition, each Water Level EDD must contain the well top of casing elevation (relative to mean sea level).

Geology EDDs: These EDDs provide information about well construction, lithology, etc.

Analytical Data EDDs: Provide the fixed-base laboratory analytical data. The data is in a three file format.

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2.5 Defining the Data Provider

The data provider in EQuIS is defined as the organization providing the data, not an individual.

For EPA lead studies, data providers are already defined. If an additional data provider must be added, the program office must provide the following information to r4dart@epa.gov:

- Organization name
- E-mail address
- Organization type (choose one):
  - SAMPLER_FEDERAL
  - SAMPLER_STATE
  - SAMPLER_CONT (RACS)
  - SAMPLER_CONT (START)
  - SAMPLER_CONT (ERRS)
  - SAMPLER_CONT (ROC)

For PRP lead studies, data providers must be defined in EQuIS. To define a data provider, the program office must provide the following information to r4dartcoordinator@epa.gov:

- Organization name
- E-mail address
- Organization type:
  - SAMPLER_REG_COMM

EPA will update the .rvf file upon receipt of the above information.

2.6 Common Fields

With few exceptions, the values described below are the first four columns of all Region 4 EDDs. See the Region 4 EDD Reference Guide for details on your specific EDD format.

2.6.1 Data Provider Codes (sampling_company)

Data Provider codes are used to identify the source of the data within DART.

For EPA lead projects, the data provider code is selected within the Project Log as the project is created.

For PRP lead projects, the data provider code is determined by Region 4, and is then provided to the PRP via an updated .rvf file. If a data provider code does not

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exist in the system, it will be created upon receipt of the information specified in Section 2.5

2.6.2 Project IDs (task_code)

The Project ID is a unique identifier for all data collected during an investigation. It allows data from a given study to be retrieved by the original report with which it was submitted.

For EPA lead projects, the Project ID is generated by Project Log when the project is created. For PRP lead studies, the Project ID is generated manually by SESD and then provided to data providers.

2.6.3 Program\Activity Codes (task_type)

The Program\Activity code identifies the program requesting the investigation to the DART database.

For EPA lead projects, the Program\Activity code is provided by the person entering project data into the SESD Project Log.

For PRP lead projects, the Program\Activity code is determined by the site manager (RPM, OSC, etc.) and is then provided to the PRP.

2.6.4 Station IDs (sys_loc_code)

A Station ID is the permanent, unique designation for a sample collection point. Once a sampling point has been established, the Station ID designation will be used for all future sampling events regardless of the entity leading the investigation. Note that the sampling point is established for a location, not a sample type.

The Sample ID is the designation given to the sample itself.

A Station ID is not a Sample ID. Sample IDs should be distinct from Station IDs to prevent confusion.

Station ID designations should be simple and easy to remember. Do not use spaces, dashes, or underscore characters. The Station ID should be kept to 8 or fewer characters if possible.

For example, two samples are collected from the same location in Sandy Creek, sample SC-001-SW (a surface water sample) and SC-001-SD (a companion sediment sample). Because they were collected at the same location, both will have the same Station ID, such as SC001.

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A soil sample is collected as a part of a monitoring well installation. The subsurface soil sample is designated RF-007C-SB, the groundwater sample is designated MW012-0810 (monitoring well sample, August 2010). The well being installed is being given the designation MW012. Sample RF-007C-SB (and all other samples collected at that well location) will have the Station ID MW012.

It may help to think of the Station ID as the permanent name for a sampling location, while any number of samples (from any media available) may be collected at that given location. A Station ID is a point on a map, and many samples may be collected from that point during an investigation (or series of investigations).

All environmental samples must have a Station ID – Surface water, groundwater, sediment, waste water, surface soil, etc.

Field Blanks (trip blanks, equipment rinse blanks, etc.) do not have coordinates and therefore do not have Station IDs. The logic for this is built into EDP – if you try to enter a Station ID for a sample type (media code) that does not allow it, EDP will display an error. Likewise, if a media code requires a Station ID that is missing, EDP will again display an error.

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3 EPA Lead Data Submittals

3.1 EPA Lead Projects

Data from all EPA lead projects (SESD, States and EPA contractor Project Leaders) using EPA laboratory resources (CLP, SESD, ANSETS and special purchase laboratories) must be permanently archived in DART. It is the responsibility of the Project Leader to ensure that the data provider(s) for the investigation properly prepare and submit all EDDs.

All questions about data submittals for EPA lead projects should be directed to: r4dart@epa.gov.

Procedures for projects that are being conducted by Responsible Parties (PRPs) can be found below (Section 4).

Table 3.1 presents the steps for successfully submitting EPA Lead Environmental Data to Region 4 in summary form. Details for each step can be found under 'Further Information'.

Table 3.1: Steps for Submitting EPA Lead Environmental Data

	Further Information
Software Requirements	Section 3.2
Create Site	Section 3.3
Obtain Project ID	Section 3.4
Submit COC	Section 3.5
Correct COC Errors (if any)	Section 3.6
Create Location EDD	Section 3.7, and Region 4 EDD Reference Guide
Error Check Location EDD	Section 3.8, and Region 4 EDP Reference Manual
Submit Location EDD	Section 3.9
Create All Other EDDs	Section 3.7, and Region 4 EDD Reference Guide
Error Check All Other EDDs	Section 3.8, and Region 4 EDP Reference Manual
Submit All Other EDDs	Section 3.9
Proofing and Corrections	Section 3.10

3.2 Software Requirements

The software listed below is required for electronic submittal of data from EPA lead projects in Region 4.

3.2.1 Project Log

Project Log is tracking software developed by Region 4 SESD to create and manage all EPA lead environmental projects within the Region utilizing the

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SESD or CLP laboratories. It is used to create projects, report data, and provide basic information to Element.

3.2.2 Chain of Custody Software

Chain of custody software is used in Region 4 to generate EDD files of COC information.

Scribe was recently adopted as the software of choice for EPA investigations. Scribe is available at http://www.ertsupport.org/scribe_home.htm.

In Region 4, Scribe is used in conjunction with a custom template, software and help file to improve compatibility with Element and EQuIS. The template, help file, and software are available at: http://www.epa.gov/region4/sesd/download/dart/scribe.html. The site requires a user name and password. Email r4dart@epa.gov to request the username and password.

The use of chain of custody software is discussed below (Section 3.5).

3.2.3 EQuIS Data Processor (EDP)

EDP is used to check EDDs for errors prior to submission, and to create the data package for submittal. It can also be used to create smaller EDDs. It is available as a free download, if the data provider does not have access to an EPA workstation. See the Region 4 EDP Reference Manual for more information on standalone EDP.

3.3 Create Site or Waterbody

Before data can be submitted, the site must be created in DART. Proper site\waterbody creation is important to success. DART is intended to be a permanent archive for the data generated by these investigations.

For EPA lead projects conducted by SESD, the Project Leader has the responsibility for site or Waterbody creation. For EPA lead projects not conducted by SESD, the Region 4 program office will submit the required information. Site creation requests must be sent to r4dart@epa.gov.

3.3.1 Site Creation

Begin by checking DART to see if the site has been created. Go to the DART Support Website (http://r4esdcf1.r4esd.epa.gov/cfdocs/dms/index.cfm), click DART Lists → Sites\Station IDs. If the site is not listed here, it must be created.

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To create a site in DART, go to the EnviroFacts Multisystem query website http://www.epa.gov/enviro/html/multisystem_query_java.html and search for the site. If the site is found, copy the URL (website address) and paste it into an email to r4dart@epa.gov requesting the site be created.

If the site is not in EnviroFacts, search the SUPRIS database at http://www.epa.gov/superfund/sites/cursites/ and click the button labeled 'Search Superfund Site Information'. If the site is found, copy the URL (website address) and paste it into an email to r4dart@epa.gov requesting the site be created.

If the site is not in these databases, send the following information to r4dart@epa.gov:

Site Name
Address,
City, State, Zip Code
County

3.3.2 Waterbody Creation

First check to see if the waterbody already exists in DART. Go to the DART Support Website (http://r4esdcf1.r4esd.epa.gov/cfdocs/dms/index.cfm), click DART Lists → Sites\Station IDs. If the waterbody is not listed here, it must be created.

To create a waterbody in DART, the project leader must provide the USGS GNIS ID number for the Waterbody. The GNIS ID numbers for all waterbodies in the US can be found at this website: http://geonames.usgs.gov/

- At the website, select 'Search Domestic Names'.
- A new web page opens. Enter the following:
    - Feature Name
    - State
    - County
    - Feature Class
- Click 'Send Query'. A new web page opens
- Select your waterbody. A new web page opens
- Click 'GNIS in Google Map' Confirm your waterbody
- Close Google Map
- Copy the URL for the waterbody and email to r4dart@epa.gov

If the waterbody does not exist in the USGS database, send the best available name to r4dart@epa.gov.

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3.3.3 Criminal and Enforcement Confidential

If the field investigation is criminal or enforcement confidential, extra precaution must be taken to keep the project data confidential.

When requesting the creation of a site or waterbody for Criminal and Enforcement Confidential studies, the subject line of the email must state the site is for criminal or enforcement confidential data.

1. For these investigations, search for the site in DART (Section 3.3). If found, check the Facility Code field. If it does not begin with 'R4SC-', copy the name and Facility Code of the site and forward to r4dart@epa.gov.

2. If the site or waterbody does not exist in DART, find the needed information (Section 3.3) and forward to r4dart@epa.gov.

3. If the site or waterbody cannot be found in the EPA or USGS databases, send the best available information (Section 3.3) to r4dart@epa.gov.

3.4 Project Creation (Project ID)

When an investigation is logged into Project Log, a Project ID is assigned and a project is created. The Project ID is then embedded in the EDDs and is used to tie that data to the original study.

For historical data (as defined in the Region 4 EDD Reference Guide), the project must be created manually.

After the project has been created, but prior to the field investigation, the data provider will receive an email with information required to successfully submit an electronic COC to SESD. Use the information in this report to setup your investigation in the Chain of Custody software.

3.5 Chain of Custody Software

Where possible, EPA lead projects in Region 4 (except those exclusively using ANSETS) must submit an electronic chain-of-custody (.xml format) to SESD. The Region 4 Scribe help file (Section 3.2.2) describes the process.

The process for submitting the COC EDD file is different in one major aspect from all other EDDs submitted from EPA lead projects: the file **is not** submitted to r4dart@epa.gov. These COC EDDs must be submitted to R4SampleCustody@epa.gov. This process is detailed in the Scribe helpfile (Section 3.2.2).

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This submittal does not satisfy the requirement for a signed COC to accompany the samples at all times.

No COC is submitted to SESD for analytical datasets exclusively using ANSETS. The data provider is still responsible for submitting all required data to r4dart@epa.gov (Section 3.6.4).

3.6 DART Reports

After your COC data is received and the samples logged into the SESD LIMS (Element) system, you will receive automated reports if additional information or corrections are required. These emails are sent the night samples are logged into the SESD LIMS (Element) system and each Monday thereafter.

When all needed corrections have been made to Project Log and Element, the project setup in the Project Log is checked to see what additional EDDs (Location, FieldResults, Geology, Water Level, etc.) are required (Section 3.4).

3.6.1 Sample Information Requests

These email alerts are triggered by missing or incorrect information in Project Log or Element that will prevent the lab analytical data from loading to DART once reported. These corrections must be made before the data is reported by the SESD laboratory. If the corrections are not made before the data is reported, it will be necessary for the lab to re-report the data.

These emails contain a due date in the subject line. Corrections and missing data must be submitted prior to the due date.

3.6.1.1 Corrections to Project Log

If the report shows information missing from Project Log, log onto the Project Log (EPA workstation only) and supply the missing information. This portion of the report checks for:

- Valid site or waterbody selected
- Valid Project ID selected
- Valid program\activity selected
- Valid data provider selected

Note: For studies with data providers with no access to the Region 4 Project Tracking System, errors will be corrected by the program office with SESD as backup.

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3.6.1.2 Corrections to Element

Errors within Element are easily corrected. The information presented in this portion of the email shows your sampling information as it currently resides in Element.

Station IDs and Media Codes are checked to ensure compliance with business rules (Section 2.6.4). If you have a missing or incorrect Station ID or Media Code, type the correct value in the appropriate 'Edited' column and forward the email to r4dart@epa.gov.

3.6.2 EDD Requests

These emails contain a due date in the subject line. Requested EDDs must be submitted prior to the due date.

- After any errors in Project Log and Element are corrected, a Location EDD is requested for Station IDs that cannot be matched in DART. A weekly reminder to submit the Location EDD will be sent until the data is received.

- Once the Location EDD has been received, requests for any additional EDDs will be sent based upon the information gathered during the creation of the project (see Section 3.4).

3.6.3 'Overdue' Reports

If corrections and EDDs are not submitted before the analytical data is reported by the lab, 'Overdue' reports will be generated. These reports will be sent each Monday morning until the requested data is received. All overdue reports for EPA Lead projects in Region 4 are tracked on the Project Tracking System.

3.6.4 ANSETS EDDs

Data providers using ANSETS are still responsible for submitting all EDDs. Information on creating EDDs for analytical data can be found in the Region 4 Electronic Data Deliverables Reference Guide. Because these samples are not entered into the SESD LIMS software, tracking is not performed at the sample level prior to analysis. Instead, sample tracking begins after the data has been reported to ANSETS.

Requests for EDDs will be made to the data provider beginning the Monday after the data is released. Because no tracking of individual samples is performed for ANSETS datasets, the requests for EDDs are not specific.

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3.7 Creating EDDs

EDDs can be created in a number of ways. The best method will depend upon the amount of data to be submitted, and how the chain-of-custody was generated.

It should be noted that for small amounts of data, any of the EDD(s) listed below can be created directly in EDP (Region 4 EQuIS Data Processor Reference Manual). Detailed instructions for required formats of the various EDDs can be found in the Region 4 EDD Reference Guide.

3.7.1 Location EDDs

Attached File: Each email request for a Location EDD has a partially completed Location EDD file attached, with the required Station IDs in the correct format. Open the attached file in a spreadsheet or complete in EDP.

Scribe: If you created your COC using Scribe, you can create a Location EDD from FieldResults. In Scribe, select Lists → Advanced → Macro. Check 'FieldResults', then click 'Run Macro(s). More detailed instructions can be found in the Region 4 Scribe help file (Section 3.2.2).

Complex Study: If your investigation is 'complex', your Location EDD must be split. Submit a Location EDD for each stream or waterbody investigated.

3.7.2 FieldResults EDDs

Scribe: If you created your COC using Scribe, you can create a FieldResults EDD from FieldResults. In Scribe, select Lists → Advanced → Macro. Check 'FieldResults', then click 'Run Macro(s). More detailed instructions can be found in the Region 4 Scribe help file (Section 3.2.2).

If you entered your field results values in Scribe, the information will be present in your FieldResults EDD. If this information is missing, the FieldResults EDD can be completed in EDP or a spreadsheet.

Niton XRF files: Field data collected with Niton instruments can be converted to the FieldResults EDD format. Email r4dart@epa.gov for help with this.

YSI Instrument files: Field data collected with YSI instruments can be converted to the FieldResults EDD format using the Darter YSI utility. Email r4dart@epa.gov for help with this.

Other Data Logging Instruments: If you are planning an investigation that will be making field measurements that will be recorded to the instruments data logger, you can request (r4dart@epa.gov) help to make conversion to the FieldResults EDD easier.

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3.7.3 Water Level EDDs

Required for all groundwater elevation measurements (top of casing to groundwater, relative to mean sea level), and for all surface water elevation measurements tied to groundwater elevation.

Scribe: If you created your COC using Scribe, you can create a WaterLevels EDD from FieldResults. In Scribe, select Lists → Advanced → Macro. Check 'FieldResults', then click 'Run Macro(s). More detailed instructions can be found in the Region 4 Scribe help file (Section 3.2.2).

3.7.4 Geology EDDs

It is recommended that these EDDs be prepared by professionals with experience with this type of data. Details for the various formats are specified in the Region 4 EDD Reference Guide.

3.7.5 Analytical Data EDDs

Preparation of these files should be performed by individuals with experience in understanding unfiltered laboratory reports. The format is specified in the Region 4 EDD Reference Guide.

Element: Analytical data reported by the Region 4 LIMS (Element) is formatted for EQuIS, and is automatically loaded upon acceptance of the Location EDD.

ANSETS and Small Purchase: This data must be placed in the EQuIS format by the data provider. To help ensure accuracy, the performing laboratory may be requested to report the data in the Region 4 EQuIS format as part of the bid.

3.8 Error Checking with EQuIS Data Processor (EDP)

For information on obtaining, installing, registering, maintaining and using standalone EDP, refer to the Region 4 EDP Reference Manual. If you are using standalone EDP, be sure EDP is up to date before using.

If you are using EDP on an EPA workstation, start EDP by logging in to EQuIS Pro and selecting your site.

Use EDP to check all EDDs for errors before submission. EDP contains a help file to assist with error correction. Let the mouse 'hover' over any cell with a non-white background to view a detailed error message.

Complete instructions for using EDP can be found in the Region 4 EQuIS Data Processor Reference Manual.

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If you are unable to correct the problem, email the file causing the problem to r4dart@epa.gov with your contact information, site name and Project ID.

3.9 Submitting EDDs

After correcting any errors in your EDD, save the file from EDP using sign and submit to create the data package. Name the file as specified in the requesting email. Attach the EDD to the email requesting the EDD and forward to r4dart@epa.gov. If the file is named improperly or not attached to the requesting email, it will be returned to the data provider.

Complete instructions for submitting EDDs can be found in the Region 4 EQuIS Data Processor Reference Manual.

3.10 Proofing and Corrections

Notify the DART system administrators of any errors you find in the system. Send corrections to r4dart@epa.gov.

After the data has been successfully loaded, reports will be sent to the data provider. The reports will consist of spreadsheets for field blanks and shapefiles for environmental samples. The data provider is responsible for proofing these files and notifying Region 4 (r4dart@epa.gov) of any errors found.

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4 PRP Lead Data Submittals

4.1 PRP Lead Projects

PRP's conducting environmental investigations in Region 4 for the Superfund program must report their data to Region 4 electronically. The types of data typically required to be submitted are outlined in Section 2.4. The PRP is responsible for the information contained in the files submitted by the data provider.

Address all data submittals and questions to r4dartcoordinator@epa.gov.

Procedures for EPA lead projects can be found in Section 3.

Table 4.1 presents the steps for successfully submitting PRP lead Environmental Data to Region 4 in summary form. Details for each step can be found under 'Further Information'.

Table 4.1: Steps for Submitting PRP Lead Environmental Data

	Further Information
Software Requirements	Section 4.2
Create Site	Section 4.3
Obtain Project ID	Section 4.4
Submit Data Summary	Section 4.5, and Region 4 EDD Reference Guide
Correct Data Summary Errors	Section 4.6
Create Location EDD	Section 4.7, and Region 4 EDD Reference Guide
Error Check Location EDD	Section 4.8, and Region 4 EDP Reference Manual
Submit Location EDD	Section 4.9
Create All Other EDDs	Section 4.7, and Region 4 EDD Reference Guide
Error Check All Other EDDs	Section 4.8, and Region 4 EDP Reference Manual
Submit All Other EDDs	Section 4.9
Proofing and Corrections	Section 4.10

4.2 Software Requirements

The software listed below is required for electronic submittal of data from PRP lead projects in Region 4.

4.2.1 EQuIS Data Processor (Standalone)

All data providers are required to use the EQuIS Data Processor (EDP) to check their data files for errors prior to submittal. EDP can also be used to create smaller EDDs.

The EQuIS Data Processor (EDP) is software used to both check all EDDs for errors prior to submittal, and to create properly formatted data packages. The

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software is available as a free download. See the Region 4 EQuIS Data Processor Reference Manual for details.

4.3 Site Creation

All National Priorities List (NPL) sites in Region 4 have been created in EQuIS. If, however, a site is found to be missing (or a new site is added to the NPL), it must first be created using information from Envirofacts, EPA's national database (http://www.epa.gov/enviro/html/multisystem_query_java.html). CERCLIS (http://www.epa.gov/superfund/sites/cursites/) is used if the site does not exist in Envirofacts.

To create the site, the Remedial Program Manager or On-Scene Coordinator (OSC) must email the URL for the search results (Envirofacts or CERCLIS) to r4dartcoordinator@epa.gov.

If the site is not in these databases, the Program Manager or OSC must send the following information to r4dart@epa.gov:

Site Name
Address,
City, State, Zip Code
County

4.4 Project Creation (Project ID)

For current data (as defined in the Region 4 EDD Reference Guide), a project is created and assigned a Project ID (tracking number) when the QAPP is logged into the QA Tracking System (a part of the Project Tracking System).

For historical data (as defined in the Region 4 EDD Reference Guide), the project must be created manually (assuming no suitable QAPP is available in the QA Tracking System). Use the SESD Project Tracking system to setup the proposed data submittal, and to get the PRP data provider contact information (email address) in the system.

Whether the data is current or historical, the system will prompt for the required information (data provider, program\activity, etc.).

When the project has been successfully created, an automated report will be sent to the data provider containing all available Station IDs and their coordinates. The data provider must review the report for existing sampling stations. If samples are to be collected at an existing Station, the established Station ID must be used.

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4.5 Data Submittal Summary

After the project is created, US EPA Region 4 will notify the PRP to submit the Data Submittal Summary and email to r4dartcoordinator@epa.gov. When this information has been accepted by the Remedial Project Manager (RPM), the PRP may then submit the data. Information on the Data Submittal Summary format can be found in the Region 4 EDD Reference Guide.

4.6 Submitting EDDs

Note the order for the data submittals below. This order is both dictated by a desire to offer data providers with the opportunity to review each step in the data submittal process, and by the database logic of EQuIS.

4.6.1 Location EDDs

If the Data Submittal Summary contains additional information for an established sampling station, the data provider **MUST** use the Station ID(s) provided.

Because the system will begin requesting the remaining EDDs upon receipt of the first Location EDD file, the data provider may prefer to submit all Station IDs in a single Location EDD file. Multiple Location EDDs may be submitted if needed.

A report containing the submitted Station IDs and coordinates will be sent to the data provider upon the receipt of each Location EDD, to provide an opportunity for proofing and correction.

If the Location EDD is found to contain an error not related to the coordinates, the PRP must send a spreadsheet with a list of the incorrect and corrected information.

For bad coordinates (or if better coordinates become available), the original Location EDD may be edited and re-submitted. Delete the rows in the original Location EDD that do not need to be updated, edit the coordinates for the remaining rows, and re-submit to r4dartcoordinator@epa.gov. The phrase 'Updated coordinates' should be in the subject line.

4.6.2 Other EDDs

The remaining EDDs will be checked against Station IDs as they are received, and rejected if no matching Station ID can be found.

4.7 Creating EDDs

EDDs can be created using spreadsheet software, directly in EDP, or in a word processor such as Notepad. More information about the file format can be found in the Region 4

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EDD Reference Guide. The best method for creating EDDs will depend upon the amount of data to be submitted.

It should be noted that for small amounts of data, any of the EDD(s) listed below can be created directly in EDP (Region 4 EDP Reference Manual). Detailed instructions for required formats and valid values of the various EDDs can be found in the Region 4 EDD Reference Guide. Section 2.4 of this Guidance has a brief summary of the most common EDDs; Section 2.6 has a brief discussion of the most common fields.

4.8 Error Checking with EDP

Use EDP to check all EDDs for errors before submission. EDP contains a help file to assist with error correction. Hold the mouse over any cell with a non-white background to view a detailed error message.

If you have errors you are unable to correct, email the file(s) causing the problem to r4dartcoordinator@epa.gov with your contact information. Place the site name and the Project ID in the subject line.

4.9 Submitting EDDs

EDDs must be submitted as detailed in the Region 4 EQuIS Data Processor Reference Manual.

Remember to submit Location EDDs **before** submitting any other EDDs. The database structure requires locations to be loaded prior to all other environmental data.

While EDP permits the submittal of combined EDDs, this feature is not supported in the Region 4 implementation. Submit each EDD separately (**except** for Analytical EDDs which are **always** submitted as a three file set – See the Region 4 Electronic Data Deliverables Reference Guide).
When all errors have been corrected, save the EDD(s) using the 'sign and submit' menu option. Name all files as specified. Improperly named files will be returned to the data provider. The required names can be found in the EDD request reports sent to the data provider.

To submit your prepared data package, attach the data package to the EDD request and forward to r4dartcoordinator@epa.gov. Data packages must be attached to the requesting report. Data packages received without the proper requesting report will be returned to the data provider.

NOTE: .zip files are automatically removed by the EPA email server. Be sure your data package is properly named and has the .edd filename extension.

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4.10 Proofing and Corrections

After the data has been successfully loaded, reports will be sent to the data provider. The reports will consist of spreadsheets for field blanks and shapefiles for environmental samples (Region 4 is responsible for sending these files to the data provider). The data provider is responsible for proofing these files and notifying Region 4 (r4dartcoordinator@epa.gov) of any errors found, and submitting corrections.

Region 4 U.S. Environmental Protection Agency Laboratory Services & Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Equipment Inventory and Management	ID: LSASDPROC-1009-R1
Issuing Authority: Deputy Director, LSASD	
Effective Date: February 28, 2020	Review Due Date: February 28, 2024

Purpose

This Operating Procedure is specific to the Region 4 Science and Ecosystem Support Division (LSASD) to maintain conformance to technical and quality system requirements. This document describes the procedures necessary to demonstrate the operational status and inventory of equipment used for measurement activities and equipment that comes into direct contact with the sample media and has the potential to cross contaminate samples between sampling stations.

Scope/Application

The requirements of this procedure apply to all personnel who perform work under the LSASD Quality Management System (QMS). This procedure covers the approaches and documentation used for the maintenance, calibration, verification and inventory of equipment used for LSASD activities. This procedure includes the maintenance and use of microscopes, volumetric equipment and equipment that may come into direct contact with the sample media and has the potential to cross contaminate samples. While this SOP may be informative, it is not intended for and may not be directly applicable to operations in other organizations. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

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1.0 Procedure

1.1 General

Equipment (hardware and related software) used for LSASD activities and equipment that comes into direct contact with the sample media and has the potential to cross contaminate samples will meet quality requirements identified for each piece of equipment. Important factors in establishing quality requirements include the parameters to be measured and the sensitivity and specificity of the detection system used. Quality requirements must include ensuring that equipment is ready for use. Specifically:

1.1.1 LSASD maintains adequate equipment to conduct field measurement and laboratory activities.

1.1.2 Equipment utilized for field and analytical measurement activities will be capable of achieving the accuracy and precision required by the measurement objectives.

1.1.3 When LSASD is required to use equipment outside its permanent control, it will ensure that all relevant LSASD criteria in this procedure are met. Procedures utilized to ensure compliance with the LSASD quality system requirements will be documented and routed to the Division Quality Assurance Coordinator (QAC).

1.1.4 Equipment utilized by LSASD are secured at all times, as feasible.

1.1.5 Operating instructions and/or manuals from the manufacturer are available for each piece of equipment.

1.1.6 Field investigators and laboratory analyst only operate equipment for procedures which they are authorized per the LSASD Operating Procedure Training and Demonstrations of Competency (LSASD PROC-1003) to perform. In the event that a field investigator or laboratory analyst is not authorized for a certain procedure, the investigator or analyst may conduct the activity under supervision of an authorized party.

1.1.7 Equipment is handled and maintained in accordance to the manufacturer's operating instructions.

Equipment used for field measurements will be handled, transported, shipped, stored and operated in a manner that prevents damage, gross contamination and deterioration. Decontamination of equipment will be in accordance to procedures described in the LSASD Operating Procedure for Field Equipment Cleaning and Decontamination (LSASD PROC-205) and Field Equipment Cleaning and Decontamination at the FEC (LSASD PROC-206).

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1.2 Equipment Inventory

1.2.1 Inventory

The Applied Science Branch (ASB), Branch Field Equipment Managers (BFEMs) are responsible for maintaining a current equipment inventory list for their specific areas. The BFEMs will maintain a, comprehensive list of all field measurement and sampling equipment subject to this procedure. Field measurement equipment, including sampling equipment that comes into contact with the sample media and has the potential to cross contaminate samples between stations (i.e., submersible pumps and vacuum chambers), will be included in this inventory. The QAC will maintain the equipment inventory for all laboratory equipment utilized within the LSASD quality system. The list is maintained on the LAN and available for all staff to review. The equipment inventory list for each instrument or piece of equipment will include:

1.2.1.1 A description of the property and software, if applicable
1.2.1.2 Manufacturer or vendor name
1.2.1.3 Model number
1.2.1.4 Serial number or other manufacturer identification number
1.2.1.5 A unique identifier, known as the LSASD ID Number
1.2.1.6 Storage location (e.g., Field Equipment Center, LSASD Laboratory)
1.2.1.7 Date received and/or date placed in service, where available.
1.2.1.8 Status of the equipment (e.g., surplus, damaged, etc.)
1.2.1.9 A reference to the manufacturer's instruction manual title.

1.2.2 Equipment Labeling and Marking

Prior to being placed into the equipment inventory, all equipment covered under this procedure will be inventoried and labeled with a unique LSASD identification number. The identification number will be assigned only to the identified equipment and will not be reused if the equipment is excised or disposed. Equipment that is no longer used or cannot be repaired will be removed from the inventory.

1.2.2.1 ASB equipment received after the effective date of this procedure will be assigned a number that includes the date the equipment was received followed by a sequential number starting at 01 (e.g., 031407-01, 031407-02, etc.). BFEMs will ensure that duplicate LSASD ID Numbers are not assigned to equipment.
1.2.2.2 LSB analytical equipment will be assigned a unique identifier compatible with the Laboratory's Informational Management System naming conventions. Support equipment will be identified by serial number or a unique identifier depending on the use of the equipment.

1.3 Equipment Maintenance

Maintenance will be categorized as preventative and/or corrective repair. Both approaches should be used to maintain equipment in working order. Each item of field and analytical measurement

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equipment will be checked by a qualified individual prior to use. For field equipment, critical spare parts that can easily be installed by field personnel, which cannot be easily obtained while in the field, will be sent out with the equipment during field investigations.

Equipment maintenance will include software upgrades for certain instruments. LSASD management will assign staff to serve as a point of contact for equipment, that may require periodic software upgrades. The point of contact will ensure that software upgrades are conducted on all equipment. The point of contacts will maintain a list of the equipment which will include the serial number, LSASD ID Number, software version, software upgrade dates and the storage location of the equipment. The point of contact will provide the information to the appropriate BFEM or QAC to be included in the equipment inventory. Updates to software program should be included in the appropriate instrument maintenance logs.

1.3.1 Repair and Re-certification for Use

Equipment known or suspected to be defective will be taken out of service and clearly labeled, preferably with a red tag, until it has been repaired and demonstrated by calibration, verification or testing to function properly. When equipment is tagged in the field as defective, the LSASD project leader will notify the appropriate BFEM in writing, either by email or by using the LSASD Field Equipment Tracking System, that equipment requires repair. When analytical equipment is defective, the analyst responsible for the equipment will notify the QAC.

For equipment maintained at the FEC, the BFEM will be responsible for equipment repairs. Upon completion of the repair, the BFEM will notify the FEC contract personnel that the equipment has been returned. The contract personnel will ensure that the equipment is functioning properly prior to it being placed back into service. The BFEMs are responsible for including all documentation associated with the equipment repair in the LSASD (SESD) Field Equipment Tracking System or appropriate maintenance section of the equipment log. This documentation includes written notifications regarding the equipment repair and any information provided from the manufacturer which describes the defect and the repair.

For equipment stored at the LSASD laboratory or stored at the FEC and not routinely handled and maintained by contract personnel, the BFEM, or primary analyst for laboratory equipment, will be responsible for having the equipment repaired. Once repaired, the BFEM or primary analyst will ensure the equipment is functioning properly prior to it being returned to service. The BFEM, or primary analyst, is responsible for placing all documentation associated with the repair of equipment stored at the LSASD laboratory in the LSASD Field Equipment Tracking System or appropriate maintenance section of the equipment maintenance log. This documentation includes the written notifications regarding the equipment repair and any information provided which describes the defect and the repair.

If there is the potential that data collected with defective equipment were adversely impacted, the issue will be handled according to the LSASD Operating Procedure for Complaints and Nonconforming Work Resolution (LSASD PROC-1006).

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1.3.2 Required Maintenance

The BFEMs and QAC are responsible for ensuring that equipment maintenance is performed in-house or by an external vendor.

1.4 Equipment Calibration

Prior to being utilized, measurement equipment will be visually inspected for cleanliness and operability and a calibration, and calibration verification or performance check will be conducted to ensure the equipment is in working condition. A post-operation instrument verification check will be performed using the appropriate standard(s) at the end of the day or after all measurements have been taken for a period of operation. When practicable, equipment requiring calibration will be labeled to indicate the status of calibration and the date when re-calibration is due. Calibration and measurement requirements are found in individual measurement procedures. For laboratory analytical equipment not calibrated with each analytical run a calibration log will be maintained with the equipment documenting the most recent calibration.

When equipment or reference standards are calibrated by an outside calibration service, LSASD will ensure the vendor is ISO 17025 accredited or has some other equivalent means for demonstrating competence, measurement capability and traceability.

All reasonable measures will be taken to safeguard equipment from adjustments which would invalidate the measurements following calibration of the equipment. LSASD personnel will handle, transport and store equipment in accordance to manufacturer recommendations. Periodic calibration or performance checks will be conducted to ensure that equipment calibration has not been adversely impacted between measurement locations.

For equipment that is not directly used for field measurement, visual examination, safety checks or, if appropriate, performance checks, will be conducted to ensure the working condition of the equipment. Microscopes, including attachments, will be cleaned and serviced as needed prior to use.

If equipment leaves the direct control of LSASD for a period of time, the BFEMs or QAC will ensure that the function and, where necessary, the calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service.

1.4.1 Traceability, Certification, and Verification Records

The program for the calibration or calibration verification of equipment must ensure that, where the concept is applicable, all significant measurements are traceable through certificates of calibration held by LSASD, and/or to National Standards of Measurement. National Institute of Standards and Technology (NIST) traceable standards will be used, if available. For equipment maintained at the FEC and sent off-site for calibration, certificates or other records of calibration will be maintained in a central file at the FEC. Additionally, NIST traceable documentation for buffers, standards, calibration gases or reference materials will be maintained in a central file at the FEC.

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For equipment maintained at the LSASD laboratory and sent off-site for calibration, certificates or other records of calibration will be maintained by the QAC. Additionally, NIST traceable documentation for buffers, standards, reagents, calibration gases or reference materials will be maintained at the LSASD laboratory.

LSASD will maintain records of actions taken to verify the quality of equipment whose properties could affect the quality of sampling, measurement and related activities. Examples would be thermometer, calibration standard or buffer verification.

Critical reference materials such as reagents and consumable materials that affect the quality of tests and/or calibrations will be verified according to the procedures described in the LSASD Operating Procedure for Purchasing Services and Supplies (LSASD PROC-1008).

1.5 Equipment Sign-out/Sign-in

All measurement equipment will be signed-out prior to use in the field and signed-in following use in the field. This will be done using the LSASD Field Equipment Tracking System. FEC contract personnel will primarily be responsible for equipment sign-out and sign-in at the FEC. However, in their absence, it is the project leader's responsibility to sign out the measurement equipment. For measurement equipment that is not routinely handled or maintained by contract personnel or equipment stored at the LSASD laboratory, the project leader or field investigator using the equipment is responsible for checking the equipment out and in.

1.6 Documentation and Records

All calibrations or calibration verifications performed in the field will be recorded in the project specific logbook(s) by the individual conducting the calibration or verification and stored in the associated project file. Calibration of equipment conducted by LSASD personnel will be conducted in accordance with the manufacturer's recommendations

When calibrations require correction factors, the correction factors will be documented in instrument operating procedures, equipment logs and written methods (field logbooks).

The BFEMs and QAC are responsible for maintaining a current equipment inventory list for their specific programs. Additionally, they are responsible for auditing and maintaining equipment maintenance, calibration and verification records in the equipment logs.

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2 Definitions

2.1 Calibration

The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system and corresponding known values. The results of a calibration permit the estimation of errors associated with the measurement equipment.

2.2 Calibration Verification

Provides a means of determining that deviations between measured values and known values are within the limits of error defined during calibration. The results provide an indication that the instrument/system is working properly.

2.3 Preventative Maintenance

A program of routine actions such as cleaning, lubrication, adjusting, or testing to keep equipment ready for use. The most important effect of a preventative maintenance program is to ensure measurement system reliability.

2.4 Branch Field Equipment Manager

Applied Science Branch, or field staff, designated by management, who are responsible for ensuring that the procedures for Equipment Inventory and Management are followed.

2.5 Qualified Individual

Individual who has received on the job training and has experience working with specific measurement instruments.

2.6 Equipment Log

Notebook, log book or electronic file that contains a copy of the purchase order, if available, as well as, maintenance, calibration, verification records, performance checks, correction factors and sign-out/sign-in records. Equipment logs will be established for all equipment used for field measurement activities or equipment that comes into direct contact with the sample media and has the potential to cross contaminate samples between sampling stations. The development of equipment logs is the responsibility of the Branch Field Equipment Managers.

2.7 LSASD Field Equipment Tracking System

Electronic database used by the Applied Science Branch to sign-out/sign-in sampling equipment, track equipment use history, and maintain equipment availability status.

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3 References

LSASD Operating Procedure Training and Demonstrations of Competency (LSASD PROC-1003), most recent version.

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination (LSASD PROC-205), most recent version.

Field Equipment Cleaning and Decontamination at the FEC (LSASD PROC-206), most recent version.

LSASD Operating Procedure for Complaints and Nonconforming Work Resolution (LSASD PROC-1006), most recent version.

LSASD Operating Procedure for Purchasing Services and Supplies (LSASD PROC-1008), most recent version.

4 Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the LSASD QAC.

History	Effective Date
SESDPROC-1009-R0, Equipment Inventory and Management, Original Issue	October 1, 2017
LSASDPROC-1009-R1, Equipment Inventory and Management, replaces SESDPROC-1009-R0 Renamed base don new Division name. Updated names of the laboratory (Laboratory Services or LSB) and field (Applied Science, or ASB) branches throughout the document. Replaced Laboratory Quality Manager, or LQM with Quality Assurance Coordinator or QAC. Editorial changes throughout.	February 28, 2020

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Field Sampling Quality Control**

Effective Date: April 26, 2017	**Number:** SESDPROC-011-R5

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-011-R5, *Field Sampling Quality Control*, replaces SESDPROC-011-R4 **Cover Page:** SESD's reorganization was reflected in the authorization section by making John Deatrick the Chief of the Field Services Branch. The FQM was changed from Bobby Lewis to Hunter Johnson. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. **General:** Corrected any typographical, grammatical and/or editorial errors. Changed name of Enforcement and Investigations Branch to Field Services Branch. Removed references to Ecological Assessment Branch. Added Section 2.9 to the Table of Contents. **Section 1.4.6:** Added definition for Organic-Free Water **Section 3.5:** Changed volume needed for soil MS/MSD samples from triple to double volume. **Section 4.1:** Modified statement to read: Each lot of chemical preservative will be tested for the appropriate analytes by either FEC Staff or the Branch QAO.	April 26, 2017
SESDPROC-011-R4, *Field Sampling Quality Control*, replaces SESDPROC-011-R3	February 5, 2013
SESDPROC-011-R3, *Field Sampling Quality Control*, replaces SESDPROC-011-R2	October 15, 2010
SESDPROC-011-R2, *Field Sampling Quality Control*, replaces SESDPROC-011-R1	January 28, 2008
SESDPROC-011-R1, *Field Sampling Quality Control*, replaces SESDPROC-011-R0.	October 19, 2007
SESDPROC-011-R0, *Field Sampling Quality Control*, Original Issue	February 5, 2007

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1 General Information

1.1 Purpose

This document describes procedures established to ensure the quality of SESD field sampling activities, including Field Equipment Center (FEC) operations involving preparation of sampling and support equipment for field operations. Collectively, these procedures ensure that field sampling teams are provided with equipment that is suitable for sampling use, and that field sampling is conducted using proper procedures, resulting in the collection of representative samples. Strict adherence to these procedures forms the basis for an acceptable field sampling quality assurance program.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators when collecting and handling samples in the field and when preparing sampling equipment for SESD field investigations. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

1.4.1 Sample

A part of a larger lot, usually a volume, area, period or population.

1.4.2 Variability

The range or "distribution" of results around the mean value obtained from samples within a population. There are three types of variability which should be measured or otherwise accounted for in field sampling, depending on the data quality objectives (DQO) for the study:

1. Temporal Variability

   Temporal variability is the range of results due to changes in contaminant

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concentrations over time. An example would be the range of concentrations obtained for a given parameter in wastewater samples collected at different times from an outfall where contaminant concentrations vary over time.

2. Spatial Variability

   Spatial variability is the range of results due to changes in contaminant concentrations as a function of their location. An example would be the range of concentrations obtained for a given parameter in surface soil from a site where discreet "hot spots" are present due to localized releases of contaminants on otherwise uncontaminated soil.

3. Sample Handling Variability

   Sample handling variability is the range of results due to the sample collection and handling techniques used by the sampler. This variability manifests itself as a positive bias due to errors such as unclean sampling equipment, cross contamination, etc., or a negative bias due to improper containers or sample preservation.

1.4.3 Grab Sample

An individual sample collected from a single location at a specific time or period of time. Grab samples are generally authoritative in nature.

1.4.4 Composite Sample

A sample collected over a temporal or spatial range that typically consists of a series of discrete, equal samples (or “aliquots”) which are combined or "composited." A composite sample represents the average characteristics of the population under consideration. Four types of composite samples are listed below:

1. Time Composite (TC) – a sample comprised of a varying number of discrete samples or “aliquots” collected at equal time intervals during the compositing period. The TC sample is typically used to sample wastewater or streams.

2. Flow Proportional Composite (FPC) – A sample consisting of discrete samples or “aliquots” collected at a rate proportional to flow. The aliquots are collected during the compositing period by either a time-varying/constant volume (TV/CV) method (“automated flow proportioning”) or a time-constant/varying volume (TC/VV) method (“manual flow proportioning”). The TV/CV method is typically used with automatic samplers that are paced by a flow meter. The TC/VV method is a manual method that individually proportions a series of discretely collected aliquots. The FPC is

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typically used when sampling wastewater.

3. Areal Composite – a sample composited from individual, equal aliquots collected on an areal or horizontal cross-sectional basis. Each aliquot is collected in an identical manner. Examples include sediment composites from quarter-point sampling of streams and soil samples from within grids.

4. Vertical Composite – a sample composited from individual, equal aliquots collected from a vertical cross section. Each aliquot is collected in an identical manner. Examples include vertical profiles of soil/sediment columns, lakes, and estuaries.

1.4.5 De-ionized Water

Tap water that has been treated by passing it through a standard de-ionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard Inductively Coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. De-ionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for de-ionized water.

1.4.6 Organic-Free Water

Tap water that has been treated with activated carbon and deionizing units. At a minimum, the finished water must meet the analytical criteria of deionized water and it should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 4 laboratory for a given set of analyses. Organic-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

1.4.7 Branch Field Equipment Manager

Staff, designated by management, who are responsible for ensuring that the procedures for Equipment Inventory and Management are followed. At least one Branch Field Equipment Manager will be designated for the Field Services Branch (FSB).

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1.5 References

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005-most recent version)

SESD Operating Procedure for Competency and Proficiency Testing, (SESDPROC-006, most recent version)

SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108-most recent version)

SESD Operating Procedure for Sediment Sampling (SESDPROC-200-most recent version)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205-most recent version)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206-most recent version)

SESD Operating Procedure for Soil Sampling (SESDPROC-300-most recent version)

SESD Operating Procedure for Waste Sampling (SESDPROC-302-most recent version)

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version

Loan-In Form (SESDFORM-011, most recent version)

SESD Operating Procedure for Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209, most recent version)

SESD Operating Procedure for Training (SESDPROC-007-most recent version)

SESD Operating Procedure for Corrective Action (SESDPROC-009-most recent version)

SESD Guidance for Design and Installation of Monitoring Wells (SESDGUID-101-most recent version)

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2 Field Sampling Quality Control Considerations

This section provides guidelines for establishing quality control procedures for sampling activities. Strict adherence to all of the standard operating procedures outlined in this subsection forms the basis for an acceptable sampling quality assurance program.

2.1 Experience Requirements

There is no substitute for field experience. This field experience will be gained by on-the-job training using the "buddy" system. Each new investigator will accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior investigators. Specific requirements covering experience, competency and proficiency are found in the SESD Operating Procedure for Competency and Proficiency Testing (SESDPROC-006) and SESD Operating Procedure for Training (SESDPROC-007).

2.2 Traceability Requirements

All sample collection and measurement activities will be traceable through field records to the person collecting the sample or making the measurement. All maintenance and calibration records for sampling and measurement equipment (where appropriate) will be kept so that they are similarly traceable. The SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108) contain specific procedures to be followed that ensure traceability.

2.3 Chain-of-Custody

Specific chain-of-custody procedures are included in SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005). These procedures will ensure that evidence collected during an investigation will withstand scrutiny during litigation. To assure that procedures are being followed, it is recommended that field investigators or their designees audit chain-of-custody entries, tags or labels, field notes, and any other recorded information for accuracy. Additionally, the SESD FQM will randomly conduct reviews of project files to ensure that quality procedures are being followed.

2.4 Sampling Equipment Construction Material

Sampling equipment construction materials can affect sample analytical results. Field investigators will ensure the sample equipment construction material will not introduce contaminants to the sample being collected.

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2.5 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analyses of samples collected are found in the USEPA Region 4 Analytical Services Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM). Chemical preservatives used will be supplied by the Region 4 laboratory or purchased by the Branch Field Equipment Manager. All samples requiring preservation should be preserved immediately upon collection in the field. Records of sample preservation, including ice, will be documented in the field log books.

Samples that **should not** be preserved in the field are:

1. Those collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials which may be highly reactive. Barrel, drum, closed container, spillage or other source samples from hazardous waste sites are not to be preserved with any chemical.

2. Those that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved according to the ASBLOQAM.

All samples preserved with chemicals will be clearly identified by indication on the sample tag or label that the sample is preserved. If samples normally requiring preservation were not preserved, field records should clearly specify the reason. Samples shipped by air will not be preserved with nitric acid, hydrochloric acid, sodium hydroxide or sulfuric acid in excess of the amount specified in the ASBLOQAM.

2.6 Sample Collection Precautions

In order to prevent cross-contamination during sample collection, the following precautions will be taken:

1. A clean pair of new, non-powdered, disposable latex or nitrile gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

2. Sample containers for source samples or samples suspected of containing high concentrations of contaminants will be placed in separate plastic bags immediately after collecting, tagging, etc.

3. If possible, environmental (low concentration) samples and source or waste samples (high concentration) should be collected by different field teams. If different field teams cannot be used, all environmental samples should be collected first and placed in separate ice chests or shipping containers. Samples of waste or

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highly contaminated samples should never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source or waste samples or any samples suspected to contain high concentrations of contaminants will be lined with new, clean, plastic bags.

4. If possible, one member of the field sampling team should record all of the field notes, collect GPS data, etc., while the other members collect the samples.

5. When sampling surface water and sediment at the same location, the water sample should always be collected before the sediment sample is collected.

6. Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

7. Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned according to either the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or the SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compounds analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC should not be used to collect samples for trace organic compounds analyses.

8. Field investigators should ensure the sample containers they are using have been verified as suitable for the analyses that will be conducted on the samples through the quality control procedures discussed in Section 4 of this procedure.

Upon returning from the field, un-used sample containers will be examined by project leaders to determine whether bottles should be discarded, recycled or re-shelved for use on other projects. A load-in form (SESDFORM-011) will be completed and signed by project leaders to identify the future use of sample containers returning from the field. Opened boxes of sampling containers that can be re-used, will be segregated from sealed boxes of new containers.

Opened bags of latex or nitrile gloves returning from the field will be segregated from unopened gloves and will not be re-used for sample collection on other projects.

2.7 Sample Handling and Mixing

Once a sample has been collected, it may have to be transferred into separate containers for different analyses. Sample transfer should be done as soon as possible. If necessary, aqueous samples may be collected into a single, larger container for homogenization and transferred into individual sample containers. However, aqueous samples collected for

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volatile organic compounds, oil and grease, bacteria, sulfides and phenols analyses may not be transferred using this procedure.

It is extremely important that waste (when appropriate), soil and sediment samples be mixed thoroughly to ensure that the sample is representative of the sample media. The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

1. The material in the sample pan should be divided into quarters and each quarter should be mixed individually.

2. Two quarters should then be mixed to form halves.

3. The two halves should be mixed to form a homogenous matrix.

This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction and occasionally turning the material over.

2.8 Special Handling of Samples for Volatile Organic Compounds Analysis

Water samples to be analyzed for volatile organic compounds should be stored in 40-ml septum vials with screw cap and Teflon®-silicone disk in the cap to prevent contamination of the sample by the cap. The disks should be placed in the caps (Teflon® side to be in contact with the sample) in the laboratory prior to the beginning of the field investigation.

The vials should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a convex meniscus. The cap is then applied and some overflow is lost, but the air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken not to flush any preservative out of the vial during topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected.

Soil and sediment samples for VOC analyses should be collected and handled as specified in the SESD Operating Procedure for Soil Sampling (SESDPROC-300), Waste Sampling (SESDPROC-302) or the SESD Operating Procedure for Sediment Sampling (SESDPROC-200). Soil and sediment samples collected for VOC analyses should <u>not</u> be mixed.

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2.9 Sample Storage and Transport

After collection, sample handling should be minimized. Field investigators should use extreme care to ensure that samples are not contaminated during storage. Environmental and waste samples are typically stored in coolers. To reduce the risk of cross contamination, smaller sample containers such as 8 ounce glass jars, 40 ml VOA vials, and one-liter amber bottles should be placed inside of sealed, plastic bags before being placed in the cooler. If ice is required for preservation of the samples, the ice should be contained in a plastic bag or some equivalent container to prevent the potential for cross contamination of the samples by water produced from melting ice. If ice is used, the coolers should be checked regularly and water should be drained as needed. Custody of samples will be maintained according to the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

Samples will either be transported to the analytical laboratory by field investigators or shipped by common carrier. Shipping of samples will be conducted in accordance with the SESD Operating Procedure for Packing, Marking, labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209).

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3 Quality Control Samples

Quality control samples are collected during field studies for various purposes, among which are to isolate site effects (control samples), to define background conditions (background sample), and to evaluate field/laboratory variability (spikes and blanks, trip blanks, duplicate, split samples, etc.).

3.1 Control Sample

A control sample is typically a discrete grab sample collected to isolate a source of contamination. Isolation of a source could require the collection of both an upstream sample at a location where the medium being studied is unaffected by the site being studied, as well as a downstream control which could be affected by contaminants contributed from the site under study.

3.2 Background Sample

A background sample (usually a grab sample) is collected from an area, water body or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

3.3 Variability Samples

Variability may be defined as a variation in concentrations of compounds or analytes across a site or area of investigation or variations, across time, of waste streams or surface water bodies. Variation can also be introduced during sample handling. The following procedures are used to assess and evaluate variability. When appropriate, spatial duplicate grab and/or composite samples should be collected during investigations and studies in accordance to the project DQOs. In general, no more than ten percent of all samples should be collected as spatial duplicates.

3.3.1 Spatial Variability Duplicate

The following spatial duplicate sampling procedures should be used during the collection of samples as a measure of variability within the area represented by the sample. These samples should be collected at the same time, using the same procedures, the same type of equipment, and in the same types of containers as the original samples. They should also be preserved in the same manner and submitted for the same analyses as the required samples.

Spatial variability duplicate samples are typically collected during investigations where samples are collected from grids that are positioned at fixed intervals over the study area and a sample collection pattern is established within the grids. Spatial variability duplicate samples are collected using the same compositing pattern as the original sample and are collected within the same general area of

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representativeness, however the pattern is shifted relative to the original aliquot locations. This amount and direction of shift for the duplicate sample is dependent upon the size of the grid or area being sampled and should be specified in the QAPP for the investigation. Data from spatial duplicates will be examined by the investigation project leader to determine if the observed spatial variability is acceptable, based on the investigation or study objectives.

3.3.2 Temporal Variability Duplicate

When appropriate, temporal variability at a given sampling location will be measured by collecting temporal duplicate samples. These samples will be collected from the same sampling location, using the same techniques and the same type of equipment, but at a time different from the original sample. The time selected for the temporal duplicate sample will be similar to the time or span of time specified for the original sample in the project work plan. Data from temporal duplicates will be examined by the project leader to determine if samples represent the time span intended in the project work plan.

3.3.3 Sample Handling Variability

The effectiveness of sample handling techniques will be measured by collecting split and blank samples.

Split Samples

Split samples will be collected by initially collecting twice as much volume as is normally collected. The material will be apportioned, after mixing, if appropriate, into two sets of containers. Both sets of containers will be submitted for analyses with one set designated as an "original sample," the other designated as a "split sample." Data from the split samples will be examined by the project leader to assess sample handling variability. On large studies (more than 20 samples collected), a minimum of 5 percent, but no more than 10 percent, of all samples will be collected as split samples unless required by site data quality objectives.

Blank Samples

The following blank samples will be prepared by the laboratory and obtained by the project leader prior to traveling to a sample site.

1. Water Sample VOC Trip Blank - A water sample VOC trip blank is required for every study where water samples are collected for VOC analysis. Sealed preserved (or unpreserved, if unpreserved vials were used during the investigation) 40-ml VOC vials will be transported to the field. Two sealed VOC vials will be submitted per trip blank sample. At least one trip blank sample will be submitted per sample shipment. Trip blanks will be prepared by lab personnel. Investigators should submit their request for trip blanks at least one week in advance of scheduled field investigations and inspections and never

(except in emergency situations) less than two days in advance of scheduled field investigations and inspections. These samples should not be picked up earlier than the morning of departure for the scheduled inspection/investigation. These trip blanks will be handled and treated in the same manner as the water samples collected for volatile organic compounds analysis on that particular study. These samples will be clearly identified on sample labels and Chain-of-Custody Records as trip blanks.

2. Soil/Sediment Sample VOC Trip Blank - A soil/sediment sample VOC trip blank is required for every study where soil and/or sediment samples are collected for VOC analysis. The required containers are specified the USEPA Region 4 ASBLOQAM. The request and pick up of the soil blank sample will be the same as for the water trip blank. En Core® containers will be transported to the field. These blanks will be handled and treated by field investigators in the same manner as the soil samples collected for VOC analysis on that particular study. These samples will be clearly identified on sample labels and Chain-Of-Custody Records as trip blanks. Two sealed En Core® containers will be submitted per trip blank sample. At least one set of trip blank samples will be submitted per sample shipment.

The following blanks are prepared in the field:

1. Sample Preservative Blanks - SESD will generally use chemical preservatives stored in individual single-use vials. The chemical preservative will be tested prior to use for the appropriate analytes. The use of pre-tested, single-use vials eliminates the need to routinely collect preservative blanks in the field. If the preservatives are stored in containers that will be used to preserve multiple samples, blanks will be collected to evaluate the potential for cross-contamination resulting from the preservation process. If preservative blanks are collected, sample containers will be filled with de-ionized water by SESD personnel and transported to the field and preserved and submitted for the same analyses as the other inorganic samples collected. These samples will be clearly identified as preservatives blanks on sample labels and the Chain-Of-Custody Record(s). At least one preservative blank for each type of preserved sample should be collected at the end of routine field investigations. In addition, one preservative blank will be collected for each multi-use bottle of preservative used.

   Note: The deionized water will be generated from a water treatment unit provided by the SESD laboratory.

2. Equipment Rinsate Blanks - Equipment rinsate blanks will be collected whenever field decontamination of equipment to be re-used in sampling activities is performed.

   When field cleaning of equipment is required during a sampling investigation, a piece of the field-cleaned equipment will be selected for collection of a rinse

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blank. At least one rinse blank will be collected during each week of sampling operations. After the piece of equipment has been field cleaned and prior to its being used for sample operations, it will be rinsed with organic-free water. The rinse water will be collected and submitted for analyses of all constituents for which normal samples collected with that piece of equipment are being analyzed.

3. Organic-Free Water System Blanks - When using a portable organic-free water generating system in the field, a sample of the water generated by the system will be collected at least once during each week of operations. Based on the objectives of the study or investigation, it may be appropriate to collect a sample of the raw source water. The collected water sample will be submitted for analyses of all constituents for which normal samples are being analyzed.

4. Material Blanks - When construction materials are being used on a site in such a way as to have a potential impact on constituent concentrations in the sample, a sample of each material will be submitted for analysis.

   Note: For drilling operations where materials are shipped directly to the site from the supplier, see SESD Guidance for Design and Installation of Monitoring Wells (SESDGUID-101) for material blank collection and reporting requirements.

5. Automatic Sampler Blanks - In general, cleaning procedures outlined in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) should be adequate to ensure sample integrity. However, it is the standard practice of the Field Services Branch to submit automatic sampler blanks for analyses when automatic samplers are used to collect samples for organic compounds and metals analyses. Automatic sampler blanks for other standard analyses may be submitted in the event of a special investigation (e.g., criminal or civil).

6. Field Blank - A field blank is a sample that is prepared in the field to evaluate the potential for contamination of a sample by site contaminants from a source not associated with the sample collected (for example air-borne dust or organic vapors which could contaminate a soil sample). Organic-free water is taken to the field in sealed containers or generated on-site. The water is poured into the appropriate sample containers at pre-designated locations at the site. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

7. Temperature Blank - A temperature blank is a container of water shipped with each cooler of samples requiring preservation by cooling to 6°C (ice). The temperature of the blank is measured at the time of sample receipt by the laboratory. No temperature blank is necessary for waste samples since waste samples do not require ice for preservation.

8. Wipe Sample Blank - A wipe sample blank is a sample of the material and solvent used for collecting wipe samples. The blank is handled, packaged and transported in the same manner as all other wipe samples with the exception that it is not exposed to actual contact with the sample medium.

9. Water Filter Blank - When filters are used for sampling a dissolved constituent, de-ionized water should be run through at least one filter from each lot and the filtered water submitted for the same analyses. When filters are used for chlorophyll sampling, the filter should be prepared using de-ionized water and submitted for the same chlorophyll analysis.

3.4 Spikes

Spike samples are used to measure bias due to sample handling or analytical procedures. Spike samples are typically used by SESD to evaluate the performance of contract laboratories and are shipped directly to the CLP laboratory by the ESAT contractor.

3.5 Matrix Spike/Matrix Spike Duplicate Samples for Water and Soil Samples for Organic Compounds Analyses

Matrix spike and matrix spike duplicate (MS/MSD) samples will be submitted to the laboratory for volatile organic compounds, extractable organic compounds, pesticides/PCBs and/or herbicides analyses from at least one sampling location per project and laboratory used. One MS/MSD sample should be collected per 20 samples per media collected.

Additional volume will be required for the soil MS/MSD samples. Semi-volatile organic compounds, pesticides, and PCB analyses of soil/sediment samples require the collection of one additional eight ounce glass jar. For VOC soil/sediment samples, double volume, i.e., six En Cores® or six 40 ml vials with syringe collected sample, is needed for the MS/MSD samples.

Additional volume will be required for the water MS/MSD samples. For routine full scan analysis, i.e., extractable organic compounds, pesticides and PCBs, four one-liter amber containers provide the required sample volume. Eight containers, therefore, should be submitted for the MS/MSD sample. For VOC water samples, a total of six 40 ml vials should be collected.

MS/MSD samples should be collected from a location expected to be relatively free from contamination, since the samples will be used for laboratory quality control purposes. The duplicate samples should be clearly identified as "Duplicate Sample for Matrix Spike" or "MS/MSD" on the Chain-Of-Custody Record, in the field logbook and on the Contract Laboratory Program (CLP) Traffic Report Form (if appropriate). This procedure will be followed for all projects where water samples are collected for the indicated analyses. For

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non-routine sampling events, the Region 4 SESD laboratory should be consulted for specific sample volume and container requirements.

3.6 Matrix Spike/Matrix Spike Duplicate Samples for Water and Soil Samples for Inorganic Analyses

A matrix spike sample and a duplicate sample (MS/MSD) will be submitted to the laboratory for inorganic analyses from at least one sampling location per project and laboratory used. One matrix spike and duplicate sample should be collected per 20 samples per media collected per laboratory.

Soil/sediment and water samples collected for inorganic analyses will normally have sufficient sample volume to perform the matrix spike analyses without requiring the collection of extra sample volume. The project leader should designate a sample, typically one considered to be representative of background or relatively uncontaminated conditions, as the matrix spike sample. For water samples, the sample volume collected will normally provide adequate volume for the MS/MSD analyses.

MS/MSD samples should be collected from a location expected to be relatively free from contamination, since the samples will be used for laboratory quality control purposes. MS/MSD samples should be clearly identified as "Duplicate Sample for Matrix Spike" or "MS/MSD" on the Chain-Of-Custody Record, in the field logbook and on the Contract Laboratory Program (CLP) Traffic Report Form (if appropriate). This procedure will be followed for all projects where water samples are collected for the indicated analyses. For non-routine sampling events, the Region 4 SESD laboratory should be consulted for specific sample volume and container requirements.

3.7 Special Quality Control Procedures for EPA Contract Laboratories

On a case-by-case basis, field investigators may be required to collect split samples (or duplicate samples if appropriate) for analyses by either the Region 4 SESD laboratory or contract laboratories. The split samples are to be submitted to the Region 4 laboratory using established procedures. The contract laboratory involved will not be notified that samples were split, i.e., there should be no indication on Chain-Of-Custody Records or CLP Traffic Report Forms submitted to the contract laboratories that these samples were split with the Region 4 SESD laboratory.

3.8 Special Quality Control Procedures for Dioxins and Furans

The Region 4 laboratory does not conduct in-house analyses for dioxins and furans. Dioxin and furans analyses are conducted by contract laboratories. The Region 4 laboratory may accept environmental samples (soil, sediment, groundwater and surface water) suspected of being contaminated with polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), as long as suspected PCDD and PCDF contamination is not due to RCRA hazardous waste classified as F020-023 and/or F026-

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028. If these environmental samples are not contaminated with an F020-023 and/or F026-028 waste, it may be analyzed for parameters other than dioxin and furans. Environmental samples known or suspected to be contaminated with the RCRA hazardous waste F020-023 and or F026-028 will not be accepted.

NOTE: Environmental samples suspected of being contaminated with RCRA hazardous waste classified in 40 CFR, 261.31 as F032 will be accepted. The F032 waste is defined as wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations. The F032 listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and or pentachlorophenol. Prior to a sampling event, the project leaders should consult with the Analytical Services Branch Sample Control Coordinator to determine if the Region 4 laboratory can accept the samples. The Region 4 SESD laboratory should also be consulted for the current quality control procedures for dioxins and furans samples prior to a sampling investigation.

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4 Internal Quality Control Procedures

The focus of this section is on Field Equipment Center (FEC) operations involving preparation of sampling and support equipment for field operations, as well as, field data generated under the specific sample collection quality control procedures discussed in Section 2. Quality control checks of these operations ensure that field sampling teams are provided with equipment that is suitable for sampling use, and that field sampling is conducted using proper procedures.

4.1 Traceability Requirements

Records, will be kept by designated SESD staff or FEC personnel documenting the dates of operations and the person performing operations for the following:

1. Organic-Free Water System Maintenance (FEC System) - Maintenance on the FEC organic-free water system will be performed at least once per 180 days.

2. Air Monitoring Safety Instrumentation Checkouts - Pre-loadout checks on safety monitoring instrumentation will be recorded each time they are performed. Discrepancies will be immediately reported to the Branch Safety Officer.

3. Self Contained Breathing Apparatus (SCBA) Checkouts - Pre-loadout checks on SCBAs will be recorded when they are performed. SCBA checkouts will be performed at least once per calendar quarter in the absence of loadout requests. Any discrepancies will be reported immediately to the Branch Safety Officer.

4. Other Equipment Maintenance - Maintenance performed on equipment other than that listed above will be accordance to the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). All required repairs will be reported to appropriate Branch Field Equipment Manager.

5. Tubing, Sampling Containers and Latex Gloves - The Field Services Branch Quality Assurance Officer (FSB QAO) is responsible for conducting verification sampling for tubing, sample containers, and latex gloves that are used during field investigations. Upon receipt, the tubing, containers and gloves are placed in the quarantine room at the FEC. A record is kept of the lot numbers for each shipment received. The FSB QAO, or designee, will collect blank samples from tubing, containers and gloves within each lot received and will review the results to ensure the sample containers and gloves are suitable for use during field investigations. Once the supplies are deemed suitable, the FSB QAO will release the items for use.

6. Chemical preservatives commercially purchased will be tested prior to use. Each lot of chemical preservative will be tested for the appropriate analytes by either the

Branch Field Equipment Manager or the FSB QAO. Once released by FSB QAO, the preservatives can be used in the field.

7. Equipment - All equipment cleaned and wrapped for field use will be marked with the date on which preparation was completed. Equipment will be stored at the FEC in specified areas to minimize the risk of contamination while awaiting use.

4.2 Specific Quality Control Checks

When collecting samples during field investigations, it is necessary to take measures to prevent cross contamination to ensure the integrity of the data generated. The field branches conduct verification sampling of sample containers, gloves, sampling equipment, tubing and water utilized during field investigations as one of these measures. At least once per calendar quarter, the FSB QAO will conduct the following checks and issue a written report to the Field Quality Manager with the results.

1. Collect and submit for analyses samples of each new lot of containers received, Bottles from each lot will be tagged and sealed, then submitted for the following analyses:

    1. 1-liter Amber – extractable organics, pesticides, and PCBs.

    2. 8-oz. Clear Glass – metals, cyanide, extractable organics, pesticides, PCBs, and volatile organic compounds.

    3. 1-Liter Polyethylene – metals and cyanide.

    NOTE: In addition to the quality control checks listed above, samples may be collected during field investigations for classical inorganic parameters such as nitrates, nitrites, sulfides, etc. Due to the detection levels generally required for these parameters, it is unlikely that cross contamination may occur in association with the sample containers and sampling equipment used during sample collection. Therefore, classical inorganic analyses are not conducted as part of the routine quality control checks. If the data quality objectives require additional quality control checks, bottles will be submitted to the laboratory for analyses.

2. Collect and submit for analyses a rinsate blank for each new lot of latex or nitrile gloves received during the calendar quarter. Samples will be collected as rinse blanks using organic-free water. The rinsate will be submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides and PCBs. A new glove will be rinsed for each parameter (e.g., one glove for the VOC sample, another glove for metals, etc.) to avoid dilution of potential contaminants on the gloves. Water for the VOC samples should be provided by the ASB laboratory.

3. Collect and submit for analyses a sample of water from the FEC organic-free water system. The sample will be submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides and PCBs.

4. Collect and submit for analyses a rinsate blank of at least one piece of sampling or sample related equipment stored at the FEC. The sample will submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides and PCBs. Water for the VOC samples should be provided by the ASB laboratory.

5. Collect and submit for analyses a rinsate blank for each new lot of Silastic® or Tygon® tubing used in peristaltic pump head. The sample will be submitted for metals and cyanide analysis.

6. Teflon® tubing – Collect and submit for analyses a rinsate blank for each new lot of Teflon® tubing received. Rinse blanks will be collected through the Teflon tubing. The sample will be submitted for metals, cyanide, extractable organics, volatile organic compounds, pesticides and PCBs. Water for the VOC samples should be provided by the ASB laboratory.

4.3 Quality Control for Special Order Equipment and Supplies

Some equipment and supplies ordered for specific projects are received in what can be considered ready to use condition. In order to ensure the integrity of these materials, an equipment rinsate blank will be collected from at least one item in each lot. The equipment and supplies will not be used until the QAO has reviewed the analytical data for the blanks and released the items.

4.4 Quality Control Evaluation and Corrective Action

All field investigation reports will contain a clearly identified section where the results for all field generated quality control (QC) samples are discussed and reported. Quality control data review includes but is not limited to detections of organic and inorganic compounds at any concentration in quality control blanks (i.e., trip blanks, equipment rinsate blanks, portable organic-free water system blanks, etc.).

All detections of organic and inorganic compounds will be immediately reported to the FSB QAO. The project leader will analyze of the results to determine if the source of contamination can be identified. If the source of contamination cannot be determined by the project leader, the branch QAO will conduct an additional review of the results to assess the source of contamination. If the source of contamination cannot be determined, the QAO will monitor all quality control results generated by the branch and assess the data for trends of contamination.

If it is determined by the project leader and the FSB QAO that the contamination adversely impacts the data collected during the investigation, the project leader will report the results to their Section Chief and the FQM. The project leader, in consultation with management, will determine whether the impacted data are usable or should be rejected. If data are

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rejected, the project leader and their management will determine whether samples must be recollected.

Data reported to the FQM will be analyzed to determine if the contamination is due to non-conforming work. If it is determined by the FQM, in consultation with management, that the contamination is due to non-conforming work, a corrective action is warranted and will be selected and implemented in a timely manner. If a corrective action is required, it must be implemented and reported according to the SESD Operating Procedure for Corrective Action (SESDPROC-009). If contamination is not due to non-conforming field work, then the source of contamination will be identified, if possible, and documented by the FQM. If the source of contamination cannot be determined, FQM will monitor all quality control results generated by SESD and assess the data for trends of contamination.

4.4.1 Quality Assurance Reports

It is each project leader's responsibility to ensure that a copy of the quality assurance data from each field investigation report is provided to the FSB QAO, who will compile a quarterly report of field quality assurance data and forward the report to the FQM.

The FQM will prepare an annual quality assurance report based on the quarterly reports. This report will be distributed to all field investigators each year and will document and discuss all quality control issues or trends identified during the data review. This report will be retained by the FQM to document that QC measures have been taken, that the QC measures are appropriate, that the QC results are acceptable or, if not, that corrective actions were taken.

Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: Soil Sampling	ID: LSASDPROC-300-R4
Issuing Authority: LSASD Field Branch Chief	
Effective Date: June 11, 2020	Review Due Date: June 11, 2024

Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil samples for field screening or laboratory analysis.

Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that LSASD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil sample, the variant procedure will be documented in the field logbook and subsequent investigation report, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

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1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD local area network (LAN). The QAC is responsible for ensuring the most recent version of the procedure is placed on the LAN, and for maintaining records of review conducted prior to its issuance.

1.2 General Precautions

1.2.1 Safety

Proper safety precautions must be observed when collecting soil samples. Refer to the LSASD Safety and Occupational Health Manual and any pertinent site-specific Health and Safety Plans (HASP) and Job Hazard Assessments for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. The reader should address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.2.2 Procedural Precautions

The following precautions should be considered when collecting soil samples:

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.

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- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader in the project files. (Air bills are generated online via UPS Campusship program and package tracking is done online). Receipts are not always received at time of shipping.
- Sampling in landscaped areas: Cuttings should be placed on plastic sheeting and returned to the borehole upon completion of the sample collection. Any 'turf plug' generated during the sampling process should be returned to the borehole.
- Sampling in non-landscaped areas: Return any unused sample material back to the auger, drill or push hole from which the sample was collected.

2 Special Sampling Considerations

2.1 Special Precautions for Trace Contaminant Soil Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different sample is collected and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers with samples suspected of containing high concentrations of contaminants shall be handled and stored separately.
- All background samples shall be segregated from obvious high-concentration or waste samples. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area. Samples of waste or highly-contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other member(s) collect the samples.
- Samplers must use new, verified/certified-clean disposable or non-disposable equipment cleaned according to procedures contained in the LSASD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), for collection of samples for trace metals or organic compound analyses.

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2.2 Sample Homogenization

1. If sub-sampling of the primary sample is to be performed in the laboratory, transfer the entire primary sample directly into an appropriate, labeled sample container(s). Proceed to step 4.

2. If sub-sampling the primary sample in the field or compositing multiple primary samples in the field, place the sample into a glass or stainless steel homogenization container and mix thoroughly. Each aliquot of a composite sample should be of the same approximate volume.

3. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the sample media. ***Samples for VOC analysis are not homogenized.*** The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

   - The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
   - Two quarters should then be mixed to form halves.
   - The two halves should be mixed to form a homogenous matrix.

   This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

2.3 Dressing Soil Surfaces

Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

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2.4 Quality Control

If possible, a control sample should be collected from an area not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same soil type. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by sampling tools. LSASD Operating Procedure for Field Sampling Quality Control (SESDPROC-011) contains other procedures that may be applicable to soil sampling investigations.

2.5 Records

Field notes, recorded in a bound field logbook, as well as chain-of-custody documentation will be generated as described in the LSASD Operating Procedure for Logbooks (SESDPROC-010) and the LSASD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Samples Collected for Volatile Organic Compounds (VOC) or for Per- and Polyfluoroalkyl Substances (PFAS) Analyses

3.1 Soil Samples Collected for Volatile Organic Compounds (VOC) Analysis

The procedures outlined here are summarized from *Test Methods for Evaluating SolidWaste, Physical/Chemical Methods SW-846, Method 5035.* If samples are to be analyzed for VOCs, they should be collected in a manner that minimizes disturbance of the sample. For example, when sampling with an auger bucket, the sample for VOC analysis should be collected directly from the auger bucket (preferred) or from minimally disturbed material immediately after an auger bucket is emptied into the pan. The sample shall be containerized by filling an En Core® Sampler or other Method 5035 compatible container. ***Samples for VOC analysis are not homogenized.*** Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

3.2 Soil Sampling for VOCs (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of VOCs in soils at a project site. Because of the large number of options

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available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

3.2.1 Equipment

Soil for VOC analyses may be retrieved using any of the LSASD soil sampling methods described in Sections 4 through 8 of this procedure. Once the soil has been obtained, the En Core® Sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40 mL vials may be used/required for sub-sampling. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various sub-sampling methods are described below.

3.2.2 Sampling Methodology - Low Concentrations (<200 µg/kg)

When the total VOC concentration in the soil is expected to be less than 200 µg/kg, the samples may be collected directly with the En Core® Sampler or syringe. If using the syringes, the sample must be placed in the sample container (40 mL pre-prepared vial) immediately to reduce volatilization losses. The 40 mL vials should contain 10 mL of organic-free water for an un-preserved sample or approximately 10 mL of organic-free water and a preservative. It is recommended that the 40 mL vials be prepared and weighed by the laboratory (commercial sources are available which supply preserved and tared vials). When sampling directly with the En Core® Sampler, the vial must be immediately capped and locked.

A soil sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (En Core® Sampler or 40 mL pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (En Core® Sampler or 40 mL pre-prepared vial) as soon as possible, not to exceed 30 minutes.

NOTE: After collection of the sample into either the En Core® Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil samples may be prepared for shipping and analysis as follows:

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En Core® Sampler - the sample shall be capped, locked, and secured in the original foil bag. All foil bags containing En Core® samplers are then placed in a plastic bag and sealed with custody tape, if required.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-mL pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40 mL containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag.

3.2.3 Sampling Methodology - High Concentrations (>200 µg/kg)

Based upon the data quality objectives and the detection level requirements, this high-level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 3.2.2, Sampling Methodology - Low Concentrations, and preserved using 10 mL methanol.

3.2.4 Special Techniques and Considerations for Method 5035

Effervescence

If low concentration samples effervesce (rapidly form bubbles) from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or un-preserved, as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence then preservation by acidification is not acceptable, and the sample must be collected un-preserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed

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into the vial. The sample may then be collected as an un-preserved sample. Note: the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size and the lack of sample mixing, sample representativeness for VOCs may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in the Laboratory Services Branch *Laboratory Operations and Quality Assurance Manual* (ASBLOQAM), Most Recent Version. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample on ice is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

Percent Solids

Samplers must ensure that the laboratory has sufficient material to determine percent solids in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent solids determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent solids determination will be required. The sample collected for percent solids may also be used by the laboratory to check for preservative compatibility.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

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Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.

The summary table on the following page lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. LASSD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

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Table 1: Method 5035 Summary

OPTION	PROCEDURE	ADVANTAGES	DISADVANTAGES
1	Collect two 40 mL vials with ≈ 5 grams of sample, and one 2 oz. glass jar w/septum lid for screening, % moisture and preservative compatibility.	Screening conducted by lab.	Presently a 48-hour holding time for unpreserved samples. Sample containers must be tared.
2	Collect three En Core® samplers, and one 2 oz. glass jar w/septum lid for screening, % solids.	Lab conducts all preservation/preparation procedures.	Presently a 48- hour holding time for preparation of samples.
3	Collect two 40 mL vials with 5 grams of sample and preserve w/methanol or sodium bisulfate, and one 2-oz. glass jar w/septum lid for screening, % solids .	High level VOC samples may be composited. Longer holding time.	Hazardous materials used in the field. Sample containers must be tared.
4	Collect one 2-oz. glass jar w/septum lid for analysis, % solids (high level VOC only).	Lab conducts all preservation/preparation procedures.	May have significant VOC loss.

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3.3 Soil Samples for Per- and Polyfluoroalkyl Substances (PFAS) Analysis

Sources of PFAS contamination in soils can include direct discharges, direct applications of some PFAS products such as aqueous film-forming foams (AFFF), air deposition from manufacturing stack emissions, landfill leachate, and land applications of biosolids or effluents. The distribution of PFAS in soils is multifaceted and will be dependent on site-specific conditions and soils as well as the individual properties of the PFAS such as chain length and functional group. Heavy PFAS contamination of subsurface soils can serve as long-term sources for both groundwater and surface water contamination. For more information about conducting site investigations for PFAS, please see the Interstate Technology and Regulatory Council's (ITRC's) April 2020 Fact Sheets: *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*, and *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances*.

3.3.1 Sampling Equipment

Guidance documents recommend sampling equipment be made of stainless-steel, high-density polyethylene (HDPE), polypropylene, and/or silicone. Standard soil sampling equipment such as stainless-steel spoons, hand augers, and direct push samplers with liners that are PFAS-free can be used to collect samples for PFAS analyses. Direct contact sampling equipment that will be used to collect samples for PFAS analyses should be decontaminated following the procedures in the *Field Equipment Cleaning and Decontamination at the FEC*, LSASDPROC-206.

3.3.2 PFAS Soil Sample Mixing and Homogenization Considerations

Because studies have shown the loss of PFAS due to adsorption to surfaces, samples should be minimally handled and directly placed into the sample container when possible. Sample preparation procedures should be specified in the Sampling and Analysis Plan (SAP). If compositing, mixing or homogenization of the sample is desired, it should preferably be done at the laboratory so that a representative subsample will be analyzed. In cases where the homogenization is conducted in the field, extra grab samples should accompany the mixed or composited samples to determine the variability and impacts on PFAS concentrations of the mixed samples.

3.3.3 Trace Level Sampling Technique for PFAS

To prevent PFAS contamination, **extreme care** is required when handling containers, samples and equipment that will be used to collect samples for PFAS analyses. **New gloves** need to be worn when decontaminating and handling sample containers and equipment. When worn gloves become compromised by potential PFAS containing materials, they need to be changed for new gloves. Nitrile gloves are recommended for PFAS sampling investigations. Also, sample containers should be kept covered in original packaging or in Whirl-Paks® until ready for use due to potential PFAS

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contamination from air deposition of vapors, aerosols, and particulates.

This trace level sampling technique is used to minimize PFAS contamination of the samples. This process will require two field personnel for PFAS sample collection. When the field investigators are prepared to fill the sample container(s), a designated sampler will don new gloves while a second designee, also with new gloves, will assist by opening sample container packaging/Whirl-Pak®. The designated sampler removes the sample container(s) from the packaging but keeps them closed. Only after the second designee is ready to fill the sample container does the designated sampler remove the cap and hold it in their hand until the appropriate sample volume is obtained. After capping the sample container(s), return them to their Whirl-Pak®. The designated sampler who holds the sample container(s) should not touch anything else during the sample collection process. This is important because of the wide use of PFAS in commercial products such as clothing, field gear, personnel protective equipment, sunscreen, insect repellants, and personal hygiene products. Additionally, the designated sampler should avoid touching the sample media and the inside of the sample container. The second designee will operate sampling equipment and assist with sample container packaging and labeling. Sampling equipment known or suspected to contain PFAS should be avoided during sampling activities.

3.3.4 Quality Control Samples and Standard Operating Procedures

For soil samples undergoing PFAS analyses, it extremely important that quality control samples be collected as part of the investigation to account for the PFAS contribution of the sample containers, decontamination solutions, gloves, decontaminated equipment and plastic used to store equipment. Equipment rinse and material blanks are needed for PFAS sampling investigations to assess the direct contact sampling equipment impact on the sampling results. It is also helpful to take field quality control samples such as field blanks, duplicates, and trip blanks to evaluate the soil sampling and sample handling activities of the investigation. Laboratory sources of water used for equipment decontamination and blank sample collection should be produced as PFAS-free or assessed for background concentrations of PFAS.

Along with a good quality assurance program, standard operating procedures (SOPs) and detailed SAPs are required for PFAS investigations to provide consistency between samplers and investigations.

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4 Manual Soil Sampling Methods

4.1 General

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The most common interval is 0 to 6 inches; however, the data quality objectives of the investigation may dictate another interval, such as 0 to 3 inches for risk assessment purposes. The shallow subsurface interval may be considered to extend from approximately 12 inches below ground surface to a site-specific depth at which sample collection using manual collection methods becomes impractical.

If a thick, matted root zone, gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials.

When compositing, make sure that each composite location (aliquot) consist of equal volumes, i.e., same number of equal spoonfuls.

4.2 Spoons

Stainless steel spoons may be used for surface soil sampling to depths of approximately 6 inches below ground surface where conditions are generally soft and non-indurated, and there is no problematic vegetative layer to penetrate.

4.2.1 Special Considerations When Using Spoons

When using stainless steel spoons, consideration must be given to the procedure used to collect the volatile organic compound sample. If the soil being sampled is cohesive and holds its in situ texture in the spoon, the En Core® Sampler or syringe used to collect the sub-sample for Method 5035 should be plugged directly from the spoon. If, however, the soil is not cohesive and crumbles when removed from the ground surface for sampling, consideration should be given to plugging the sample for Method 5035 directly from the ground surface at a depth appropriate for the investigation Data Quality Objectives.

4.3 Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 3-inch stainless steel auger buckets with cutting

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heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle with extensions (if needed).

4.3.1 Surface Soil Sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is advanced to the appropriate depth and the contents are transferred to the homogenization container for processing. Observe precautions for volatile organic compound and PFAS sample collection found in Section 3.

4.3.2 Subsurface Soil Sampling

Hand augers are the most common equipment used to collect shallow subsurface soil samples. Auger holes are advanced one bucket at a time until the sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and removed.

The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. Hand augers may also be of limited use in tight clays or cemented sands. In these soil types, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions. At some point these problems become so severe that power equipment must be used.

4.3.3 Special Considerations for Soil Sampling with the Hand Auger

- Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- Observe precautions for volatile organic compound (VOC) and PFAS sample collection found in Section 3. Collect the VOC sample directly from the auger bucket, if possible.
- Power augers, such as the Little Beaver® and drill rigs may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
- When moving to a new sampling location, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

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5 Direct Push Soil Sampling Methods

5.1 General

These methods are used primarily to collect shallow and deep subsurface soil samples. Three samplers are available for use within the Division's direct push tooling inventory. All of the sampling tools involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe each of the specific sampling methods that can be accomplished using direct push techniques, along with details specific to each method. While LSASD currently uses the sample tooling described, tooling of similar design and materials is acceptable.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with these devices.

5.2 Large Bore® Soil Sampler

The Large Bore® (LB) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of depth-discrete subsurface soil samples. The sample barrel is approximately 30-inches (762 mm) long and has a 1.5-inch (38 mm) outside diameter. The LB® sampler is capable of recovering a discrete sample core 22 inches x 1.0 inch (559 mm x 25 mm) contained inside a removable liner. The resultant sample volume is a maximum of 283 mL.

After the LB® sample barrel is equipped with the cutting shoe and liner, the piston-rod point assembly is inserted, along with the drive head and piston stop assembly. The assembled sampler is driven to the desired sampling depth, at which time the piston stop pin is removed, freeing the push point. The LB® sampler is then pushed into the soil a distance equal to the length of the LB® sample barrel. The probe rod string, with the LB® sampler attached, is then removed from the subsurface. After retrieval, the LB® sampler is then removed from the probe rod string. The drive head is then removed to allow removal of the liner and soil sample.

5.3 Macro-Core® Soil Sampler

The Macro-Core® (MC) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Although other lengths are available, the standard MC® sampler has an assembled length of approximately 52 inches (1321 mm) with an outside

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diameter of 2.2 inches (56 mm). The MC® sampler is capable of recovering a discrete sample core 45 inches x 1.5 inches (1143 mm x 38 mm) contained inside a removable liner. The resultant sample volume is a maximum of 1300 mL. The MC® sampler may be used in either an open-tube or closed-point configuration. Although the MC® sampler can be used as an open-barrel sampler, in LSASD usage, the piston point is always used to prevent the collection of slough from the borehole sides.

5.4 Dual Tube Soil Sampling System

The Dual Tube 21 soil sampling system is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.125-inch (54 mm) OD probe rod. The samples are collected within a liner that is threaded onto the leading end of a string of 1.0-inch diameter probe rod. Collected samples have a volume of up to 800 mL in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. Use of this method allows for collection of continuous core inside a cased hole, minimizing or preventing cross-contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual tube assembly and core to its initial sample depth.

5.5 Special Considerations When Using Direct Push Sampling Methods

- *Liner Use and Material Selection* – Direct Push Soil Samples are collected within a liner to facilitate removal of sample material from the sample barrel. The liners may only be available in a limited number of materials for a given sample tool, although overall, liners are available in brass, stainless steel, cellulose acetate butyrate (CAB), polyethylene terepthalate glycol (PETG), polyvinyl chloride (PVC) and Teflon®. For most LSASD investigations, the standard polymer liner material for a sampling tool will be acceptable. When the study objectives require very low reporting levels or unusual contaminants of concern, the use of more inert liner materials such as Teflon® or stainless steel may be necessary.

- *Sample Orientation* – When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which an aliquot was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.

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- *Core Catchers* – Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In cases such as these, the use of core catchers on the leading end of the sampler may help retain the sample until it is retrieved to the surface. Core catchers may only be available in specific materials and should be evaluated for suitability. However, given the limited sample contact that core-catchers have with the sample material, most standard core-catchers available for a tool system will be acceptable.

- *Decontamination* – The cutting shoe and piston rod point are to be decontaminated between each sample, using the procedures specified for the collection of trace organic and inorganic compounds found in Field Equipment and Decontamination – SESDPROC-205, most recent version. Within a borehole, the sample barrel, rods, and drive head may be subjected to an abbreviated cleaning to remove obvious and loose material, but must be cleaned between boreholes using the procedures specified for downhole drilling equipment in Field Equipment and Decontamination – SESDPROC-205, most recent version.

- *Decommissioning* – Boreholes must be decommissioned after the completion of sampling. Boreholes less than 10 feet deep that remain open and do not approach the water table may be decommissioned by pouring 30% solids bentonite grout from the surface or pouring bentonite pellets from the surface, hydrating the pellets in lifts. Boreholes deeper than 10 feet, or any borehole that intercepts groundwater, must be decommissioned by pressure grouting with 30% solids bentonite grout, either through a re-entry tool string or through tremie pipe introduced to within several feet of the borehole bottom.

- *VOC and PFAS Sample Collection* – Observe precautions for volatile organic compounds and Per- and Polyfluoroalkyl Substances sample collection found in Section 3 of this procedure.

6 Split Spoon/Drill Rig Methods

6.1 General

Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples. All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the sub used to attach the spoon to the string of drill rod. Two basic methods are available for use, including the smaller diameter standard split spoon, driven with the drill rig safety hammer, and the larger diameter continuous split spoon,

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advanced inside and slightly ahead of the lead auger during hollow stem auger drilling. The following sections describe each of the specific sampling methods, along with details specific to each method.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with these devices.

6.2 Standard Split Spoon

A drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of stainless steel and are typically 2.0-inches OD (1.5-inches ID) and 18-inches to 24-inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod, it is lowered into the borehole. The safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

6.3 Continuous Split Spoon

The continuous split spoon is a large diameter split spoon that is advanced into the soil column inside a hollow stem auger. Continuous split spoons are typically 3 to 5 inches in diameter and either 5 feet or 10 feet in length, although the 5-foot long samplers are most common. After the auger string has been advanced into the soil column a distance equal to the length of the sampler being used it is returned to the surface. The sampler is removed from inside the hollow stem auger and the threaded collars are removed. The split spoon is then opened for sampling.

6.4 Special Considerations When Using Split Spoon Sampling Methods

- Always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during inserting the split spoon.
- Observe precautions for volatile organic compounds and Per- and Polyfluoroalkyl Substances sample collection found in Section 3.

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7 Shelby Tube/Thin-Walled Sampling Methods

7.1 General

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses, such as hydraulic conductivity and permeability, to support hydrogeologic characterizations at hazardous waste and other sites.

If gravel, concrete, etc. is present at or near the surface, it should be removed before the sample is collected. The depth measurement for the sample begins at the top of the soil horizon, immediately following any removed materials. Turf grass is not typically removed prior to sampling with this device.

7.2 Shelby Tube Sampling Method

A typical Shelby tube is 30 inches in length and has a 3.0-inch OD (2.875-inch ID) and may be constructed of steel, stainless steel, galvanized steel, or brass. They also typically are attached to push heads that are constructed with a ball-check to aid in holding the contained sample during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed material by hydraulic force. After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition. If the sample is collected for geotechnical parameters, the tube is typically capped, maintaining the sample in its relatively undisturbed state, and shipped to the appropriate geotechnical laboratory.

7.3 Special Considerations When Using Split Spoon Sampling Methods

Observe precautions for volatile organic compounds and Per- and Polyfluoroalkyl Substances sample collection found in Section 3.

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8 Backhoe Sampling Method

8.1 General

Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. If possible, the sample should be collected without entering the trench. Samples may be obtained from the trench wall or they may be obtained directly from the bucket at the surface. The following sections describe various techniques for safely collecting representative soil samples with the aid of a backhoe.

The depth measurement for the sample begins at the top of the soil horizon.

8.2 Scoop-and-Bracket Method

If a sample interval is targeted from the surface, it can be sampled using a stainless steel scoop and bracket. First a scoop and bracket are affixed to a length of conduit and is lowered into the backhoe pit. The first step is to take the scoop and scrape away the soil comprising the surface of the excavated wall. This material likely represents soil that has been smeared by the backhoe bucket from adjacent material. After the smeared material has been scraped off, the original stainless steel scoop is removed and a clean stainless steel scoop is placed on the bracket. The clean scoop can then be used to remove sufficient volume of soil from the excavation wall to make up the required sample volume.

8.3 Direct-from-Bucket Method

It is also possible to collect soil samples directly from the backhoe bucket at the surface. Some precision with respect to actual depth or location may be lost with this method but if the soil to be sampled is uniquely distinguishable from the adjacent or nearby soils, it may be possible to characterize the material as to location and depth. In order to ensure representativeness, it is also advisable to dress the surface to be sampled by scraping off any smeared material that may cross-contaminate the sample.

8.4 Special Considerations When Sampling with a Backhoe

- Do not physically enter backhoe excavations to collect a sample. Use either procedure 8.2, Scoop-and-Bracket Method, or procedure 8.3, Direct-from-Bucket Method to obtain soil for sampling.

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- Smearing is an important issue when sampling with a backhoe. Measures must be taken, such as dressing the surfaces to be sampled (see Section 2.3), to mitigate problems with smearing.
- Paint, grease and rust must be removed and the bucket decontaminated prior to sample collection.
- Observe precautions for volatile organic compound and PFAS sample collection found in Section 3.

9 Incremental Sampling Method

9.1 General

ISM is a structured composite sampling and processing protocol that reduces data variability and provides an unbiased estimate of mean contaminant concentrations in the area targeted for sampling. ISM provides representative samples of specific soil volumes defined as decision units (DUs) by collecting numerous increments of soil (typically 30–100) that are combined, processed, and subsampled according to specific protocols. Triplicate samples are collected to measure and evaluate the reproducibility of the sample data.

Like all sampling approaches, ISM should be applied within a systematic planning framework. The size, orientation, and location of a DU is site-specific and represents the smallest volume of soil about which a decision is to be made (USEPA 1999, Ramsey and Hewitt 2005, HDOH 2008a, ADEC 2009). DUs are based on project-specific needs and site-specific DQOs. More detailed information on conducting sampling using ISM can be found in the Interstate Technology and Regulatory Council's *Incremental Sampling Methodology* (ISM-1).

9.2 Field Implementation, Sample Collection, and Processing

9.2.1 Introduction

The goal of most sampling efforts is to collect a sample that is representative of the target area (or DU). ISM is designed to collect representative and reproducible soil data. To help ensure data quality, all field sampling and field processing activities should be performed and supervised by personnel trained in ISM implementation

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9.2.2 Sampling Tools

The selection of the appropriate sampling tool for collecting an ISM sample depends on the cohesiveness and composition of the soil substrate. The sampling tool should obtain cylindrical or core-shaped increments of a constant depth from the presented surface so that each increment collected is the same approximate volume and mass.

See Figures 1 and 2 for examples of sampling tools for nonvolatile ISM sample collection. Various other hand augers, core sampling tools, step probes, etc., are available from environmental or agricultural suppliers and are applicable to ISM if the specifications meet project DQOs. It is highly recommended that the proposed sampling tool is tested at the sample location prior to full mobilization to ensure that the sampling tool is appropriate for site conditions. If a pilot sampling effort is not possible, a variety of tools to address different soil types or site conditions should be taken into the field.

Note: Volatile ISM sample collection should follow Method 5035 recommendations. See Section 3 of this SOP.

9.2.3 Field Collection

Incremental soil samples are prepared by collecting multiple increments of soil (typically 30 or more) from a specified DU and physically combining these increments into a single sample, referred to as the "incremental sample." Samples are collected in triplicate from different locations within the same DU. Sample increments locations can be selected by a random number generator or evenly spaced across the DU to ensure that the incremental sample is representative of the DU. Survey flags or other markers can be helpful in identifying increment collection locations prior to beginning sample location.

The number of increments to be collected from each DU of a site investigation should be evaluated during systematic planning as part of the DQO process and documented in the sampling and analysis plan (SAP).See section 5.3.2 of ISM-1 for subsurface ISM sample collection.

9.2.4 Field Handling of ISM Samples

ISM samples collect a larger volume of soil than discrete samples and will require a larger collection container than may be specified by the laboratory or that is typically used. For example, a gallon-sized sealable plastic bag or a liter glass jar may be used depending upon the suspect analytes. When building the incremental sample by collecting increments, it may be more practical to collect the sample in an aluminum pan, plastic bucket, stainless-steel bowl, or other easily transported

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container until the entire sample has been collected. The final sample can then be processed in the field or transferred to a container for shipment to a laboratory for sample processing and analysis.

Processing of ISM samples is ideally performed in a laboratory. However, subsampling, disaggregation, drying, and sieving are some processing steps that may be required to be performed in the field. Field processing may be necessary if field analysis will be performed on the samples of if the laboratory is unable to perform the sample processing steps required. Any field processing steps should be rigorously performed to ensure that the sample representativeness is maintained through analysis. To ensure proper sample size reduction and representative subsampling, they should be performed using a 2-D Japanese slab cake and specialized subsampling tool, a riffle splitter, rotary cone sample splitter, or similar. Sample volume reduction of ISM samples should not be conducted with a stainless-steel spoon and a stainless-steel bowl. All sample processing equipment should be appropriately decontaminated between sample stations.

9.3 Special Considerations When Using Incremental Sampling Methods

- Selection of an appropriately sized and positioned Decision Unit is important to ensuring quality data and useful results
- Steps should be taken throughout the sampling effort to ensure that the representativeness of the sample is maintained from collection through analysis
- Advance coordination with the laboratory is necessary to ensure that the laboratory has the capability and capacity to conduct any sample processing that may be necessary. If the lab cannot complete the required processing steps, the sampling team may need to perform the sample processing steps in the field.

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Figure 1

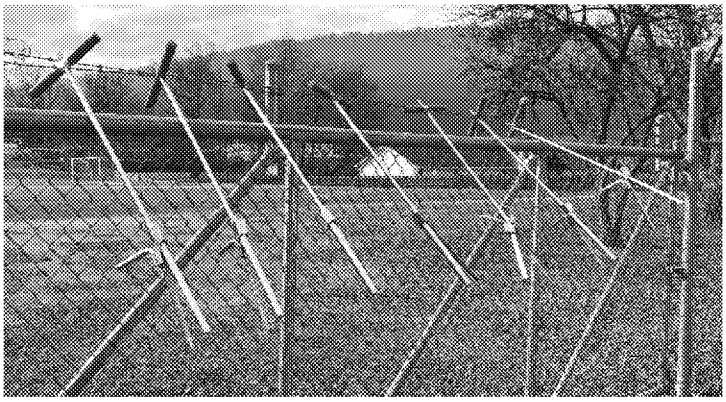

Figure 2

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10 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

LSASD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

LSASD Operating Procedure for Field X-Ray Fluorescence (XRF) Measurement, SESDPROC-107, Most Recent Version

LSASD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

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US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, Most Recent Version (Method 5035)

US EPA Region 4 Safety and Occupational Health Manual. Region 4 LSASD, Athens, GA, Most Recent Version

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ITRC (Interstate Technology and Regulatory Council) April 2020 Fact Sheets: *Site Characterization Considerations, Sampling Precautions,* and *Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*, and *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances*

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11 Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the LSASD Quality Assurance Coordinator (QAC) on the LSASD local area network (LAN).

History	Effective Date
LSASDPROC-300-R4, *Soil Sampling,* replaces SESDPROC-300-R3Added Section 3.3. Soil Samples Collected for PFAS Analysis. Added Section 9, Incremental Sampling Method including Figures 1 and 2. **General:** Throughout the document, mention of SESD was replaced with LSASD as appropriate. Mention of Document Control Coordinator changed to Quality Assurance Coordinator. **Cover Page:** Changed Kevin Simmons, Environmental Scientist to Life Scientist. Changed Acting Chief, John Deatrick of the Enforcement and Investigations Branch to Chief, Applied Science Branch. Changed Acting Chief, Laura Ackerman, Ecological Assessment Branch to Chief, Hunter Johnson, Superfund Section. Changed Bobby Lewis, Field Quality Manager, Science and Ecosystem Support Division to Stacie Masters, Quality Assurance Coordinator, Laboratory Services and Applied Science Division.	June 11, 2020
SESDPROC-300-R3, *Soil Sampling*, replaces SESDPROC-300-R2. **General:** Corrected any typographical, grammatical and/or editorial errors. **Title Page:** Updated the author from Fred Sloan to Kevin Simmons. Updated the Enforcement and Investigations Branch Chief from Archie Lee to Acting Chief, John Deatrick. Section 1.5.1: Added "The reader should" to last sentence of the paragraph. Section 1.5.2: Omitted "When sampling in landscaped areas," from first sentence of eighth bullet. Section 3.2.4: In the first paragraph, first sentence, added "(rapidly form bubbles)." Omitted "(rapidly form bubbles)" from second paragraph, second sentence. Any reference to "Percent Moisture and Preservation Compatibility (MOICA)" or "Percent Moisture" was changed to "Percent Solids", both in the text and in Table 1.	August 21, 2014
SESDPROC-300-R2, *Soil Sampling*, replaces SESDPROC-300-R1.	December 20, 2011

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SESDPROC-300-R1, *Soil Sampling*, replaces SESDPROC-300-R0.	November 1, 2007
SESDPROC-300-R0, Soil Sampling, Original Issue	February 05, 2007

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

GUIDANCE

Title: **Design and Installation of Monitoring Wells**

Effective Date: January 16, 2018 | **Number:** SESDGUID-101-R2

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDGUID-101-R2, *Design and Installation of Monitoring Wells*, replaces SESDPROC-101-R1 **General:** Corrected any typographical, grammatical and/or editorial errors. **Cover Page:** Cover page was updated to reflect reorganization and new personnel. **Section 2.2.5:** Added Direct Push Technology as drilling method. **Section 2.7:** Added additional cautions regarding early sampling of permanent wells **Section 2.8:** Added greater detail to decommissioning procedures **Section 4:** Generalized description of screen point installation. Added section on direct push technology well installation.	January 16, 2018
SESDGUID-101-R1, *Design and Installation of Monitoring Wells*, replaces SESDPROC-101-R0.	January 29, 2013
SESDGUID-101-R0, *Design and Installation of Monitoring Wells*, Original Issue	February 18, 2008

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when designing and installing permanent and temporary groundwater monitoring wells to be used for collection of groundwater samples.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when designing, constructing and installing groundwater monitoring wells. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used for any aspect of the design, construction and/or installation of a groundwater monitoring well, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

USEPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Science and Ecosystem Support Division, Region 4, Athens, GA, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

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SESD Operating Procedure for Groundwater Sampling, SESDPROC-301, Most Recent Version

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

EPA/540/S-95/503, *Nonaqueous Phase Liquids Compatibility with Materials Used in Well Construction, Sampling, and Remediation*

ASTM standard D5092, *Design and Installation of Ground Water Monitoring Wells in Aquifers*

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when constructing and installing groundwater monitoring wells. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy (SHEMP) Manual (Most Recent Version) and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, eye wear and gloves. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate. Section 2.6, Safety Procedures for Drilling Activities, contains detailed and specific safety guidelines that must be followed by Branch personnel when conducting activities related to monitoring well construction and installation.

1.5.2 Procedural Precautions

The following precautions should be considered when constructing and installing groundwater monitoring wells.

- Special care must be taken to minimize or prevent inadvertent cross-contamination between borehole locations. Equipment, tools and well materials must be cleaned and/or decontaminated according to procedures found in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).
- All field activities are documented in a bound logbook according to the procedures found in SESD Operating Procedure for Logbooks (SESDPROC-010).

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2 Permanent Monitoring Well Design Considerations

2.1 General

The design and installation of permanent monitoring wells involves drilling into various types of geologic formations that exhibit varying subsurface conditions. Designing and installing permanent monitoring wells in these geologic environments may require several different drilling methods and installation procedures. The selection of drilling methods and installation procedures should be based on field data collected during a hydrogeologic site investigation and/or a search of existing data. Each permanent monitoring well should be designed and installed to function properly throughout the duration of the monitoring program. When designing monitoring wells, the following should be considered:

- Short-and long-term objectives;
- Purpose of the well(s);
- Probable duration of the monitoring program;
- Contaminants likely to be monitored;
- Surface and subsurface geologic conditions;
- Properties of the aquifer(s) to be monitored;
- Well screen placement;
- General site conditions; and
- Potential site health and safety hazards.

In designing permanent monitoring wells, the most reliable, obtainable data should be utilized. Once the data have been assembled and the well design(s) completed, a drilling method(s) must be selected. The preferred drilling methods for installing monitoring wells are those that temporarily case the borehole during drilling and the construction of the well, e.g. hollow-stem augers and sonic methods. However, site conditions or project criteria may not allow using these methods. When this occurs, alternate methods should be selected that will achieve the project objectives. The following discussion of methods and procedures for designing and installing monitoring wells will cover the different aspects of selecting materials and methods, drilling boreholes, and installing monitoring devices.

2.2 Drilling Methods

The following drilling methods may be used to install environmental monitoring wells or collect samples under various subsurface conditions. In all cases the preferred methods are those that case the hole during drilling, i.e. Hollow Stem Augers (HSA) and sonic methods using an override system. Other methods may be used where specific subsurface or project criteria dictate.

2.2.1 Hollow Stem Auger (HSA)

This type of auger consists of a hollow, steel stem or shaft with a continuous, spiraled steel flight, welded onto the exterior. A hollow auger bit, generally with

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carbide teeth, disturbs soil material when rotated, whereupon the spiral flights transport the cuttings to the surface. This method is best suited in soils that have a tendency to collapse when disturbed. A monitoring well can be installed inside of hollow-stem augers with little or no concern for the caving potential of the soils. If caving sands exist during monitoring well installations, a drilling rig must be used that has enough power to extract the augers from the borehole without having to rotate them. A bottom plug, trap door, or pilot bit assembly can be used at the bottom of the augers to keep out most of the soils and/or water that have a tendency to enter the bottom of the augers during drilling. Potable water (analyzed for contaminants of concern) may be poured into the augers during drilling to equalize pressure so that the inflow of formation materials will be held to a minimum. Water-tight center bits are not acceptable because they create suction when extracted from the augers. This suction forces or pulls cuttings and formation materials into the augers, defeating the purpose of the center plug. Augering without a center plug or pilot bit assembly is permitted, provided that the soil plug, formed in the bottom of the augers, is removed before sampling or installing well casings. Removing the soil plug from the augers can be accomplished by drilling and washing out the plug using a rotary bit, or augering out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger. Bottom plugs can be used where no soil sampling is conducted during the drilling process. The bottom plug is wedged into the bottom of the auger bit and is knocked out at depth with drill pipe or the weight of the casing and screen assembly. The plug material should be compatible with the screen and casing materials. The use of wood bottom plugs is not acceptable. The type of bottom plug, trap door, or pilot bit assembly proposed for the drilling activity should be approved by a senior field geologist prior to drilling operations. Boreholes can be augered to depths of 150 feet or more (depending on the auger size), but generally boreholes are augered to depths less than 100 feet.

2.2.2 Solid Stem Auger

This type of auger consists of a sealed hollow or solid stem or shaft with a continuous spiraled steel flight welded on the outside of the stem. An auger bit connected to the bottom disturbs soil material when rotated and the helical flights transport cuttings to the surface. At the desired depth the entire auger string is removed to gain access to the bottom of the borehole. This auger method is used in cohesive and semi-cohesive soils that do not have a tendency to collapse when disturbed. Boreholes can be augered to depths of 200 feet or more (depending on the auger size), but generally boreholes are augered to depths less than 100 feet.

Both of the previously discussed auger methods can be used in unconsolidated soils and semi-consolidated (weathered rock) soils, but not in competent rock. Each method can be employed without introducing foreign materials into the borehole such as water and drilling fluids, minimizing the potential for cross contamination. Minimizing the risk of cross contamination is one of the most important factors to consider when selecting the appropriate drilling method(s) for a project.

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2.2.3 Sonic Methods

These methods generally alternately advance concentric hollow drill stems using rotation in conjunction with axial vibration of the drill stem. After each stage of drill stem advancement, the inner string is removed with a core of drill cuttings while the outer 'override' string remains to hold the borehole open. The cuttings can be removed nearly intact from the inner casing for examination of the stratigraphy prior to sampling or disposal. Because there are no auger flights to increase the borehole diameter, the quantity of cuttings removed from the hole is minimized as compared to hollow stem augering. With moderate rotation, smearing of the formation materials on the borehole walls is reduced as well. This drilling method is useful in a variety of materials, from flowing sands to heavily consolidated or indurated formations.

In flowing sands, the drill casings can be filled and/or pressurized with potable water to prevent excess entry of formation materials into the drill string. The same QA/QC requirements for sampling of material introduced to the borehole apply as in other drilling methods. Because the amount of water introduced into the borehole can be significant, an approximation of the water used in the drilling process should be logged for use in estimating appropriate well development withdrawal.

Sonic drilling allows a larger diameter temporary casing to be set into a confining layer while drilling proceeds into deeper aquifers. This temporary casing is then removed during the grouting operation. In many cases this will be acceptable technique. However, the level of contamination in the upper aquifer, the importance of the lower aquifers for drinking water uses, the permeability and continuity of the confining layer, and state regulations should be taken into account when specifying this practice as opposed to permanent outer casing placed into the confining unit. Note that when using the temporary casing practice, it is critical that grout be mixed and placed properly as specified elsewhere in this section.

Because the total borehole diameter in sonic drilling is only incrementally larger than the inner casing diameter, particular care should be taken that the well casing is placed in the center of the drill stem while placing the filter pack. Centralizers should be used in most cases to facilitate centering, particularly in the case of deep wells with PVC casing.

2.2.4 Rotary Methods

These methods consist of a drill pipe or drill stem coupled to a drilling bit that rotates and cuts through the soils. The cuttings produced from the rotation of the drilling bit are transported to the surface by drilling fluids which generally consist of water, drilling mud, or air. The water, drilling mud, or air are forced down through the drill pipe, and out through the bottom of the drilling bit. The cuttings

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are then lifted to the surface between the borehole wall and the drill pipe, (or within a concentric drill stem in reverse rotary). Except in the case of air rotary, the drilling fluid provides a hydrostatic pressure that reduces or prevents borehole collapse. When considering this method, it is important to evaluate the potential for contamination when fluids and/or air are introduced into the borehole.

Due to the introduction of the various circulating fluids, the use of rotary methods requires that the potential for contamination by these fluids be evaluated. Water and mud rotary methods present the possibility of trace contamination of halogenated compounds when municipal water supplies are used as a potable water source. Air rotary drilling can introduce contamination through the use of lubricants or entrained material in the air stream. Unless contaminated formations are cased off, the circulation of drilling fluids presents a danger of cross contamination between formations. In any of the rotary (or sonic) methods, care must be exercised in the selection and use of compounds to prevent galling of drill stem threads.

2.2.4.1 Water Rotary

When using water rotary, potable water (that has been analyzed for contaminants of concern) should be used. If potable water (or a higher-quality water) is not available on-site, then potable water will have to be transported to the site or an alternative drilling method will have to be selected. Water does not clog the formation materials, but the suspended drilling fines can be carried into the formation, resulting in a very difficult to develop well. This method is most appropriate for setting isolation casing.

2.2.4.2 Air Rotary

Air rotary drilling uses air as a drilling fluid to entrain cuttings and carry them to the surface. High air velocities, and consequently large air volumes and compressor horsepower are required. "Down-the-hole" (DTH) percussion hammers driven by the air stream can be used with this method to rapidly penetrate bedrock materials. Where a casing through unconsolidated material is required to prevent borehole collapse, it can be driven in conjunction with advancement of the drill stem.

When using air rotary drilling in any zone of potential contamination, the cuttings exiting the borehole must be controlled. This can be done using the dual-tube reverse circulation method where cuttings are carried to the surface inside dual-wall drill pipe and separated with a cyclone separator. An air diverter with hose or pipe carrying cuttings to a waste container is also an acceptable alternative. Allowing cuttings to blow uncontrolled from the borehole is not acceptable.

When using air rotary, the issue of contaminants being introduced into the borehole by the air stream must be addressed. Screw compressor systems

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should have a coalescing filter system in good working order to capture excess entrained compressor oils. The lubricant to be used with DTH hammers as well as thread lubricants to be used on drill stem should be evaluated for their potential impact on analytical samples.

2.2.4.3 Mud Rotary

Mud rotary is an undesirable drilling method because contamination can be introduced into the borehole from the constituents in the drilling mud, cross contamination can occur along the borehole column, and it is difficult to remove the drilling mud from the borehole after drilling and during well development. The drilling mud can also carry contaminates from a contaminated zone to an uncontaminated zone thereby cross-contaminating the borehole. If mud rotary is selected, only potable water and pure (no additives) bentonite drilling muds should be used. All materials used should have adequate documentation as to manufacturer's recommendations and product constituents. QA/QC samples of drilling muds and potable water should be sampled at a point of discharge from the circulation system to assure that pumps and piping systems are not contributing cross-contamination from previous use.

2.2.5 Direct Push Technology

Direct Push Technology (DPT) uses hollow drive rods either driven percussively or by large forces from a rig weighted or anchored to the ground. Percussive rigs are used for general soil and groundwater investigations and the push only rigs are generally used for cone penetrometer testing (CPT). DPT does not bring cuttings to the surface but instead compresses them into the borehole walls. A variety of tool systems are available to perform soil sampling, groundwater sampling, well installation, and to profile contamination with in situ systems. The light tooling, small crews required, and reduced IDW can make DPT operations an economical investigation tool. Although significant depths have been explored with DPT, investigations are generally limited to 100 ft (and more practically 50 ft.) in unconsolidated materials.

2.2.6 Other Methods

Other methods such as the cable-tool method, jetting method, and boring (bucket auger) method are available. If these and/or other methods are selected for monitoring well installations, they should be approved by a senior field geologist before field work is initiated.

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2.3 Borehole Construction

2.3.1 Annular Space

The borehole or hollow stem auger should be of sufficient diameter so that well construction can proceed without major difficulties. For open boreholes, the annular space should be approximately 2" to allow the uniform deposition of well materials around the screen and riser, and to allow the passage of tremie pipes and well materials without unduly disturbing the borehole wall. For example, a 2" nominal diameter (nom.) casing would require a 6" inside diameter (ID) borehole.

In hollow stem augers and sonic method drill casing, the ID should be of sufficient size to allow the passage of the tremie pipe to be used for well grout placement, as well as free passage of filter sands or bentonite pellets dropped through the auger or casing. In general, 4-1/4" ID should be the minimum size used for placement of 2" nom. casing and 8-1/4" ID for 4" nom. casing. Larger augers should be used where installation difficulties due to geologic conditions or greater depths are anticipated, e.g. larger augers might be required to place a bentonite pellet seal through a long water column.

2.3.2 Over-drilling the Borehole

Sometimes it is necessary to over-drill the borehole in anticipation of material entering the augers during center bit removal or knocking out of the bottom plug. Normally, 3 to 5 feet is sufficient for over-drilling. The borehole can also be over-drilled to allow for an extra space or a "sump" area below the well screen. This "sump" area provides a space to attach a 5 or 10 foot section of well casing to the bottom of the well screen. The extra space or "sump" below the well screen serves as a catch basin or storage area for sediment that flows into the well and drops out of suspension. These "sumps" are added to the well screens when the wells are screened in aquifers that are naturally turbid and will not yield clear formation water (free of visible sediment) even after extensive development. The sediment can then be periodically pumped out of the "sump" preventing the well screen from clogging or "silting up". If the borehole is inadvertently drilled deeper than desired, it can be backfilled to the design depth with bentonite pellets, chips, or the filter sand that is to be used for the filter pack.

2.3.3 Filter Pack Placement

When placing the filter pack into the borehole, a minimum of 6-inches of the filter pack material should be placed under the bottom of the well screen to provide a firm base. Also, the filter pack should extend a minimum of 2-feet above the top of the well screen to allow for settling and to isolate the screened interval from the grouting material. In open boreholes, the filter pack should be placed by the tremie or positive displacement method. Placing the filter pack by pouring the sand into

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an open drill stem is acceptable with the use hollow stem augers, and other methods where the borehole is temporarily cased down to the filter pack.

2.3.4 Filter Pack Seal – Bentonite Pellet Seal (Plug)

Bentonite pellets consist of ground, dried bentonite compacted into pellets available in several sizes. Bentonite pellets are compressed to a bulk density of 70-80 lbs/ft^3 and hydrate to a 30% min. solids material. Where neat cement grouts are to be used, the placement of a bentonite pellet seal above the filter pack is mandatory to prevent the possibility of grout infiltration into the screened interval prior to setting. Bentonite chips or other sealing products should not be substituted in this application. Where bentonite grouts are to be used, the placement of a bentonite pellet seal is optional, but desirable.

Since bentonite pellets begin hydrating rapidly, they can be very difficult to place properly. They are generally placed by pouring slowly into open boreholes, hollow stem augers or sonic drill pipe. In some cases, pellets are placed by tremie pipe and flushed into place with potable water. A tamper can be used to ensure that the material is being placed properly and to rapidly break up any pellet bridging that occurs.

Pellet seals should be designed for a two-foot thickness of dry pellets above the filter pack. Hydration may extend the height of the seal. Where neat cement grouts are to be used, the pellets should be hydrated for eight hours, or the manufacturer's recommended hydration time, whichever is greater. Where the water table is temporarily below the pellet seal, potable (or higher quality) water should be added repeatedly to hydrate the pellets prior to grouting.

2.3.5 Grouting the Annular Space

The annular space between the casing and the borehole wall should be filled with either a 30% solids bentonite grout, a neat cement grout, or a cement/bentonite grout. Each type of grout selected should be evaluated as to its intended use and integrity. Bentonite grouts are preferred unless the application dictates the use of another material.

Bentonite grout shall be a 30% solids pure bentonite grout. Drilling muds are not acceptable for grouting. The grout should be placed into the borehole, by the tremie method, from the top of the bentonite seal to within 2-feet of the ground surface or below the frost line, whichever is the greater depth. The bentonite pellet seal or filter pack should not be disturbed during grout placement, either by the use of a side discharge port on the tremie tube, or by maintaining clearance between the bottom of the tremie tube and the bentonite seal or filter pack. The grout should be allowed to cure for a minimum of 24 hours before the concrete surface pad is installed. The preferred method of achieving proper solids content is by measurement of ingredients per the manufacturer's specifications during mixing with a final check by grout balance after mixing. Bentonite grouts should have a

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minimum density of 10 lbs/gal to ensure proper gelling and low permeability. The density of the first batch of grout should be measured while mixing to verify proper measurement of ingredients. In addition, the grouting operation should not cease until the bentonite grout flowing out of the borehole has a minimum density of 10 lbs/gal. Estimating the grout density is not acceptable.

Cement grouts are generally dictated where a high level of dissolved solids or a particular dissolved constituent would prevent proper gelling of a bentonite grout. Neat cement grouts (cement without additives) should be mixed using 6 gallons of water per 94-lb bag of Type 1 Portland cement to a density of 15lbs/gal. The addition of bentonite (5 to 10 percent) to the cement grout can be used to delay the "setting" time and may not be needed in all applications. The specific mixtures and other types of cement and/or grout proposed should be evaluated on a case by case basis by a senior field geologist.

2.3.6 Above Ground Riser Pipe and Outer Casing

The well casing, when installed and grouted, should extend above the ground surface a minimum of 2.5 feet. A vent hole should be drilled into the top of the well casing cap to permit pressure equalization, if applicable. An outer protective casing should be installed into the borehole after the annular grout has cured for at least 24 hours. The outer protective casing should be of steel construction with a hinged, locking cap. Generally, outer protective casings used over 2-inch well casings are 4 inches square by 5 feet long. Similarly, protective casings used over 4-inch well casings are 6 inches square and 5 feet long. Other types of protective casing including those constructed of pipe are also acceptable. All protective casings should have sufficient clearance around the inner well casings, so that the outer protective casings will not come into contact with the inner well casings after installation. The protective casings should have a weep hole to allow drainage of accumulated rain or spilled purge water. The weep hole should be approximately 1/4-inch in diameter and drilled into the protective casings just above the top of the concrete surface pad to prevent water from standing inside of the protective casings. Protective casings made of aluminum or other soft metals are normally not acceptable because they are not strong enough to resist tampering. Aluminum protective casing may be used in very corrosive environments such as coastal areas.

Prior to installing the protective casing, the bentonite grout in the borehole annulus is excavated to a depth of approximately two feet. The protective casing is installed by pouring concrete into the borehole on top of the grout. The protective casing is then pushed into the wet concrete and borehole a minimum of 2 feet. Extra concrete may be needed to fill the inside of the protective casing so that the level of the concrete inside of the protective casing is at or above the level of the surface pad. In areas where frost heave of the surface pad is possible, the protective casing should first be pressed into the top surface of the bentonite grout seal and concrete poured around the protective casing. A granular material such as sand or gravel can then be used to fill the space between the riser and protective casing. The use of granular material instead of concrete between the protective casing and riser will also facilitate the future conversion of the well to a flush-mount finish, if required.

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The protective casing should extend above the ground surface to a height so that the top of the inner well casing is exposed when the protective casing is opened. At each site, all locks on the outer protective casings should be keyed alike.

2.3.7 Concrete Surface Pad

A concrete surface pad should be installed around each well at the same time as the outer protective casing is being installed. The surface pad should be formed around the well casing. Concrete should be placed into the pad forms and into the borehole (on top of the grout) in one operation making a contiguous unit. The size of the concrete surface pad is dependent on the well casing size. If the well casing is 2 inches in diameter, the pad should be 3 feet x 3 feet x 4 inches. If the well casing is 4 inches in diameter, the pad should be 4 feet x 4 feet x 6 inches. Round concrete surface pads are also acceptable. The finished pad should be slightly sloped so that drainage will flow away from the protective casing and off of the pad. A minimum of one inch of the finished pad should be below grade to prevent washing and undermining by soil erosion.

2.3.8 Surface Protection – Bumper Guards

If the monitoring wells are located in a high traffic area, a minimum of three bumper guards consisting of steel pipes 3 to 4 inches in diameter and a minimum 5-foot length should be installed. These bumper guards should be installed to a minimum depth of 2 feet below the ground surface in a concrete footing and extend a minimum of 3 feet above ground surface. Concrete should also be placed into the steel pipe to provide additional strength. Substantial steel rails and/or other steel materials can be used in place of steel pipe. Welding bars between the bumper posts can provide additional strength and protection in high traffic areas, but the protective bumpers should not be connected to the protective casing.

2.4 Construction Techniques

2.4.1 Well Installation

The borehole should be bored, drilled, or augered as close to vertical as possible, and checked with a plumb bob or level. Deviation from plumb should be within 1° per 50ft of depth. Slanted boreholes are undesirable and should be noted in the boring logs and final construction logs. The depth and volume of the borehole, including the over-drilling if applicable, should have been calculated and the appropriate materials procured prior to drilling activities.

The well casings should be secured to the well screen by flush-jointed threads and placed into the borehole and plumbed by the use of centralizers and/or a plumb bob and level. Another method of placing the well screen and casings into the borehole and plumbing them at the same time is to suspend the string of well screen and casings in the borehole by means of a hoist on the drill rig. This wireline method is especially useful if the borehole is deep and a long string of well screen and casings have to be set and plumbed.

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No lubricating oils or grease should be used on casing threads. No glue of any type should be used to secure casing joints. Viton® O-rings can be used where the joints are designed for same.

Before the well screen and casings are placed on the bottom of the borehole, at least 6 inches of filter material should be placed at the bottom of the borehole to serve as a firm footing. The string of well screen and casings should then be placed into the borehole and plumbed. Centralizers can be used to plumb a well, but centralizers should be placed so that the placement of the filter pack, bentonite pellet seal, and annular grout will not be hindered. Centralizers placed in the wrong locations can cause bridging during material placement. Monitoring wells less than 50 feet deep generally do not need centralizers. If centralizers are used they should be placed below the well screen and above the bentonite pellet seal. The specific placement intervals should be decided based on site conditions.

When installing the well screen and casings through hollow-stem augers, the augers should be slowly extracted as the filter pack, bentonite pellet seal, and grout are tremied and/or poured into place. The gradual extraction of the augers will allow the materials being placed in the augers to flow out of the bottom of the augers into the borehole. If the augers are not gradually extracted, the materials (sand, pellets, etc.) will accumulate at the bottom of the augers causing potential bridging problems.

After the string of well screen and casing is plumb, the filter pack material should then be placed around the well screen to the designated depth. With cased drilling methods, the sand should be poured into the casing or augers until the lower portion is filled. The casing or augers are then withdrawn, allowing the sand to flow into the evacuated space. With hollow stem augers, sand should always fill the augers 6-12 inches, maintained by pouring the sand while checking the level with a weighted tag line. The filter pack sand in open boreholes should be installed by tremie methods, using water to wash the sand through the pipe to the point of placement.

After the filter pack has been installed, the bentonite pellet seal (if used) should be placed directly on top of the filter pack to an unhydrated thickness of two feet. When installing the seal for use with cement grouts, the bentonite pellet seal should be allowed to hydrate a minimum of eight hours or the manufacturer's recommended hydration time, whichever is longer.

After the pellet seal has hydrated for the specified time, the grout should then be pumped by the tremie method into the annular space around the casings. The grout should be allowed to set for a minimum of 24 hours before the surface pad and protective casing are installed.

After the surface pad and protective casing are installed, bumper guards should be installed (if needed). The bumper guards should be placed around the concrete surface pad in a configuration that provides maximum protection to the well. Each

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piece of steel pipe or approved material should be installed into an 8-to 10-inch diameter hole, to a minimum depth of 2 feet below ground surface, and filled with concrete. As previously stated, the bumper guard should extend above the ground surface a minimum of 3 feet. The total length of each bumper guard should be a minimum of 5 feet.

After the wells have been installed, the outer protective casing should be painted with a highly visible paint. The wells should be permanently marked with the well number, date installed, site name, elevation, etc., either on the cover or an appropriate place that will not be easily damaged and/or vandalized.

If the monitoring wells are installed in a high traffic area such as a parking lot, in a residential yard, or along the side of a road it may be desirable to finish the wells to the ground surface and install water-tight flush mounted traffic and/or man-hole covers. Flush mounted traffic and man-hole covers are designed to extend from the ground surface down into the concrete plug around the well casing. Although flush mounted covers may vary in design, they should have seals that make the unit water-tight when closed and secured. The flush mounted covers should be installed slightly above grade to minimize standing water and promote runoff. Permanent identification markings should be placed on the covers or in the concrete plug around the cover. Expansive sealing plugs should be used to cap the well riser to prevent infiltration of any water that might enter the flush cover.

2.4.2 Double-Cased Wells

Double-cased wells should be constructed when there is reason to believe that interconnection of two aquifers by well construction may cause cross-contamination or when flowing sands make it impossible to install a monitoring well using conventional methods. A highly contaminated surface soil zone may also be cased off so that drilling may continue below the casing with reduced danger of cross contamination. A pilot borehole should be bored through the overburden and/or the contaminated zone into the clay confining layer or bedrock. An outer casing (sometimes called surface or pilot casings) should then be placed into the borehole and sealed with grout. The borehole and outer casing should extend into tight clay a minimum of two feet and into competent bedrock a minimum of 1 foot. The total depths into the clay or bedrock will vary, depending on the plasticity of the clay and the extent of weathering and\or fracturing of the bedrock. The final depths should be approved by a senior field geologist. The size of the outer casing should be of sufficient inside diameter to contain the inner casing, and the 2-inch minimum annular space. In addition, the borehole should be of sufficient size to contain the outer casing and the 2-inch minimum outer annular space, if applicable.

The outer casing should be grouted by the tremie, displacement, grout shoe, or Halliburton method from the bottom to the ground surface. The grout should be pumped into the annular space between the outer casing and the borehole wall. A minimum of 24 hours should be allowed for the grout plug (seal) to cure before attempting to drill through it. The grout mixture used to seal the outer annular space should be either a neat cement, cement/bentonite, cement/sand, or a 30% solids

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bentonite grout. However, the seal or plug at the bottom of the borehole and outer casing should consist of a Type I portland cement/bentonite or cement/sand mixture. The use of a pure bentonite grout for a bottom plug or seal is not acceptable, because the bentonite grout cures to a gel-like material, and is not rigid enough to withstand the stresses of drilling. When drilling through the seal, care should be taken to avoid cracking, shattering, or washing out the seal. If caving conditions exist so that the outer casing cannot be sufficiently sealed by grouting, the outer casing should be driven into place and a grout seal placed in the bottom of the casing.

2.4.2.1 Bedrock Wells

The installation of monitoring wells into bedrock can be accomplished in two ways:

1. The first method is to drill or bore a pilot borehole through the soil overburden into the bedrock. An outer casing is then installed into the borehole by setting it into the bedrock, and grouting it into place as described in the previous section. After the grout has set, the borehole can then be advanced through the grout seal into the bedrock. The preferred method of advancing the borehole into the bedrock is rock coring. Rock coring makes a smooth, round hole through the seal and into the bedrock without cracking and/or shattering the seal. Roller cone bits are used in soft bedrock, but extreme caution should be taken when using a roller cone bit to advance through the grout seal in the bottom of the borehole because excessive water and "down" pressure can cause cracking, eroding (washing), and/or shattering of the seal. Low volume air hammers may be used to advance the borehole, but they have a tendency to shatter the seal because of the hammering action. If the structural integrity of the grout seal is in question, a pressure test can be utilized to check for leaks. A visual test can also be made by examining the cement/concrete core that is collected when the seal is cored with a diamond coring bit. If the seal leaks (detected by pressure testing) and/ or the core is cracked or shattered, or if no core is recovered because of washing, excessive down pressure, etc., the seal is not acceptable. The concern over the structural integrity of the grout seal applies to all double cased wells. Any proposed method of double casing and/or seal testing will be evaluated on its own merits, and will have to be approved by a senior field geologist before and during drilling activities, if applicable. When the drilling is complete, the finished well will consist of an open borehole from the ground surface to the bottom of the well. There is no inner casing, and the outer surface casing, installed down into bedrock, extends above the ground surface, and also serves as the outer protective casing. If the protective casing becomes cracked or is sheared off at the ground surface, the well is open to direct contamination from the ground surface and will have to be repaired

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immediately or abandoned. Another limitation to the open rock well is that the entire bedrock interval serves as the monitoring zone. In this situation, it is very difficult or even impossible to monitor a specific zone, because the contaminants being monitored could be diluted to the extent of being non-detectable. The installation of open bedrock wells is generally not acceptable in the Superfund and RCRA programs, because of the uncontrolled monitoring intervals. However, some site conditions might exist, especially in cavernous limestone areas (karst topography) or in areas of highly fractured bedrock, where the installation of the filter pack and its structural integrity are questionable. Under these conditions the design of an open bedrock well may be warranted.

2. The second method of installing a monitoring well into bedrock is to install the outer surface casing and drill the borehole (by an approved method) into bedrock, and then install an inner casing and well screen with the filter pack, bentonite seal, and annular grout. The well is completed with a surface protective casing and concrete pad. This well installation method gives the flexibility of isolating the monitoring zone(s) and minimizing inter-aquifer flow. In addition, it gives structural integrity to the well, especially in unstable areas (steeply dipping shales, etc.) where the bedrock has a tendency to shift or move when disturbed. Omitting the filter pack around the well screen is a general practice in some open rock borehole installations, especially in drinking water and irrigation wells. However, without the filter pack to protect the screened interval, sediment particles from the well installation and/or from the monitoring zone could clog the well screen and/or fill the screened portion of the well rendering it inoperable. Also, the filter pack serves as a barrier between the bentonite seal and the screened interval. Rubber inflatable packers have been used to place the bentonite seal when the filter pack is omitted, but the packers have to remain in the well permanently and, over a period of time, will decompose and possibly contribute contaminants to the monitoring zone.

2.5 Well Construction Materials

2.5.1 Introduction

Well construction materials are chosen based on the goals and objectives of the proposed monitoring program and the geologic conditions at the site(s). In this section, the different types of available materials will be discussed.

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2.5.2 Well Screen and Casing Materials

When selecting the materials for well construction, the prime concern should be to select materials that will not contribute foreign constituents, or remove contaminants of concern from the ground water. If the monitoring program is designed to analyze for organic compounds, stainless steel materials are the preferred choice. If the monitoring program calls for the analyses of only inorganic compounds or the contaminants or formation are highly corrosive, then rigid PVC materials meeting National Sanitary Foundation (NSF) Standard 14 type WC (Well Casing) are acceptable. PVC materials may be acceptable for monitoring identified organic compounds in a soluble aqueous phase where incompatibilities are known to not exist. EPA document EPA/540/S-95/503, *Nonaqueous Phase Liquids Compatibility with Materials Used in Well Construction, Sampling, and Remediation* should be used for guidance in this area and in the use of PVC with non-aqueous phase liquids (NAPLs). Another concern is to select materials that will be rugged enough to endure the entire monitoring period. Site conditions will generally dictate the type of materials that can be used. A preliminary field investigation should be conducted to determine the geologic conditions, so that the most suitable materials can be selected. The best grade or highest quality material for that particular application should be selected. Each manufacturer can supply the qualitative data for each grade of material that is being considered. All materials selected for monitoring well installation should be evaluated and approved by a senior field geologist prior to field activities.

Well screen and casing materials generally used in monitoring well construction on RCRA and Superfund sites are listed in order of preference:

1. Stainless Steel (304 or 316)
2. Rigid PVC meeting NSF Standard 14 (type WC)
3. Other (where applicable)

There are other materials used for well screens and casings such as black iron, carbon steel, galvanized steel, and fiberglass, but these materials are not recommended for use in long term monitoring programs at hazardous waste sites, because of their low resistance to chemical attack and potential constituent contribution to the ground water. In cases where a driven casing is used, or a high strength outer casing is needed, carbon steel may be acceptable in non-corrosive aquifers. This outer casing should have threaded connections. Welding casing is not an acceptable practice unless all relevant safety issues have been adequately addressed.

The minimum nominal casing size for most permanent monitoring wells will be 2". Where a complete program of installation, monitoring, and abandonment is being designed, smaller wells may be installed if suitable purging and sampling equipment for the smaller diameter wells can be specified and obtained. The length of well screens in permanent monitoring wells should be long enough to effectively monitor the interval or zone of interest. However, well screens designed for long

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term monitoring purposes should normally not be less than 5 feet in length. Well screens less than 5 feet long are generally only used in temporary monitoring wells where ground water samples are collected for screening purposes.

2.5.3 Filter Pack Materials

The filter pack materials should consist of clean, rounded to well-rounded, hard, insoluble particles of siliceous composition. The required grain-size distribution or particle sizes of the filter pack materials should be selected based upon a sieve analysis conducted on the soil samples collected from the aquifer materials and/or the formation(s) to be monitored. Filter pack materials should not be accepted unless proper documentation can be furnished as to the composition, grain-size distribution, cleaning procedure, and chemical analysis. If a data search reveals that there is enough existing data to adequately design the well screen and filter pack, then it may not be necessary to conduct a sieve analysis on the formation materials to be monitored. However, all data and design proposals will be evaluated and approved by a senior staff geologist before field activities begin.

2.5.4 Filter Pack and Well Screen Design

The majority of monitoring wells are installed in shallow ground water aquifers that consist of silts, clays, and sands in various combinations. These shallow aquifers are not generally characteristic of aquifers used for drinking water. Therefore, modifications to the procedures used for the design of water well filter packs may be required. In cases where insufficient experience exists with local or similar materials, the filter pack and well screen design should be based on the results of a sieve analysis conducted on soil samples collected from the aquifer or the formation(s) that will be monitored.

In formations consisting primarily of fines (silts and clays), the procedures for water well screen design may result in requirements for filter packs and screen slot sizes that are not available. In those cases the selection of 0.010" screen slots with a 20-40 sand filter pack, or 0.005" screen slots with 100 sand filter pack for very fine formations, will be acceptable practice. Table 6.6.1 provides size specifications for the selection of sand packs for fine formation materials. ASTM standard D5092, *Design and Installation of Ground Water Monitoring Wells in Aquifers*, may be consulted for further guidance on specifications for sand appropriate for these applications.

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Table 6.6.1
Sand Pack Specifications

Screen Opening (in)	Sand Pack Mesh Name	1% Passing Size (d-1) (in)	10% Passing Size (d-10) (in)	30% Passing Size (d-30) (in)	Derived 60% Passing Size (d-60) (in)	Range for Uniformity Coefficient
0.005-0.006	100	.0035 - .0047	.0055 - .0067	.0067 - .0083	.0085 - .0134	1.3 - 2.0
0.010"	20-40	.0098 - .0138	.0157 - .0197	.0197 -.0236	.020 - .0315	1.1 - 1.6

The following procedure should be used in coarser grained formations:

The data from the sieve analysis are plotted on a grain-size distribution graph, and a grain-size distribution curve is generated. From this grain-size distribution curve, the uniformity coefficient (Cu) of the aquifer material is determined. The Cu is the ratio of the 60 percent finer material (d60) to the 10 percent finer material (d10)

$$Cu = (d60/d10)$$

The Cu ratio is a way of grading or rating the uniformity of grain size. For example, a Cu of unity means that the individual grain sizes of the material are nearly all the same, while a Cu with a large number indicates a large range of particle sizes. As a general rule, a Cu of 2.5 or less should be used in designing the filter pack and well screen.

Before designing the filter pack and well screen, the following factors should be considered:

1. Select the well screen slot openings that will retain 90 percent of the filter pack material.

2. The filter pack material should be of the size that minimizes head losses through the pack and also prevents excessive sediment (sand, silt, clay) movement into the well.

3. A filter material of varying grain sizes is not acceptable because the smaller particles fill the spaces between the larger particles thereby reducing the void spaces and increasing resistance to flow. Therefore, filter material of the same grain size and well-rounded is preferred.

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4. The filter pack design is based on the gradation of the finest aquifer materials being analyzed.

Steps to design a filter pack in aquifers:

1. Construct a grain-size distribution curve, on a grain-size distribution graph, from the sieve analysis of the aquifer materials. The filter pack design (as stated above) is based on the gradation of the finest aquifer materials.

2. Multiply the d30 size from the grain-size distribution graph by a factor of four to nine (Pack-Aquifer ratio). A factor of four is used if the formation is fine-grained and uniform (Cu is less than 3), six if it is coarse-grained and non-uniform, and up to nine if it is highly non-uniform and contains silt. Head losses through filter packs increase as the Pack-Aquifer (P-A) ratios decrease. In order to design a fairly stable filter pack with a minimum head loss, the d30 size should be multiplied by a factor of four.

3. Plot the point from step 2 on the d30 abscissa of a grain-size distribution graph and draw a smooth curve with a uniformity coefficient of approximately 2.5.

4. A curve for the permissible limits of the filter pack is drawn plus or minus 8 per cent of the desired curve with the Cu of 2.5.

5. Select the slot openings for the well screen that will retain 90 per cent or more of the filter pack material.

The specific steps and procedures for sieve analysis and filter pack design can be found in soil mechanics, ground water, and water well design books. The staff geologists and/or engineers should be responsible for the correct design of the monitoring wells and should be able to perform the design procedures.

2.6 Safety Procedures for Drilling Activities

A site health and safety plan should be developed and approved by the Branch Safety Officer or designee prior to any drilling activities, and should be followed during all drilling activities. The driller or designated safety person should be responsible for the safety of the drilling team performing the drilling activities. All personnel conducting drilling activities should be qualified in proper drilling and safety procedures. Before any drilling activity is initiated, utilities should be marked or cleared by the appropriate state or municipal utility protection organization. In developed areas, additional measures should be taken to locate utilities not covered by the utility protection program. Before operating the drill rig, a pilot hole should be dug (with hand equipment) to a depth of three feet to check for undetected utilities or buried objects. Proceed with caution until a safe depth is reached where utilities normally would not be buried. The following safety requirements should be adhered to while performing drilling activities:

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1. All drilling personnel should wear safety hats, safety glasses, and steel toed boots. Ear plugs are required and will be provided by the safety officer or driller.

2. Work gloves (cotton, leather, etc.) should be worn when working around or while handling drilling equipment.

3. All personnel directly involved with the drilling rig(s) should know where the kill switch(s) is located in case of emergencies.

4. All personnel should stay clear of the drill rods or augers while in motion, and should not grab or attempt to attach a tool to the drill rods or augers until they have completely stopped rotating. Rod wipers, rather than gloves or bare hands should be used to remove mud, or other material, from drill stem as it is withdrawn from the borehole.

5. Do not hold drill rods or any part of the safety hammer assembly while taking standard penetration tests or while the hammer is being operated.

6. Do not lean against the drill rig or place hands on or near moving parts at the rear of the rig while it is operating.

7. Keep the drilling area clear of any excess debris, tools, or drilling equipment.

8. The driller will direct all drilling activities. No work on the rig or work on the drill site will be conducted outside of the driller's direction. Overall drill site activities will be in consultation with the site geologist or engineer, if present.

9. Each drill rig will have a first-aid kit and a fire extinguisher located on the rig in a location quickly accessible for emergencies. All drilling personnel will be familiarized with their location.

10. Work clothes will be firm fitting, but comfortable and free of straps, loose ends, strings etc., that might catch on some moving part of the drill rig.

11. Rings, watches, or other jewelry will not be worn while working around the drill rig.

12. The drill rig should not be operated within a minimum distance of 20 feet of overhead electrical power lines and/or buried utilities that might cause a safety hazard. In addition, the drill rig should not be operated while there is lightening in the area of the drilling site. If an electrical storm moves in during drilling activities, the area will be vacated until it is safe to return.

2.7 Well Development

A newly completed monitoring well should not be developed for at least 24 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before development procedures are initiated. The main purpose of developing new monitoring wells is to remove the residual materials remaining in the wells after installation has been completed, and to try to re-establish the natural hydraulic flow

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conditions of the formations which may have been disturbed by well construction, around the immediate vicinity of each well. A new monitoring well should be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. In most cases the above requirements can be satisfied; however, in some cases the pH, temperature, and specific conductivity may stabilize but the water remains turbid. In this case the well may still contain well construction materials, such as drilling mud in the form of a mud cake and/or formation soils that have not been washed out of the borehole. Excessive or thick drilling mud cannot be flushed out of a borehole with one or two well volumes of flushing. Continuous flushing over a period of several days may be necessary to complete the well development. If the well is pumped to dryness or near dryness, the water table should be allowed to sufficiently recover (to the static water level) before the next development period is initiated. Caution should be taken when using high rate pumps and/or large volume air compressors during well development because excessive high rate pumping and high air pressures can damage or destroy the well screen and filter pack. The onsite geologist should make the decision as to the development completion of each well. All field decisions should be documented in the field log book.

The following development procedures, listed in approximate increasing order of the energy applied to the formation materials, are generally used to develop wells:

1. Bailing
2. Pumping/overpumping
3. Surging
4. Backwashing ("rawhiding")
5. Jetting
6. Compressed air (with appropriate filtering): airlift pumping and air surging

These development procedures can be used, individually or in combination, in order to achieve the most effective well development. In most cases, over-pumping and surging will adequately develop the well without imparting undue forces on the formation or well materials. Because of the danger of introducing contaminants with the airstream, the possibility of entraining air in the aquifer, and the violent forces imparted to the formation, air surging is the least desired method of development and should only be used where there is a specific need for the procedure. Air-lift pumping is permissible where an eductor pipe is used and several well volumes of water are removed from the well by other pumping means after air-lift pumping. Additional time before the first sampling event should be allowed when using air development methods, particularly airlift. The selected development method(s) should be approved by a senior field geologist before any well installation activities are initiated.

Wells can require a considerable length of time to equilibrate with the aquifer after construction and development. The length of time between development and the first sampling event should be as long as possible with times from 1 to 14 days recommended. The possibility of the first sampling event's results being non-representative should always be considered.

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2.8 Well Decommissioning (Abandonment)

When a decision is made to decommission (abandon) a monitoring well, the borehole should be sealed in such a manner that the well cannot act as a conduit for migration of contaminants from the ground surface to the water table or between aquifers. To properly decommission a well, the preferred method is to completely remove the well casing and screen from the borehole, clean out the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. In order to comply with state well decommissioning requirements, the appropriate state agency should be notified (if applicable) of monitoring well decommissioning. However, some state requirements are not explicit, so a technically sound well abandonment method should be designed based on the site geology, well casing materials, and general condition of the well(s).

2.8.1 Decommissioning Procedures

As previously stated, the preferred method should be to completely remove the well casing and screen from the borehole. This may be accomplished by augering with a hollow-stem auger over the well casing down to the bottom of the borehole, thereby removing the grout and filter pack materials from the hole. The well casing should then be removed from the hole with the drill rig. The clean borehole can then be backfilled with the appropriate grout material. The backfill material should be placed into the borehole from the bottom to the top by pressure grouting with the positive displacement method (tremie method). This abandonment method can be accomplished on small diameter (1-inch to 4-inch) wells without too much difficulty. With wells having 6-inch or larger diameters, the use of hollow-stem augers for casing removal is very difficult or almost impossible. Instead of trying to ream the borehole with a hollow-stem auger, it is more practical to force a drill stem with a tapered wedge assembly or a solid-stem auger into the well casing and extract it out of the borehole. Wells with little or no grouted annular space and/or sound well casings can be removed in this manner. However, old wells with badly corroded casings and/or thickly grouted annular space have a tendency to twist and/or break-off in the borehole. When this occurs, the well will have to be grouted with the remaining casing left in the borehole. The preferred method in this case should be to pressure grout the borehole by placing the tremie tube to the bottom of the well casing, which will be the well screen or the bottom sump area below the well screen. The pressurized grout will be forced out through the well screen into the filter material and up the inside of the well casing sealing holes and breaks that are present.

A PVC well casing may be more difficult to remove from the borehole than a metal casing, because of its brittleness. If the PVC well casing breaks during removal, the borehole should be cleaned out by using a drag bit or roller cone bit with the wet rotary method to grind the casing into small cuttings that will be flushed out of the borehole by water or drilling mud. Another method is to use a solid-stem auger with a carbide tooth pilot bit to grind the PVC casing into small cuttings that will be brought to the surface on the rotating flights. After the casing materials have been removed from the borehole, the borehole should be cleaned out and pressure grouted with the approved grouting materials.

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Where state regulations and conditions permit, it may be permissible to grout the casing in place. This decision should be based on confidence in the original well construction practice, protection of drinking water aquifers, and anticipated future property uses. The pad should be demolished and the area around the casing excavated. The casing should be sawn off at a depth of three feet below ground surface. The screen and riser should be tremie grouted with a 30% solids bentonite grout. Pouring bentonite chips into the well will be acceptable with wells large enough for the chips to fall to the bottom (generally 4" or larger).

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3 Temporary Monitoring Well Installation

3.1 Introduction

Five types of temporary monitoring well installation techniques have been demonstrated as acceptable. The type selected for a particular site is dependent upon site conditions. The project leader and site geologist should be prepared to test temporary well installations on site and select the best solution. Temporary wells are cost effective, may be installed quickly, and can provide a rapid assessment of ground water quality.

Temporary monitoring well locations are not permanently marked, nor are their elevations normally determined. Sand pack materials may or may not be used, but typically there is no bentonite seal, grout, surface completion, or extensive development (as it normally applies to permanent monitoring wells). Temporary wells are generally installed, purged, sampled, removed, and backfilled in a matter of hours.

Due to the nature of construction, turbidity levels may initially be high. However, these levels may be reduced by low flow purging and sampling techniques as described in SESD Operating Procedure for Groundwater Sampling, SESDPROC-301.

Temporary wells may be left overnight, for sampling the following day, but the well must be secured, both against tampering and against the fall hazard of the open annulus. If the well is not sampled immediately after construction, the well should be purged prior to sampling as specified in SESD Operating Procedure for Groundwater Sampling, SESDPROC-301.

3.2 Data Limitation

Temporary wells described in this section are best used for delineation of contaminant plumes at a point in time, for some site screening purposes, or for determination of groundwater elevations and gradients. They are not intended to replace permanent monitoring wells. Temporary wells can be used in conjunction with a mobile laboratory, where quick-turnaround analytical results can be used to rapidly delineate contaminant plumes.

3.3 Temporary Well Materials

Materials used in construction of temporary monitoring wells are the same standard materials used in the construction of permanent monitoring wells. Sand used for the filter pack (if any) should be as specified in Section 2.5.3, Filter Pack Materials. The well screen and casing should be stainless steel for ruggedness and suitability for steam cleaning and solvent rinsing. Other materials may be acceptable, on a case by case basis. Some commercially available temporary well materials, pre-packed riser, screen and filter pack assemblies are available commercially; however, these pre-assembled materials cannot be

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cleaned. Appropriate QA/QC must be performed to assure there will be no introduction of contamination.

3.4 Temporary Monitoring Well Borehole Construction

Borehole construction for temporary wells is as specified in Section 2.3, using a drill rig. Alternatively, boreholes may be constructed using hand augers or portable powered augers (generally limited to depths of ten feet or less). If a drill rig is used to advance the borehole, the augers must be pulled back the length of the well screen (or removed completely) prior to sampling. When hand augers are used, the borehole is advanced to the desired depth (or to the point where borehole collapse occurs). In situations where borehole collapse occurs, the auger bucket is typically left in the hole at the point of collapse while the temporary well is assembled. When the well is completely assembled, a final auger bucket of material is quickly removed and the well is immediately inserted into the borehole, pushing, as needed, to achieve maximum penetration into the saturated materials.

3.5 Temporary Monitoring Well Types

Five types of monitoring wells which have been shown to be acceptable are presented in the order of increasing difficulty to install and increasing cost:

3.5.1 No Filter Pack

This is the most common temporary well and is effective in many situations. After the borehole is completed, the casing and screen are simply inserted. This is the least expensive and fastest well to install. This type of well is extremely sensitive to turbidity fluctuations because there is no filter pack. Care should be taken to not disturb the casing during purging and sampling.

3.5.2 Inner Filter Pack

This type differs from the "No Filter Pack" well in that a filter pack is placed inside the screen to a level approximately 6 inches above the well screen. This ensures that all water within the casing has passed through the filter pack. For this type well to function properly, the static water level must be at least 6-12 inches above the filter pack. The screen slots may plug with this construction method.

3.5.3 Traditional Filter Pack

For this type of well, the screen and casing are inserted into the borehole, and the sand is poured into the annular space surrounding the screen and casing. It may be difficult to effectively place a filter pack in open boreholes, due to collapse.

3.5.4 Double Filter Pack

The borehole is advanced to the desired depth. As with the "inner filter pack" the well screen is filled with filter pack material and the well screen and casing inserted

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until the top of the filter pack is at least 6 inches below the water table. Filter pack material is poured into the annular space around the well screen. This type temporary well construction can be effective in aquifers where fine silts or clays predominate.

3.5.5 Well-in-a-Well

The borehole is advanced to the desired depth. At this point, a 1-inch well screen and sufficient riser is inserted into a 2-inch well screen with sufficient riser, and centered. Filter pack material is then placed into the annular space surrounding the 1-inch well screen, to approximately 6 inches above the screen. The well is then inserted into the borehole.

This system requires twice as much well screen and riser, with attendant increases in assembly and installation time. The increased amount of well construction materials results in a corresponding increase in decontamination time and costs. The use of pre-packed well screens in this application will require rinse blanks of each batch of screens. Pre-pack Screen assemblies cannot be decontaminated for reuse.

3.6 Decommissioning

Temporary well boreholes must be decommissioned after sampling and removal of the screen and riser. Use of cuttings for backfilling holes will not be acceptable practice.

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4 Direct-Push Technology in Groundwater Investigations

4.1 Screen Point Samplers

Screen Point samplers allow temporary wells to be established quickly and can return high quality samples. The sampler consists of a stainless steel or PVC screen housed in a hollow steel sheath and topped with a drive cap to adapt to the drive rods in use. A disposable point is inserted in the bottom of the sheath and serves to prevent soil from entering the sheath and damaging the screen during driving.

After driving the sampler to the target depth, an inner rod is inserted to hold the screen down at the bottom of the borehole while the sheath and rods are withdrawn to expose the screen. The disposable point stays at the bottom of the borehole. The inner rod system is withdrawn and sampling can commence immediately.

O-rings are commonly used on the disposable point. The additional friction from the O-ring can prevent the point from being driven off of the sampler in loose material or when encountering a hollow space such as during redriving.

Screen point samplers are deployed to a specified interval. If a greater sampling depth is desired after deployment, the sampler must be withdrawn, reassembled with a new point, and redriven to the greater depth. The standard screens can be withdrawn to a shallower interval if needed, but the sampler would still be accessing the deeper aquifer to some extent.

4.1.1 Special Considerations for Screen Point Samplers

Decommissioning (Abandonment)

Like other wells, temporary screen points should be properly decommissioned. The most common means of decommissioning at SESD is to withdraw the screen point sampler, remove the screen, install a new disposable point, and redrive the sheath to the previously screened interval. A grouting head is attached to the probe rods, and grout pressure applied while withdrawing the rods to pull the disposable point free. The grout volume pumped is carefully managed to match the volume grouted during rod withdrawal.

Where preventing cross-connection of aquifers is critical or potential caving would prevent re-entry, a disposable screen can be used with some systems. The disposable screen is not linked to the sheath and will pull out and be left in the borehole. After sampling, the grouting head is attached to the rods, the rods pumped full of grout, and the sampler sheath is pulled off of the screen. Grouting proceeds as with re-entry grouting.

Geoprobe® Screen Points samplers have a feature available to knock a plug out of the bottom of the screen and thread a small diameter high-pressure grouting tube to

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the bottom of the borehole. Grout is pumped through the tubing while rods are withdrawn and left threaded over the tubing aboveground. As this system is unwieldy and cannot reliably pump grout over 20% solids, it is not used at SESD.

SESD pressure-grouts soil sampling boreholes by reentry grouting or tremie grouting when depths exceed 10 ft, or groundwater is encountered. Shallower boreholes can be decommissioned by pouring pellets in short lifts and hydrating each lift with water, or by pouring a pourable grout.

Screen Material Selection

The screen point screens are available in stainless steel and PVC. Because of stainless steel's durability, ability to be cleaned and re-used, and overall inertness and compatibility with most contaminants, it is the material most used for SESD investigations. When stainless steel screens are stowed wet, they should be segregated from carbon steel components. Contact of the stainless screens with carbon steel when wet will cause galvanic corrosion that will shed chrome-bearing material when first flushed.

4.2 Groundwater Profiling

Rapid investigations can be facilitated by the use of groundwater profiling systems. A groundwater profiler allows a sampler to be advanced from one area of interest to the next with a discrete groundwater sample collected at each. The system may allow soil samples to be collected during advancement. As some sampler components are common for all samples, the groundwater profiler does not offer the same protection from cross-contamination that separate screen point samples would.

4.3 Small-Diameter Well Installation

With some limitations, direct push technology can be used to install permanent monitoring wells of quality commensurate with other drilling systems. The use of small diameter wells limits the possibilities for the pumps to be used in sampling. For shallow groundwater with water levels higher than 25 ft below ground surface, peristaltic pumps can be used with no limitation on minimum well diameter. For water levels deeper than 25 feet below ground surface, bladder pumps may be the only pumping option and well diameters should be 1" nominal diameter with an absolute minimum of ¾" nominal diameter.

Well materials are difficult to place with DPT systems and best results will be achieved with total depths less than 50 ft. It is also difficult or impossible to place bentonite seals, and caution should be used when aquifer isolation is particularly

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important. Grout should be placed in the annular space by tremie pipe, as with conventional drilling installation. Grout placement by tremie will likely rule out the use of the smaller diameter tool strings such as 2.125" and 2.25" outside diameter (od). A 3.5" tool string with 2.75" inside diameter (id) will allow room for a 1" nom. diam. casing with grout pumped through ½" nom. dia. tremie. Pre-pack screens are available to install 2" nom. dia. wells in 3.5" od tool string, but grout cannot be placed by tremie with these systems and they should not be used.

Pre-packed screens are typically used, consisting of a slotted well screen surrounded by a sand filter pack wrapped in stainless steel screen wire. Sand packs wrapped by textile materials capable of or intended to filter fines or lower turbidity are unacceptable. Above the pre-packed screen standard well casing matching the slotted screen diameter is used.

Installation involves driving a tool string with disposable point to depth, placing the screen and casing inside, and withdrawing the tool string to dislodge the disposable point. The drive casing is withdrawn to fully expose the screen. Filter pack sand is then added during drive casing withdrawal until sand is placed to 2 ft above the screen. There is a narrow annular space between the pre-pack screen and borehole walls that the added sand may not fully fill. The placement of 2 ft of sand above the screen allows for settling.

Bentonite grout mixed to 30% solids content is then installed by tremie pipe while withdrawing the remaining drive casing. Care must be taken to not jet out the placed filter sand by resting the tremie on the bottom.

Alternate systems are available that use a polyethylene and foam skirt to isolate a bentonite seal wrapped in kraft paper from the screened interval. These systems result in natural development of the entire annular space around the pre-pack screen and introduce several materials that may have compatibility, contaminant leaching, or long-term stability issues. Although the placement of a bentonite seal is desirable, SESD does not use these systems due to concern over the other issues.

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Appendix B
Analytical SOPs

eurofins	Always check on-line for validity. **Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A/6020B(aqueous, solid, tissue) and EPA 200.8 (aqueous)**	Level: **Work Instruction**
Document number: **T-MET-WI11933**		
Old Reference: **1-P-QM-WI-9018443**		
Version: **11**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date **12-NOV-2020**	Document users: **6_EUUSLA_Metals_ICP-MS Analysis, 6_EUUSLA_Metals_ICP-MS Analysis Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Figure I - Daily Performance Acceptance Criteria and Tuning Solution Concentrations

Revision Log

Revision: 11	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference	Reflects current protocol	Removed 7500 information
Cross Reference	Enhancement	Added *T-MET-WI35797* Metals Data Verification Process
Routine Methods	Added/Deleted	Removed old LIMs analysis numbers
Basic Principles	Reflects current protocol	Corrected instrument and equipment information. Removed 7500 information, added 7900 information. Corrected gas mode order.

Revision: 11	**Effective Date:**	This version
Section	**Justification**	**Changes**
Interferences	Reflects current protocol	Removed 7500 and 7700 references.
Safety Precautions and Waste Handling	Reflects current protocol	Removed responsibilities for chemical spills that are now taken care of by the ERT.
Apparatus and Equipment	Reflects current protocol	Removed 7500 information, added 7900 information. Corrected instrument/equipment information. Removed references to Parallax and updated to reflect procedures for TALS. Removed adjustable pipette information.
Reagents and Standards	Reflects current protocol	Corrected standard/reagent name(s) from Parallax to TALS formatting.
Calibration	Reflects current protocol	Corrected standard/reagent name(s) from Parallax to TALS formatting. Added LRC
Procedure	Reflects current protocol	Removed procedure for old LIMS. Added the procedure for new LIMS. Corrected standard/reagent and QC name(s) from Parallax to TALS formatting.
Quality Assurance/Quality Control	Reflects current protocol	Corrected QC name(s) from Parallax to TALS formatting. Removed 7500 information and added 7900 information. Updated 7700 usage. Removed verification process and added cross reference to *T-MET-WI35797*
Figure 1	Enhancement	Removed erroneous information and replaced with correct tuning parameters/concentration(s).
Table I	Enhancement	Removed table and cross referenced to *T-MET-WI35797*.
Table II	Enhancement	Removed table and cross referenced to *T-MET-WI35797*.

Revision:10	**Effective Date:**	05.JUL.2019
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Table II - ICPMS Metals by EPA 6020/6020A/6020B	Update to method requirements	Internal standard requirements

Reference

1. Method 200.8 (rev 5.4), Determination of Metals and Trace Metals in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry, USEPA 600/R-94/111 May 1994.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020, September 1994.

3. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020A, February 2007.

4. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020B, Rev. 2, July 2014.

5. ESI SC Manual.

6. Agilent 7700 and 7900 Series ICP-MS MassHunter Workstation Guide and Hardware Maintenance Manual.

7. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
Q-EQA-FRM6869	Nonconformance Form
T-MET-WI12065	Working Instructions for Preparation of ICP-MS Solutions and Standards
S-SS-WI10695	Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits
QA-SOP11901	Instrument Maintenance and Calibration
T-MET-WI18027	Instrument Operations for Agilent 7700
T-MET-WI18029	Instrument Maintenance for Agilent 7700
T-MET-WI21589	Instrument Operations for Agilent 7900
T-MET-WI21590	Instrument Maintenance for Agilent 7900
T-MET-WI35797	Metals Data Verification Process

Scope

This procedure applies to analyses performed at Eurofins Lancaster Laboratories Environmental (ELLE) using ICP-MS for identification and quantitation of metallic constituents.

Aqueous undigested samples and digestates (aqueous and solid matrices) are analyzed via this SOP.

Limits of Quantitation (LOQs), Method Detection Limits (MDLs) and linear ranges are maintained in the LIMS. These are subject to change without notification.

Routine Methods

Analyte	Mass
Be	9
B	11
Na	23
Mg	24
Al	27
K	39
Ca	44
Ti	47
V	51
Cr	52
Mn	55
Fe	57
Co	59
Ni	60
Cu	63
Zn	66
As	75
Se*	78
Se**	82

Sr	88
Mo	98
Ag	107
Cd	111
Sn	120
Sb	121
Ba	137
Tl	203
Pb 206	206
Pb 207	207
Pb 208***	208
U	238
*Se 78 is the mass reported from collision cell ICPMS only **Se 82 is the mass reported from non-collision cell ICPMS only ***For Pb masses 206, 207 and 208 are summed for calibration and analysis	

Basic Principles

ICP-MS is an analytical instrument that uses the energy of inductively coupled plasma to generate ions to be analyzed in the mass spectrometer.

The instruments use a discrete sampling system that first loads the sample into a Teflon sample loop. The sample is then pushed by a carrier solution using a computer controlled peristaltic pump that delivers the sample from the loop into the nebulizer attached to a cooled Scott double pass spray chamber.

The Agilent 7700 (E05) and 7900 (E07/E08/E09) can analyze samples in 3 different modes of operation, although typically analysis is done in 3 mode or No Gas mode only:

1. Mode 1 – no gas. This mode does not use a collision or reaction gas. Elements with a low atomic mass or that have no interferences can be analyzed using the "no gas" mode.

2. Mode 2 – Hydrogen (H_2) mode. This mode uses H_2 as a reaction gas, since it reacts quickly and efficiently with the Argon-based interfering species, but reacts slowly or not at all with the analyte(s) of interest. In this mode, interferences can be reduced to the level of baseline noise, allowing lower detection limits to be achieved for some difficult elements.

3. Mode 3 – Helium (He) mode. This mode uses He as a collision gas for reliable, predictable removal of unknown matrix interferences. No new interferences are formed in the cell, and no analytes are lost by a reaction.

Interferences

ICP-MS interferences include isobaric elemental interferences and polyatomic ion interferences derived from the plasma gas, reagents, and/or sample matrix. The Agilent 7900 utilize helium as an inert collision gas to reduce or eliminate many types of polyatomic ion interferences.

Physical interferences caused by the change in sample matrix affecting sample transport and/or nebulization must be compensated for using internal standardization.

Memory interference is the contribution of analyte signal from a previous sample onto the next sample analysis. Adequate rinse time with an appropriate rinse solution of the sample introduction system overcomes any memory interference.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.
See the *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Hydrochloric acid (HCl) – This acid can cause skin burns. Only mix with approved solutions. Always use this chemical in a fume hood.

Hydrofluoric acid (HF) – This acid is very toxic and absorbs through the skin without pain. This acid is found at trace levels in standard solutions.
Hydrogen Peroxide 30% (H2O2) - This oxidizer can cause skin burns. Always use in a fume hood.

Nitric acid (HNO3) – This acid can cause skin burns and burning of the respiratory tract. Add nitric acid to samples in a fume hood to avoid exposure to toxic fumes.

When diluting strong acids, never add water to acid; always add acid to water.
Store concentrated acids in the prep room acid cabinets. Only acids are to be stored in these cabinets. Flammable solvents are stored in flammable liquid storage cabinets. Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Large spills are cleaned by HSE. For large spills of concentrated acid, immediately evacuate the area and dial 1-1-1. HSE will use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.)

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing the instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the sequence editor to set up the run, perform calculations, interpret raw data, and enter/transfer data into the LIMS. Proficiency is measured through documented audits of the tasks listed, and checking of data as well as an IDOC (Initial Demonstration of Capability) and continued DOCs (Demonstration of Capability) as defined in *QA-SOP11178*.

Sample Collection, Preservation, and Handling

Aqueous undigested samples, aqueous digestates, and solid digestates are analyzed via this SOP. Samples must be analyzed within 6 months of collection for all methods in this SOP.

Aqueous samples are collected in plastic or glass containers. Drinking Water samples are collected in 1-L plastic or glass containers. Aqueous samples are preserved with nitric acid with a pH of < 2 and stored at 0° to 6°C, not frozen.

Aqueous digestates are digested per the method in SOP *T-MET-WI11939* (aqueous samples). Aqueous samples are stored in 50 ml plastic vials at room temperature.

Solid samples are collected in glass containers and stored at 0° to 6°C, not frozen. Refer to the protocols in the digestion SOP T-MET-WI8636. Solid samples are stored in 100 ml plastic vials at room temperature.

Store standards and digestates separately.

The general practice in the metals group is to discard the digestions after all the required metals from a batch of samples have been analyzed and verified in the LIMS. Samples which require the digestate to be held for long term storage are periodically evaluated for discard.

Apparatus and Equipment

A. The following is a list of the hardware used in the Agilent 7700 and 7900 ICP-MS systems.

1. Inductively Coupled Plasma Mass Spectrometers (ICP-MS)

a. The Agilent 7700 and 7900 - The sample introduction system consists of an ESI FAST discrete sampling system, Teflon nebulizer and cooled spray chamber attached to a concentric quartz tube plasma torch.

2. Autosampler

a. The Agilent 7700 and 7900 (E08) systems use an ESI SC-8 FAST autosampler. The Agilent 7900 (E07 & E09) systems use an ESI SC-14 FAST autosampler. The autosampler parameters for each automated run are entered into the Sample List in MassHunter software.

3. Coolflow

a. The Agilent 7700 and 7900 G3292A Recirculating Chillers are set up to deliver cooling liquid to the ICP-MS at a regulated pressure of ~40 psi.

4. Computer

a.The Agilent 7700 and 7900 are controlled by a Windows-based IBM compatible PC with MassHunter software installed.

5. Vacuum Pumps

a. The Agilent 7700 and 7900 both have a 2-stage vacuum system. A rotary pump evacuates the interface chamber; a turbo molecular pump evacuates the ion lens chamber and the analyzer chamber.

B. The following is a list of the apparatus necessary for the setup of an ICP-MS run for analysis:

1. ICP-MS prep batch sheets.
2. Test tube racks
3. Graduated 15-mL polypropylene tubes and caps
4. 50-mL polypropylene screw cap tubes
5. FilterMate 2 µm filters and plungers
6. 10-mL sterile disposable syringes
7. 25-mm syringe filters, PTFE, 0.45µm
8. 30-mL polypropylene medicine cups
9. Fixed volume hand-held pipettes (25 – 2000 µL) - Eppendorf or equivalent.

NOTE: For routine operation, calibration, and maintenance of fixed-volume, hand-held pipettes, see *QA-SOP11880*.

Reagents and Standards

Refer to Form *T-MET-WI12065* for reagent and standard information and the preparation of the following standards and solutions

1. ICP-MS Calibration Standards and ICP-MS LOQ Check Standard Solution (CRI)
2. ICP-MS Initial and Continuing Calibration Verification Standards
3. Interference Check Solutions
4. Rinse/Carrier, Tuning, and Calibration Solutions
5. Internal Standard Solution
6. PDS Solutions
7. General Acids and Chemicals

Calibration

Before calibration is performed, allow the instrument to warm up for the recommended time, usually at least 15 minutes, if the plasma has been off for 15 minutes or less, or at least 30 minutes if the plasma has been off for more than 15 minutes. Daily tuning requirements must be performed prior to calibration of the instrument and after warm up occurs. Refer to forms *T-MET-WI18027*, and *T-MET-WI21589* for detailed tuning and calibration information. Full Tuning and Optimization is done as needed, or when required by the Group Leader.

Calibration is performed daily. Calibrations consist of a blank and one to three standards, followed by analysis of an ICV, ICB, CCV, CRI, ICSA/ICSAB, LRC, CCV, and CCB.

A single point calibration, consisting of a blank and one standard, is used for all analysis except samples requiring a multi-point calibration (either MA MCP or CT RCP protocol or a lab note indicating a multi-point calibration is needed). For samples requiring a multi-point calibration the calibration consists of a blank, "S1", "S2", and "S3" standards. The concentrations of the calibration standards are defined in *T-MET-WI12065*.

For acceptance criteria and corrective action, see *T-MET-WI35797*.

Procedure

A. Setting up an ICP-MS run

The procedure is the same for the Agilent 7700 (E05) and 7900 (E07/E08/E09) instruments.

1. In MassHunter open the method batch file used for analysis.

2. Enter the calibration standards and lot numbers in the order of:
ICV/ICB/CRI/ICSA/ICSAB/LRC(s)/Rinse(s)/CCV/CCB

3. Scan all samples into the sample list and add PDS/SD and/or dilutions as needed.

4. Add a CCV/CCB block after every 10 samples (or ending the run) as well as an ending CRI/ICSA/ICSAB as needed.

5. Enter the locations of the samples to match the rack in which they will loaded onto the auto-sampler. Ensure that the order of the samples on the batch paperwork/re-read sheet match the order in which they are loaded.

6. Right click on the sample list and print a copy.

7. Use the print out to confirm the sample ID(s) and locations of the samples on the auto-sampler.

8. Load the auto-sampler based off of the printed out sample list. Sign off on the sample list with your initials, employee number and the date.

9. Keep the sample list with the batch(es) paperwork until the batch is imported into the LIMS. Note the analytical and prep batch(es) numbers on the sample list and give to the Group Leader.

B. Pouring an ICP-MS run (Waters only in 50 mL digestion tubes):

The procedure is the same for the Agilent 7700 (E05) and 7900 (E07/E08/E09) instruments.

It is important to minimize any chance of contamination, to both yourself and the samples. Keep your hands and the work area clean at all times. Wear appropriate PPE at all times to prevent exposure to chemicals and samples.

NOTE: See Form *T-MET-WI12065* for standards and solutions used during the analytical run.

1. Choose the appropriate prep batch sheet.

NOTE: When retrieving the batch from the shelf for the first time, record the batch location on the cap of the prep blank in black sharpie. This saves time when returning the batch to the proper location after analysis and shows that the batch has been poured before and verified to be in the correct order. To prevent more than one batch from being assigned to the same location, the digestion trays all have the location written on the foam holder.

2. Verify that each digestion tube is in the correct order according to the prep sheet. If anything is missing, correct the prep sheet and notify PREP or the Group Leader to correct the LIMS and put the sample back in for digestion. If the order is incorrect, reorder the sample digestion tubes to match the paperwork.

3. For batches prepared in hot blocks in 50-mL digestion tubes:

a. The only tubes that typically need to be poured for the initial run are the post digestion spike (PDS) and serial dilution (SD)samples. These are prepared using the background sample (BKG) or the duplicate background sample (DUP) when limited sample volume is available.

b. All other samples remain in the 50-mL digestion tubes for analysis.

4. Samples that need to be poured into test tubes:

a. Obtain the appropriate number of tubes.

b. Write the last four digits of the sample number and the dilution factor if greater than 1 on each tube. If the MB or LCS must be in tubes, write MB/LCS and the prep batch number/location on the tubes.

c. Place tubes in test tube racks in the same order as the samples on the prep batch cover sheet and/or re-read.

d. The analyst must ensure that tubes are labeled correctly, that dilutions are performed accurately, and that the dilutions are recorded on the prep cover sheet and/or re-read.

5. Post-digest spike (PDS):

a. A PDS is required for each batch (sample volume permitting).

b. A PDS is prepared by pipetting 0.2 mL of the appropriate PDS solution into a 14-mL graduated test tube, and bringing it to a volume of 10 mL with the background sample, "BKG". If the PDS must be diluted, pipette 0.2 mL of the PDS solution into a 14 mL graduated test tube, add the appropriate amount of background sample, "BKG", and dilute to 10 mL using matrix rinse. If there is limited volume for the background sample, "BKG", then the "DUP" may be used for dilutions of the PDS or SD.

c. Record the lot number of PDS solution used on the prep batch cover sheet and/or re-read.

6. Serial dilution (SD)

a. Prepare the SD by diluting the background sample at a dilution that is equal to 5× the dilution factor of the PDS sample (i.e.if PDS= DF1, SD must = DF5; if PDS=DF5, SD must=DF25).

7. Filtering samples

a. Samples that are cloudy or have particulate suspended in solution must be filtered prior to analysis to prevent clogging of the sample introduction system, which causes run failures and instrument down time to correct the problem.

b. Samples that are digested using the 50-mL hotblock tubes need to be filtered using the FilterMate filtration devices and plunger.

c. Attach a filtration device to the plunger and very carefully insert the filter into the hotblock tube until the filter reaches the bottom of the digestion tube.

d. Remove and discard the plunger.

e. An alternative for samples in any type of vessel is to filter using a 10-mL sterile disposable syringe fitted with a 0.45µm PTFE syringe filter.

f. If any samples are filtered, the MB and LCS must also be filtered. If any QC sample is filtered (BKG, DUP, MS, or MSD), then all QC including the MB and LCS must be filtered.

g. Document all filtrations on the prep batch cover sheet.

NOTE: It is not necessary to filter all samples (in hotblock tubes only) that contain particulate, as long as all of the particulate is settled to the bottom of the tube below the 5-mL mark in 50-mL digestion vessels. The sampling

depth of the autosampler probe is set such that the tip of the probe is approximately 100 mm above the bottom of the digestion tube.

8. Verify that all samples in the hotblock tray are in the correct position and/or pour each sample (or sample filtrate) into the appropriate tube. Usually, the order of the batch QC is MB, LCS, (LCSD), Bkg, PDS, DUP, MS, (MSD), and SD. Most importantly, the actual positions of the samples in the tray must match the autosampler table used for analysis.

NOTE: Immediately prior to beginning analysis, the analyst must visually verify that each sample is in the position indicated in the autosampler table used for the run.

9. If not being analyzed immediately,cap any poured tubes to prevent contamination of the samples (hotblock tubes and dilutions prepared in graduated test tubes must be capped tightly except during pouring and/or analysis).

10. Return samples to sample storage, being sure to place the batch back into the location recorded on the prep batch sheet.

11. Record the following on the prep batch cover sheet: initials, employee number, and the date.

12. NOTES:

a. A PDS and a SD are performed on one sample in each digestion batch. Typically, the background sample is chosen. If the batch QC is split between two samples, the PDS is performed on the background sample accompanied by a matrix spike; the SD is performed on the background sample accompanied by a matrix duplicate. If sample volume is limited, it is acceptable to use the duplicate for the PDS and SD.

b. Batches with only field blanks or equipment blanks do not need a PDS or a SD.

c. Air filter batches need only a SD on one sample in the batch (a PDS is not required).

d. "As Received" samples are analyzed with a blank and LCS, LCSD (prepared by the analyst).

e. Documentation is of utmost importance. Verify all entries.

Calculations

1. Final Result

a. Water sample

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Volume}}$$

b. Solid sample (mg/kg)

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Weight (grams)}}$$

2. Relative percent different (RPD)

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = first sample value

D = duplicate sample value

3. Spike recovery

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = spiked sample result

SR = sample result

SA = spike added

4. Correlation Coefficient

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

Where :

X = the known concentration

Y = the instrument response

N = the total number of data points

5. Serial Dilution

$$\%\ Difference = \frac{(5 \times SDR) - SR}{SR} \times 100$$

Where:

SDR = serial dilution result

SR = sample result

6. Methods of standard additions (MSA)
Take either 4 identical aliquots (for 3 point MSA) or 2 identical aliquots (for one point MSA) of the same sample. Leave one unspiked. Spike the other 3 aliquots with different levels of a standard solution (for 3 point MSA) and spike the other aliquot at approximately the indigenous concentration of the sample (for one point MSA). Add blank solution to sample aliquots so that the final volume is the same for all. Use small volumes of spiking solution to avoid diluting the sample more than 10%. Analyze the 4 aliquots or 2 aliquots and record the instrument readings in absorbance. Use the readings and spike values to find the slope and x- and y- intercepts. The x- intercept is the result.

$$\text{Slope} = m = \frac{\sum x_i y_i - (\sum x_i \sum y_i)/n}{\sum x_i^2 - (\sum x_i)^2/n}$$

$$\text{Y-Intercept} = b = \bar{y} - m\bar{x}$$

$$\text{Result} = -\frac{b}{m}$$

$$\text{Correlation Coefficient} = r = \frac{\sum\{(x_i - \bar{x})(y_i - \bar{y})\}}{\sqrt{\left[\sum (x_i - \bar{x})^2\right]\left[\sum (y_i - \bar{y})^2\right]}}$$

The correlation coefficient (r) for the least squares fit must be ³0.995. If the r value is <0.995, the MSA must be repeated at the same dilution. If the r value is again low, the result with the higher r value is verified and both are flagged with a "+" in the data package. If the r value is <0.990, the sample is run at an interference dilution to overcome matrix effects. This usually requires a raised limit of quantitation. If a client requests a particular limit of quantitation that prohibits further dilution, then the sample is repeated at the same dilution and the best of the two results is verified.

7. Average, Standard Deviation and Relative Standard Deviation

The average result, $\bar{x}$, is calculated by summing the individual results and dividing this sum by the number (n) of individual values:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + \ldots x_n}{n}$$

Standard deviation is a measure of how precise the average is or how well the individual numbers agree with each other.

$$\text{Standard deviation, } S = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2 + \ldots + (x_n - \bar{x})^2}{n-1}}$$

Relative standard deviation (RSD) is expressed in percent and is obtained by multiplying the standard deviation by 100 and dividing this product by the average.

$$\text{Relative standard deviation, RSD} = \frac{100 \times S}{\bar{x}}$$

Statistical Information/Method Performance

Generate MDLs and LOQs according to *QA-SOP11892*.

The department supervisor maintains annual study data. The department supervisor requests that a Quality Assurance Specialist update to the LIMS as needed. Update the department database via a download from the LIMS.

Refer to *QA-SOP11896* for statistical information.

Quality Assurance/Quality Control

A. For 6020, 6020A and 6020B, each digestion batch (up to 20 samples) must contain a method blank, LCS, and either an BKG, DUP, MS, MSD or an LCS/LCSD.

B. For 200.8, each digestion batch (up to 10 samples) must contain a method blank, LCS, and either an BKG, DUP, MS or an LCS/LCSD.

C. QC limits for MS/MSD, and LCS/LCSD are established through statistical analysis of historical data.

1. The limits are maintained in the LIMS for the relevant analysis numbers.

2. The limits are evaluated every 6 months and updated as needed.

3. The limits are subject to change without notification.

D. Batch Quality Control

1. For the preparation and concentrations of Batch Quality Control see *T-MET-WI12065*.

2. For the frequency, acceptance criteria and corrective action see Tables I and II.

E. Raw data quality checks

1. Make sure that the run is correctly labeled, and dated and that the corresponding prep sheet is attached to the run.

2. Verify that the appropriate Tuning Report is with the run.

3. For run and batch QC/Calibration frequency, acceptance criteria and corrective action, see Method Specific Tables I (EPA 200.8), and II (EPA 6020). For information on statistical windows refer to *QA-SOP11896*.

4. Spike levels of batch QC are available in the LIMS and on T-MET-WI9082.

5. LOQs are available to analysts in the LIMS.

6. Check to make sure that all results are not> 90% of the Linear Range. If a sample reading is above 90% of the linear range, then reread the sample at a dilution sufficient to bring the sample concentration to approximately the middle of the calibration range.

7. Check that the **absolute** value of all nondetected analytes is less than the LOQ. A technical decision must be made as to whether a reread is warranted for readings <|-LOQ|.

8. Check for carryover between samples. Sample RSD >20%, with a concentration > the LOQ decreasing progressively over time (i.e., Reading 3<2<1). Flag any suspect samples for reread.

NOTE: Whenever a sample is encountered that exceeds the calibration range, the following sample must be checked for carryover for the over range analyte (s) and any suspect results must be deselected and reanalyzed. During reanalysis the sample order must be modified as needed to avoid carryover from any over range sample(s).

9. For all EW (samples from public drinking water sources), check the results against the MCL (maximum contaminant level). If an analyte **exceeds** the MCL notify a verifier at once. An automated email is sent to the Client Service Representative and the state for the analytes listed below with the exception of Pb and Cu which follow the 90th percentile rule (the CSR tracks the lead and copper and notifies the supplier when necessary). Suppliers must be notified within 24 hours.

10. To avoid the risks associated with polyatomic interferences in wastewater and soil matrices all analytes must be analyzed on the collision cell ICP-MS instruments which include Agilent 7900, Equipment #27813, Equipment #30647, Equipment #30921).

a. Because EPA 200.8 rev. 5.4 does not currently allow the analysis of drinking water samples using collision cell ICP-MS all drinking water samples must be analyzed using a method with no gas mode for all analytes on the Agilent 7700, Equipment #19204.

11. Check the internal standard level for the entire run. If the internal standard reading for any sample is out of the acceptance range of the S0 reading, evaluate whether this is a result of the sample matrix or drift from other samples in the run. Only reread the sample at a dilution if the internal standard appears to be out of range due to the sample matrix. For samples where an internal standard is above the acceptance range it is acceptable to reprocess the data using an alternate internal standard. This is the preferred approach in order to avoid raised reporting limits. The acceptance criteria differ based on the method being used. Refer to Table I, and II for the method acceptance criteria.

NOTE: The internal standard is added in equal concentration to all of the samples and standards via a dedicated line on the peristaltic pump. The analytical lines referenced to an internal standard report a corrected concentration value based on the ratio of analyte to internal standard intensities. All the calculations for determining concentration are based on Intensity Ratio (IR). The IR is defined as the background corrected intensity signal of the analyte line (Ia) divided by the internal standard value (Iis). IR= Ia/Iis.

12. For TCLP and SPLP samples, an MSA (method of standard additions) is required if:

a. The sample concentration falls between 80% and 100% of the regulatory limit.

b. If the TCLP or SPLP matrix spike (QA) recovers <20%, all samples in the leachate batch must be reanalyzed using the method of standard additions for that analyte.

13. When items 1 – 12 are complete, check the following:

a. All samples requiring reread/redigestion are listed on the reread/redigestion schedule forms.

b. The data are uploaded to LIMS via IDAT by the reviewer.

Figure I - Daily Performance Acceptance Criteria and Tuning Solution Concentrations

Be (9)	10 or 100 PPB
Mg (24)	10 or 100 PPB
Co (59)	10 or 100 PPB
In (115)	10 or 100 PPB
Pb (208)	10 or 100 PPB
CeO/Ce	<3%
Ce++/Ce	<3%

Background	<30 cps @ Mass 220
RSD	<5%
Peak Width at 10% Peak Height	<0.9 AMU
Res/Axis	< +/- 0.1 AMU from unit mass

Q-EQA-FRM6869 Nonconformance Form
QA-SOP11178 Demonstrations of Capability
QA-SOP11880 Balance, Syringe, Pipette, Weights and Labware Verification
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896 Establishing Control Limits
QA-SOP11901 Instrument Maintenance and Calibration
S-SS-WI10695 Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
T-MET-FRM8822 ICPMS Analysis
T-MET-WI11939 Digestion by EPA 200.8 for the Analysis of Total Recoverable Metals in Water by ICPMS
T-MET-WI12065 Working Instructions for Preparation of ICP-MS Solutions and Standards
T-MET-WI18026 Instrument Operations for Agilent 7500
T-MET-WI18027 Instrument Operations for Agilent 7700
T-MET-WI18028 Instrument Maintenance for Agilent 7500
T-MET-WI18029 Instrument Maintenance for Agilent 7700
T-MET-WI21589 Instrument Operations for Agilent 7900
T-MET-WI21590 Instrument Maintenance for Agilent 7900
T-MET-WI35797 Metals Data Verification Process

End of document

Version history

Version	Approval	Revision information
9	21.MAR.2019	
10	05.JUL.2019	
11	12.NOV.2020	

eurofins	Always check on-line for validity. **Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS**	Level: **Work Instruction**
Document number: **T-SVOA-WI9995**		
Old Reference: **1-P-QM-WI-9015192**		
Version: **18**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date **07-JUL-2020**	Document users: **5_EUUSLA_GC/MS Semivolatiles_All**	Responsible: **5_EUUSLA_GC/MS Semivolatiles_Manager**

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Sample Collection, Preservation, and Handling
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Revision Log

Revision: 18	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout document	Clarification	Removed all references to footnotes regarding qualified data and drafted a general statement addressing data qualification as a means to differentiate between data that needs to be qualified and instances that require corrective action
LIMS ID	Reflects current LIMS	Removed Parallax analysis numbers
Cross Reference	Updated title	*T-OE-SVOA-WI10947* - removed 625 from title and added 612

Revision: 18	**Effective Date:**	This version
Section	**Justification**	**Changes**
Personnel Training and Qualifications	Reflects current practice	Revised the standard deviation criteria for 625.1 DOC to use the limits in Table VI, removed option to use 1CCV and 4 CCVs as an ongoing DOC as these do not include the preparation step
Procedure	Updated process	Laboratory will begin using ICV/CCV acceptance criteria put forth by the method rather than in-house limits
Statistical Information/Method Performance	Text duplicated	Removed duplicated text; revised statement about which methods use statistical surrogate limits
Quality Assurance/Quality Control	Clarification	Clarified that marginal exceedance is only used for 8270C/D/E
Table VII	New table	Added surrogate table containing method-specific surrogate limits for method 625.1

Revision: 17	**Effective Date:**	25 MAR, 2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Title	New method version	Added method 8270E
LIMS ID	New LIMS	Added TALS method names, removed deactivated master 10010
Throughout document	New method version	Added 8270E method reference and criteria
Cross Reference	Enhancement	Added references to controlled documents that are referenced throughout this SOP
Interferences	Enhancement	Reworded entire section
Safety Precautions and Waste Handling	Enhancement	Added discussion about waste handling
Personnel Training and Qualifications	Clarification	Added specific information about IDOC spiking and acceptance criteria
Apparatus and Equipment	Enhancement	Added amber vials with crimp caps and GC columns
Reagents and Standards	Documentation change	All standard preparation information was relocated to *T-SVOA-WI11998*
Procedure B.	Enhancement	Moved internal standard concentrations from reagents and standards to this section
Procedure D.2.	Reflects current practice	Changed ions to match current instrument and data processing methods
Procedure E.2. (tables)	Reflects current practice	Added allowance of PCP tailing factor failure and tune time allowance for 625.1
Procedure F.	Reflects current practice	Added discussion on the allowance of the dropping of calibration points; added 250mL analysis calibration range; removed %RSD criteria for ISTDs as this is not required by the methods; added quadratic fit option
Procedure G.	New requirement	Removed requirement to pass two consecutive CCVs and replaced this requirement with new requirement to document corrective action after a CCV failure and re-calibrate if necessary
Calculations	Documentation change	Removed all calibrations and referred to *T-SVOA-WI11998*

Revision: 17	**Effective Date:**	25 MAR, 2020
Section	**Justification**	**Changes**
Statistical Information/Method Performance	Clarification	Reworded entire section
Quality Assurance/Quality Control	Clarification	Reworded entire section and replaced table

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 8270C (SIM), December 1996
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8270D (SIM), July 2014
3. Hazardous Waste Test Method, SW-846 Test Method 8270E (SIM), June 2018
4. Test Methods for Evaluating Solid Wastes, SW-846 Method 8000D, July 2014
5. USEPA, 40 CFR Part 136, Method 625.1, December 2016 (SIM); MUR Effective September 2017
6. *Hewlett-Packard Operations Manuals*
7. *Chemical Hygiene Plan*, current version

Cross Reference

Document	Document Title
T-OE-SVOA-WI10925	Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Solid Matrix by SIM
T-OE-SVOA-WI10928	Microwave Extraction by Method 3546 for Semivolatiles
T-OE-SVOA-WI10931	Separatory Funnel Extraction by Method 3510C for BNAs by 8270 SIM in Wastewater
T-OE-SVOA-WI10947	Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1
T-SVOA-FRM9602	Dept 4026 Calculations
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-SVOA-WI9598	GC/MS Preventative and Corrective Maintenance
T-SVOA-WI9604	Monitoring GC/MS Semivolatile QC Data Acceptance Limits
Q-EQA-FRM6869	Nonconformance Form
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is suitable for the determination of low-level semivolatile compounds in soils and waters by selected ion monitoring (SIM) Gas Chromatography/Mass Spectrometry (GC/MS). The analysis applies to a concentration range that spans from an MDL of 0.01 µg/L in water (0.33 µg/kg for soil) to an upper calibration concentration of 10 µg/L in water (330 µg/kg for soil). Specific compound lists and their associated MDLs/LOQs are found in the Laboratory Information Management System (LIMS) under the analysis numbers listed on the front page of this SOP.

Basic Principles

Water samples are extracted according to *T-OE-SVOA-WI10931* for 8270 analysis or *T-OE-SVOA-WI10947* for 625.1 analysis. Soil samples are extracted according to either *T-OE-SVOA-WI10928* or *T-OE-SVOA-WI10925*.

An environmental sample (soil, water, sludge, etc.) is solvent extracted and then analyzed by electron impact gas chromatography/mass spectrometry (EI GC/MS). A predetermined aliquot of an extract containing organic compounds in solvent is injected onto a fused silica capillary column coated with a relatively non-polar stationary phase, which is enclosed in a temperature controlled oven. A carrier gas, which is ultra-pure helium, passes continuously through the column. The GC oven is temperature programmed and the organic mixture separates into its individual components as it moves along the length of the column. This separation is the function of the polarity and boiling point of the individual compounds. This column empties into a mass selective detector. When a compound reaches the detector, it is bombarded by high-energy electrons (70 eV). This causes the compounds to fragment, forming ions. By applying various voltages to the lens, the positive ions are thrust into a quadrupole mass analyzer, which selects for a given mass fragment at a given time. These selected fragments reach an electron multiplier that detects and generates a signal for each mass fragment. The signals are amplified and sent to a computer. By analyzing for specific masses over a narrow mass range, SIM analysis allows for longer dwell times at specific masses. This allows for significantly greater sensitivity of analysis with a small reduction in specificity of analysis.

Target compounds are identified on the basis of spectral match and relative retention times as they compare to standards that are injected every 12 hours on the same system. Quantification is achieved via use of the internal standard calibration technique. The average relative response factor of a multi-point calibration is used for quantification when the appropriate criteria are met.

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in the processing of samples. All glassware is solvent rinsed before use and a method blank is extracted with each extraction batch to demonstrate that the extraction system is free of contamination.

Sample matrices can have an effect on the ability of the GC/MS system to resolve the individual masses used for quantification. Samples may require dilutions, a reduction in the extraction volume/weight used, a raised final extraction volume, or extract clean-up using various techniques in order to achieve proper target separation and determination.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See Chemical Hygiene Plan for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; therefore, each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as the use of fume hoods, lab coats, safety glasses, and gloves.

All solvent waste generated from this analysis must be collected for recycling (if applicable) or must be disposed of in designated containers. These will then be transferred to a lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, and pH paper) must be disposed of in the normal solid waste collection containers or sharps containers, as applicable.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently perform daily maintenance, calibrate the instrument, change the column, clean the source, interpret chromatograms, perform calculations, review data, and enter data into the LIMS. The analyst is also trained on the preparation of dilutions and calibration standards. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are spiked at 1-4x the LOQ and are carried through all steps of the procedure. The defined acceptance criteria must be met. The criteria include the calculation of mean accuracy and standard deviation. The mean accuracy for all compounds must fall within the laboratory's most recent statistically derived LCS limits ±20% and must exhibit a standard deviation ≤20% for methods 8270C/D/E. The mean accuracy for all compounds must fall within the limits listed in table VI under 'X' and must exhibit a standard deviation less than or equal to the limits listed in Table VI under 's' for method 625.1.

Various options are available for a DOC and can include four laboratory control samples or one blind sample. Refer to *QA-SOP11178* for more guidance on these options.

Sample Collection, Preservation, and Handling

Water samples are collected in 250mL or 1L glass amber containers with PTFE-lined lids and may be preserved with sodium thiosulfate ($Na_2S_2O_3$). They are stored at 0°C to 6°C, not frozen, prior to extraction and must be extracted within 7 days of collection.

Solid samples are collected in Solid samples are collected in glass wide-mouth jars with PTFE-lined lids and are not preserved. They are stored at 0°C to 6°C, not frozen, prior to extraction and must be extracted within 14 days of collection.

All sample extracts must be stored at ≤-10°C (freezer) and protected from light using amber glass vials. All samples, sample extracts, and standards must be stored separately and in an area free from contamination. All extracts must be analyzed within 40 days of sample extraction.

Apparatus and Equipment

1. Hewlett-Packard Model 6890 Gas Chromatograph or equivalent

2. Hewlett-Packard Model 5973 and 5975 Mass Selective Detector or equivalent

3. Hewlett-Packard ChemStation Software or equivalent

4. Thru-Put Systems Target data system or equivalent

5. Column:

30 m x 0.25 mm x 0.5 µm film thickness, Restek Rxi-5Sil MS or equivalent
30 m x 0.25 mm x 0.25 µm film thickness, Agilent DB-5MS or equivalent

6. Hamilton Gastight syringe, or equivalent – various volumes

7. Amber GC vials with crimp caps

Reagents and Standards

Refer to *T-SVOA-WI11998* for all standard preparation information.

Calibration

Calibration is accomplished using an internal standard calibration technique. Calibration standards at five or more concentration levels are analyzed. See Procedure F for the initial calibration process and criteria and see Procedure G for the continuing calibration process and criteria. If any client, state, or agency has more stringent calibration criteria, these must be followed instead.

NOTE: South Carolina does not allow the use of quadratic fits.

Procedure

A. Standard preparation

Solutions are used to standardize the GC/MS system every 12 hours. Refer to *T-SVOA-WI11998* for standard preparation. Calibration solutions may be used up to the labeled expiration date or until component degradation is observed. Degradation is determined by the inability to pass continuing calibration checks or by observations of unacceptable chromatography.

B. Internal standards

Internal standard mix is added to all standards and subsequent samples at a concentration of 1 µg/mL for soil and 1L analyses, and 0.25 µg/mL for 250 mL analyses. Using a 25 µL syringe, add 10 µL of internal standard to 1 mL of sample extract or standard. See Table IV for the list of compounds calibrated for and the internal standard that is assigned to each.

C. Daily maintenance

Refer to *T-SVOA-WI9598* for this procedure

D. Instrument conditions

1. The GC/MS system must be capable of meeting the following specifications:

Mass range:	35 to 500 amu
Scan time:	1 scan/sec
GC column:	30 m x 0.25 mm x 0.5 µm film Restek Rxi – 5 or equivalent
Injector temperature and mode:	250° to 300°C; splitless
Transfer line temperature:	250° to 300°C
Detector temperature:	300°C
EI condition:	70 eV
Mass scan:	Capable of SIM scanning (see manufacturer's instructions)
Carrier gas:	Helium at approximately 30 cm/sec.
GC Oven temperature program:	Initial temperature – 35°C Initial hold time – 1.82 minutes GC Ramp #1 – 20°C/minute to 310°C GC Ramp #2 – 4°C/minute to 325°C Final hold time – 4.30 minutes

NOTE: It is not necessary to use the exact parameters listed above. Equivalent columns and conditions may be used to improve the linearity, sensitivity, overall chromatography, and performance required by the method on each GC/MS system.

2. Prior to analysis by SIM, a check standard must be analyzed in the full scan mode to determine where the specific start and stop times are for each of the groups. Each time column maintenance is performed, the scan times are reviewed to ensure that all ions are included. The GC/MS is configured in the SIM mode with a total cycle time (including voltage reset time) of 1 second or less. Set the Low Res to "N" and the Start Time for each group. In the m/z field, enter the ions for each group from the following tables:

GROUP 1 (Dwell – 60 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
1,4-Dioxane	Target	88	58
N-Nitrosodimethylamine	Target	74	42

GROUP 2 (Dwell – 40 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Quinoline	Target	129	102
Benzenethiol	Target	110	66
1,4-Dichlorobenzene-d4	ISTD	152	115
Naphthalene-d8	ISTD	136	68
Naphthalene	Target	128	129,102
Bis(2-chloroethyl)ether	Target	93	63

GROUP 3 (Dwell – 40-50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Dimethylphthalate	Target	163	194
2-Methylnaphthalene	Target	142	141
1-Methylnaphthalene	Target	142	141
1-Methylnaphthalene-d10	Surrogate	152	76
Acenaphthylene	Target	152	76
Acenaphthene-d10	ISTD	164	162

GROUP 3 (Dwell – 40-50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Acenaphthene	Target	154	152

GROUP 4 (Dwell – 25-30 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Dibenzofuran	Target	168	139
Diethylphthalate	Target	149	177
Fluorene	Target	166	165
Hexachlorobenzene	Target	284	142
N-Nitrosodiphenylamine	Target	169	168
Phenanthrene-d10	ISTD	188	94
Phenanthrene	Target	178	176
Anthracene	Target	178	176

GROUP 5 (Dwell – 50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Di-n-butylphthalate	Target	149	150
Fluoranthene	Target	202	101
Pyrene	Target	202	101
Flouranthene-d10	Surrogate	212	106

GROUP 6 (Dwell – 40 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Butylbenzylphthalate	Target	149	91
Benzo(a)anthracene	Target	228	229
Chrysene-d12	ISTD	240	236
Chrysene	Target	228	229
Bis(2-ethylhexyl)phthalate	Target	149	167
Di-n-octylphthalate	Target	149	150
Benzo(b)fluoranthene	Target	252	253
Benzo(k)fluoranthene	Target	252	253
Benzo(e)pyrene	Target	252	253
Benzo(a)pyrene	Target	252	253
Perylene-d12	ISTD	264	260
Benzo(a)pyrene-d12	Surrogate	264	132
Perylene	Target	252	253

GROUP 7 (Dwell – 100 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Indeno(1,2,3-cd)pyrene	Target	276	138
Dibenz(a,h)anthracene	Target	278	139
Benzo(g,h,i)perylene	Target	276	138

NOTE: Each program must be identical for the Temperature and Pressure programs so that the peak retention times are the same.

E. Tuning

1. The DFTPP tune check standard is used to assess GC column performance and injection port inertness as well as mass spectrometer performance. The GC/MS system's tune is checked by inspecting the mass spectrum of the DFTPP peak and column performance and injection port inertness is evaluated with pentachlorophenol, benzidine, and DDT.

2. The GC/MS should be tuned using a 50 ng/µL solution (12.5 ng/µL for 250 mL analyses) of DFTPP containing decafluorotriphenylphosphine, pentachlorophenol, benzidine, and DDT. This solution is prepared as indicated in *T-SVOA-WI11998*. See the table below for acceptance criteria and corrective actions.

Frequency	Acceptance Criteria	Corrective Action
Prior to initial calibration and every 12 hours prior to continuing calibration standard **NOTE**: Analysis of DFTPP, the LCS, and the blank are outside of the 12-hour analysis shift for method 625.1. The total time for DFTPP, the LCS, the blank, and the 12-hour shift must not exceed 15 hours.	1. Ion Acceptance Criteria: a. 8270C: Criteria in Table I b. 8270D/E/625.1: Criteria in Table II 2. DDT breakdown ≤20%* 3. Tailing factors: a. 8270C: - Benzidine ≤3 - Pentachlorophenol ≤5** b. 8270D/E: - Benzidine ≤2 - Pentachlorophenol ≤2** c. 625.1: - Benzidine <2 - Pentachlorophenol <2**	1. Re-tune. Analysis cannot proceed until tune meets criteria. 2. More aggressive injection port maintenance. 3. Clean the source. 4. Change the column.

*DDT breakdown greater than 20% may be acceptable if calibrating for polynuclear aromatic hydrocarbon (PAH) compounds only. Consult supervisor when this situation occurs.

**Unless project requirements dictate otherwise, the PCP tailing factor may fail acceptance criteria as only compounds with basic or neutral properties are targets of interest by SIM.

3. Use only the background-subtracted spectrum of the following when evaluating the DFTPP:

A three scan average of the apex of the scan, the apex of the scan -1, and the apex of the scan +1.

NOTE: All standards, samples, and associated quality control samples analyzed within a particular tune must use the identical conditions of the mass spectrometer.

F. Initial calibration (ICAL)

1. The initial calibration consists of analyzing standards at 6 concentration levels (0.05, 0.2, 0.5, 1, 5, and 10 ng/µL) (0.01, 0.05, 0.1, 0.5, 1, and 2.5 ng/µL for 250-mL analyses). The initial calibration for 8270D soil and 1L water extractions includes an additional calibration point at 0.01 ng/µL. Response factors are produced for each level. An average response factor is then generated for each compound and surrogate. The relative standard deviation (%RSD) of the response factors determines the suitability of the average relative response factor for calculation of compound concentration. Use of the average relative response factor requires at least four calibration levels. If an alternate fit is required for any compound, at least five calibration levels are required for linear fits, and six calibration levels are required for quadratic fits. At the end of the calibration standard injections, inject the Method Detection Limit (MDL) standard and an initial calibration verification (ICV) standard. See the tables below for acceptance criteria and corrective actions.

ICAL Frequency	Acceptance Criteria	Corrective Action
1. Initially establish with at least 6 levels of standards.	1. %RSD requirements (if these criteria are met, then calculate concentrations based upon the average response factor fit):	1. If the %RSD for any compound is greater than the defined acceptance criteria, use a first degree(linear) fit provided the

2. When % drift in the daily continuing calibration check standard fails criteria.	a. 8270C: %RSD ≤15% b. 8270D/E: %RSD ≤20% c. 625.1: %RSD ≤35% 2. The relative retention time of each target compound in each calibration standard should agree within 0.06 relative retention time units. 3. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer-peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. 4. 8270D/E: See table III for minimum response factors for each compound. It is not necessary to meet these specifications. They are provided merely as guidance. 5. The %Error is measured between the calculated and expected amounts of a compound at each calibration level to determine the calibration function acceptability for linear and quadratic curve fits. The % error must be ≤50% for the low calibration point. For calibration points above the LOQ the % error must be ≤30%. **NOTE:** For 625.1 calibrations, only the low calibration point and the mid-point need to be evaluated.	correlation coefficient (CC; r) is ≥0.995 or the coefficient of determination (COD;r2) is ≥0.99. If the linear fit fails to meet this criteria, then a second order (quadratic) fit may be used provided the coefficient of determination is ≥0.99.* If use of both the linear fit and the quadratic fit is acceptable using these criteria for any given compound, then use the fit with the smallest negative y-intercept. When using a quadratic fit, if the y-intercept quantifies to be greater than the MDL, consult your supervisor immediately or re-calibrate. 2. Re-inject any levels that appear to be outliers due to an injection error. 3. If standard levels on the outside of the curve appear to be outliers for individual compounds and are throwing off the calibration curve, they can be dropped from the calibration keeping the following in mind: a. If a low calibration point is dropped, the analyst must ensure that the compound is still being calibrated down to or below its LOQ. b. If a high calibration point is dropped, any detections must recover below the new upper calibration limit. 4. Re-prep calibration standards. 5. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

*South Carolina does not allow the use of quadratic fits.

MDL Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The system must be able to detect all compounds in the MDL solution.	1. If any compounds are not detected in the MDL standard, analysis can proceed if the compound is detected at or below its MDL in a higher concentration level. 2. If the system does not detect the compound(s), then the tuning and/or calibration procedure must be repeated under conditions that will yield a detection for the compound(s) or the MDL must be raised for the compound(s).

		3. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

NOTE: 625.1 does not require the analysis of an MDL standard as part of the initial calibration.

ICV Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The ICV must be prepared using a second source standard 2. %D requirements: a. 8270C/D/E: ±30%D b. 625.1: Criteria listed under Q in Table VI of this SOP 3. The EICP area for each internal standard must fall within the window of -50% to +100% of the areas from the mid-level calibration standard produced during the initial calibration. Surrogate compounds must be included in the processing list for analysis 625.1 and must meet the same criteria as target compounds.	1. Re-prep and re-analyze the ICV. 2. If the recovery for any compound fails these criteria low, the compound cannot be analyzed for under the calibration until a new ICV has been analyzed. 3. If the recovery for any compound fails these criteria high, the compound may be analyzed for but any samples with detections should be re-analyzed under a valid ICAL or will be reported with a qualifying comment. 4. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

2. One of the calibration standards must be at a concentration at or below the limit of quantitation (LOQ). The other concentrations correspond to the expected range of concentrations found in samples or should define the working range of the GC/MS system.

3. The concentration of the MDL standard may require modification dependent upon the current MDL values.

G. Continuing calibrations

Perform the continuing calibration verification (CCV) by injecting a predetermined aliquot of a calibration standard at a concentration near the mid-point of the calibration, not to exceed ½ the highest level in the calibration. See the table below for acceptance criteria and possible corrective actions.

CCV Frequency	Acceptance Criteria	Corrective Action
1. Every 12 hours. 2. The CCV is analyzed each day a curve is not analyzed. 3. The CCV is analyzed after DFTPP.	1. %Drift: a. 8270C/D/E: ≤20% b. 625.1: Criteria listed under Q in Table VI of this SOP 2. The relative retention times of the internal standards must be within 10 seconds of the retention times from the mid-level calibration standard of the last initial calibration. The exception would be in the case of column maintenance. 3. The EICP area for each internal standard must fall within the window of -50% to +100% of the areas from the mid-level calibration standard produced	1. If the CCV fails and the cause is obvious such as in the case of a concentrated standard or a mis-injection, re-inject the CCV, making sure to select another standard vial if a bad standard is suspected. 2. If the %Drift for any compound is >20% high and it is not detected in samples, data can be reported. 3. If the %Drift for any compound is >20% low, perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* or adjust the tune file. Document the corrective action in the form of a non-conformance memo or with an

	during the last initial calibration. 4. 8270D/E: See Table III for minimum response factors for each compound. It is not necessary to meet these specifications. They are provided merely as guidance. 5. Structural isomers that produce very similar mass spectra are identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved when the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.	internal non-conformance form (*Q-EQA-FRM6869*). Re-inject DFTPP and the calibration standard. If the CCV does not pass after corrective action, a new initial calibration must be established. **NOTE:** For method 8270D, in cases where compounds recover >20%D low, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compounds at the applicable quantitation limit. For situations when the failed compound is present, the concentrations must be reported as estimated values.

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

H. Analysis of Samples

1. All sample extracts are stored at ≤-10°C and protected from light from the time of sample extraction.

2. Prior to sample analysis, add 10 µL of internal standard to each 1.0 mL of sample extract.

3. Analyze a predetermined aliquot of each sample extract under the same conditions used for the initial and continuing calibrations.

4. At the conclusion of data acquisition, use the same software to tentatively identify peaks within the retention time window of interest. Examine the ion abundances of components of the chromatogram. If the ion abundance of the target ion used for quantitation exceeds the calibration range, dilute the aliquot and reanalyze. When preparing dilutions, add sufficient internal standard to maintain the same concentration as that of the ICAL.

a. Dilution criteria

I. Initial dilutions are recommended in the following situations:

i. More than three internal standard recoveries are <50%.

ii. Either of the last two internal standard recoveries are <20%.

iii. The analyst's judgment of a sample extract's color or viscosity indicates possible matrix interference.

II. Secondary dilutions are required to bring all target compounds into the calibration range of the GC/MS.

I. Qualitative Analysis:

A compound is identified by comparison of the following parameters with those of a standard of the suspected compound (standard reference spectra). The reference mass spectrum used for this comparison should be generated by the laboratory using the conditions of the method. In order to verify identification, the following criteria must be met:

1. The sample component relative retention time should compare within ±0.06 RRT units of the RRT of the standard component.

2. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 20% relative intensity if less than three such ions occur in the reference spectrum.

3. The relative intensities of the characteristic ions:

a. 8270C/D/E - The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum,

the corresponding abundance in a sample spectrum can range between 20% and 80%.)

b. 625.1 - The relative intensities of the characteristic ions must agree within 50% to 200% (0.5 to 2 times) for the quantitation and secondary m/z's in the reference mass spectrum stored in the data system. For example, if a peak has an intensity of 20% relative to the base peak, the analyte is identified if the intensity of the peak in the sample is in the range of 10% to 40% of the base peak. Analyst discretion is used to determine compound identification.

4. The above criteria apply to detections greater than or equal to the LOQ. For detections between the MDL and the LOQ, the above criteria and analyst discretion are used to determine compound identification. If identification is ambiguous, an experienced spectrometrist must determine the presence or absence of the compound.

J. Quantitative Analysis:

When a compound has been identified, quantitation is based on the internal standard technique and the integrated abundance from the extracted ion current profile (EICP) of the primary characteristic ion.

Calculations

Refer to *T-SVOA-FRM9602* for all departmental calculations.

Statistical Information/Method Performance

LCS, MS, surrogate, and RPD recoveries are compared to the limits stored in the LIMS. The surrogate recoveries will be compared to statistically generated limits for acceptance criteria for 8270C/D/E and for the surrogate in Table V for 625.1. The LCS and MS recoveries will be compared to statistically generated limits for 8270C/D/E and for all 625.1 compounds contained in Table V. For any compounds not contained in table V, the LCS and MS recoveries will be compared to limits contained in Table VI and the surrogate recoveries will be compared to limits contained in Table VII for 625.1.

LCS and surrogate limits are statistically derived every six months in accordance with *T-SVOA-WI9604*. All RPDs are set to a default value of 30%, and MS limits are set equal to LCS limits.

All current and historical limit data is stored in the LIMS under the methods listed in the header of this SOP. The historical data for MDLs, MS/D, LCS/D, and measurement of uncertainty is reviewed at least annually and kept on file. Refer to the QA/QC section of this SOP and the criteria listed throughout this procedure for additional information on the performance of this method.

Quality Assurance/Quality Control

A. Batch QC

1. Each extraction batch of ≤20 samples must contain a method blank, a laboratory control sample (LCS) and an unspiked background sample (US), a matrix spike (MS), and a matrix spike duplicate(MSD).

2. A laboratory control sample/laboratory control sample duplicate (LCS/LCSD) is prepared with the extraction batch if adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate.

3. Additional QC samples may be required to meet project or state certification requirements.

B. QC and sample spiking

1. The LCS/D and MS/D are spiked at a concentration of 1 ppm.

2. All samples are spiked with surrogates at a concentration of 1 ppm by the extraction group to evaluate the extraction process.

3. Prior to analysis each sample extract is spiked with an internal standard mix.

4. All spiking concentrations are 4x lower for 250-mL aqueous analyses.

C. QC items, acceptance criteria, and corrective actions.

NOTE: If any client, state, or agency has more stringent QC, QC limits, or batch requirements, these must be followed instead.

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards	1. Peak area within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then re-inject sample(s). 2. If re-injection meets the criteria, report this injection. 3. If re-injection still shows the same problem, report first injection. 4. If there is substantial matrix interference, the analyst may dilute the extract as outlined in Procedure H.4.
Method Blank	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All target compounds must be less than the reporting limit for the associated samples. 4. For 625.1 the method blank must be analyzed immediately after the LCS and before the MS/D.	1. Inspect system for possible problems and reanalyze. 2. If the surrogates are out of spec high data can be used provided there aren't detections in the method blank. 3. If the surrogates are out of spec low and there aren't detections in the associated samples, the data can be used.* 4. If the method blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. 5. If the target compounds in the blank are also in the associated samples at a concentration <10x that in the blank, the samples are re-extracted unless the detection does not interfere with project data requirements. 6. If the target compounds in the blank are also in the associated samples at a concentration >10x that in the blank the data is usable. 7. Phthalates may be detected in the method blank and data reported as long as the phthalate detection is <LOQ.

Quality Control Item	Acceptance Criteria	Corrective Action
Instrument Blank**	1. Must run after the CCV if no clean method blank is analyzed at the beginning of the 12-hour analytical period. 2. Must meet internal standard criteria. 3. All target compounds must be less than the reporting limit for the associated samples.	1. Inspect system for possible problems and reanalyze. 2. If the instrument blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. 3. If the target compounds in the blank are also in the associated samples, the samples should be re-extracted unless it does not interfere with project data requirements or if sample detections are at a level 10x higher than the detections in the blank.
Laboratory Control Sample/Laboratory Control Sample Duplicate	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within QC limits. Refer to the analysis numbers in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD recoveries are still outside acceptance limits, one of the following actions must be taken: a. if recoveries are outside acceptance limits low, the sample(s) must be re-extracted. b. if recoveries are outside acceptance limits high, data may be usable if the compounds that recovered above QC limits are not detected in samples. c. if recoveries are outside acceptance limits high and there are detections of the failing compounds, the sample(s) must be re-extracted. 4. If RPDs fail but recoveries are within QC limits, no further action is required. 5. If surrogates fail to meet criteria but all target compounds are within specification, data is usable.* 6. Marginal exceedance limits, as defined in the NELAC standards, may be used if the defined requirements have been met for 8270C/D/E. 7. If surrogates fail to meet criteria but all target compounds are within specification, data is usable. 8. South Carolina requires an aqueous LCS recovery criterion of 70-130% for PAH SIM analysis.

Quality Control Item	Acceptance Criteria	Corrective Action
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within LCS limits. Refer to the analysis number in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries or RPDs out of spec, consult supervisor. BKG, MS, MSD may need to be re-extracted.
Surrogates	1. %Recoveries within QC limits. Refer to the methods in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If no problem is found, re-extract and reanalyze. 4. If surrogates are out of spec high and no targets are detected in the sample no corrective action is required. 5. For samples analyzed only at a dilution ≥10x, no further action is required for surrogate failures.

*Requires approval of supervisor.
**Method blank or instrument blank in each 12-hour analytical period required for 8270E. (an instrument blank is recommended for all methods to demonstrate the instrument is free of contamination)

NOTE: Any failures without corrective action require approval of supervisor and completion of a non-conformance memo (NCM).

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

D. Lower Limit of Quantitation (LLOQ)

1. The lower limit of quantitation (LLOQ) is verified annually through the extraction and analysis of an LCS at 0.5 to 2 times the established LLOQ.
2. The LLOQ is performed on similar analytical instruments such that all are included, at a minimum, within a 3 year time period.
3. Until the laboratory has sufficient data to determine the acceptance limits, the LLOQ criteria is ± 20% of the LCS limits.
4. Refer to *QA-SOP11892* for additional initial and ongoing LLOQ requirements.

E. Method Detection Limit (MDL)

1. Initial MDL studies must contain at least seven replicates and must be prepped across three different calendar days.
2. The MDLs must be analyzed on every instrument used for that analysis across three different calendar days.
3. Two ongoing MDLVs are analyzed and confirmed quarterly on each instrument, and MDLs are updated, if necessary, after enough points have been collected.
4. All compounds in the ongoing MDL verifications must be spiked at the same concentration level as the initial study.
5. Refer to *QA-SOP11892* for additional initial and ongoing MDL requirements.

F. Limit of Quantitation (LOQ)

1. Initial LOQ studies are spiked with compounds at the laboratory assigned LOQ and are analyzed on every instrument used for that analysis.
2. One ongoing LOQV is analyzed and confirmed quarterly on each instrument, and the LOQs are updated, if necessary.
3. Until the laboratory has sufficient data to determine the acceptance limits, the LOQ criteria is ±20% of the LCS limits.
4. Refer to *QA-SOP11892* for additional initial and ongoing LOQ requirements.

Table I

DFTPP Key Ion Abundance Criteria (8270C)

Mass	Ion Abundance Criteria
51	30% to 60% of mass 198
68	less than 2% of mass 69
70	less than 2% of mass 69
127	40% to 60% of mass 198
197	less than 1% of mass 198
198	base peak, 100% relative abundance
199	5% to 9% of mass 198
275	10% to 30% of mass 198
365	greater than 1% of mass 198
441	present but less than mass 443
442	greater than 40% of mass 198
443	17% to 23% of mass 442

Table II

DFTPP Key Ion Abundance Criteria (8270D/E/625.1)

Mass	Ion Abundance Criteria
51	10% to 80% of mass 198
68	less than 2% of mass 69
70	less than 2% of mass 69
127	10% to 80% of mass 198
197	less than 2% of mass 198
198	base peak, or >50% mass 442
199	5% to 9% of mass 198
275	10% to 60% of mass 198
365	greater than 1% of mass 198
441	present but less than 24% of mass 442
442	Base peak, or >50% of mass 198
443	15% to 24% of mass 442

Table III

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification (8270D)

Semivolatile Compounds	Minimum Response Factor (RF)
Naphthalene	0.700
2-Methylnaphthalene	0.400
Dimethylphthalate	0.010
Acenaphthylene	0.900
Acenaphthene	0.900
Dibenzofuran	0.800
Diethylphthalate	0.010
Fluorene	0.900
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Phenanthrene	0.700
Anthracene	0.700
Di-n-butylphthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butylbenzylphthalate	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Benzo(a)anthracene	0.800
Bis(2-ethylhexyl)phthalate	0.010
Di-n-octlyphthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500

Table IV

Semivolatile Internal Standard with Corresponding Analytes Assigned for Quantitation

1,4-Dichlorobenzene-d_4	Naphthalene-d_8	Acenaphthene-d_{10}
1,4-Dioxane	Quinoline	Acenaphthene
Benzenethiol	2-Methylnaphthalene	Acenaphthylene
N-Nitrosodimethylamine	Naphthalene	Diethyl phthalate
	Bis(2-chloroethyl)ether	Dimethyl phthalate
	1-Methylnaphthalene	Fluorene
	1-Methylnaphthalene-d10 (surr)	Dibenzofuran

Semivolatile Internal Standard with Corresponding Analytes Assigned for Quantitation

Phenanthrene-d_{10}	Chrysene-d_{12}	Perylene-d_{12}
Anthracene	Pyrene	Benzo(b)fluoranthene
Phenanthrene	Benzo(a)anthracene	Benzo(k)fluoranthene
Di-n-butyl phthalate	Bis(2-ethylhexyl) phthalate	Benzo(g,h,i)perylene
Fluoranthene	Butyl benzyl phthalate	Benzo(a)pyrene
Hexachlorobenzene	Chrysene	Benzo(a)pyrene-d12 (surr)
N-Nitrosodiphenylamine		Dibenz(a,h)anthracene
Fluoranthene-d10 (surr)		Indeno(1,2,3-cd)pyrene
		Di-n-octylphthalate
		Benzo(e)pyrene
		Perylene

(surr) = surrogate

Table V

625.1 Analytes and Surrogate that use statistical limits

1,4-Dioxane
1-Methylnaphthalene
2-Methylnaphthalene
Dibenzofuran
N-Nitrosodimethylamine
1-Methylnaphthalene-d10 (surr)

(surr) = surrogate

Table VI

Table 6 – QC Acceptance Criteria – Method 625 [1]					
Analyte	**Range for Q (%) [2]**	**Limit for s (%) [3]**	**Range for X (%) [3]**	**Range for P_1, P_2(%) [3]**	**Limit for RPD (%)**
Acenaphthene	70-130	29	60-132	47-145	48
Acenaphthylene	60-130	45	54-126	33-145	74
Anthracene	58-130	40	43-120	27-133	66
Benzo(a)anthracene	42-133	32	42-133	33-143	53
Benzo(b)fluoranthene	42-140	43	42-140	24-159	71
Benzo(k)fluoranthene	25-146	38	25-146	11-162	63
Benzo(a)pyrene	32-148	43	32-148	17-163	72
Benzo(ghi)perylene	13-195	61	10-195	10-219	97
Benzyl butyl phthalate	43-140	36	10-140	10-152	60
bis(2-Chloroethyl)ether	52-130	65	43-126	12-158	108
bis(2-Ethylhexyl) phthalate	43-137	50	29-137	10-158	82
Chrysene	44-140	53	44-140	17-168	87

Dibenz(a,h)anthracene	13-200	75	10-200	10-227	126
Di-n-butyl phthalate	52-130	28	10-120	10-120	47
Diethyl phthalate	47-130	60	10-120	10-120	100
Dimethyl phthalate	50-130	110	10-120	10-120	183
Di-n-octyl phthalate	21-132	42	19-132	10-146	69
Fluoranthene	47-130	40	43-121	26-137	66
Fluorene	70-130	23	70-120	59-121	38
Hexachlorobenzene	38-142	33	10-142	10-152	55
Indeno(1,2,3-cd)pyrene	13-151	60	10-151	10-171	99
Naphthalene	70-130	39	36-120	21-133	65
Phenanthrene	67-130	24	65-120	54-120	39
Pyrene	70-130	30	70-120	52-120	49

[1] Acceptance criteria are based upon method performance data in Table 7 and from EPA Method 1625. Where necessary, limits for recovery have been broadened to assure applicability to concentrations below those used to develop Table 7.
[2] Test concentration = 100 µg/mL
[3] Test concentration = 100 µg/L
Q = Calibration verification
s = Standard deviation for four recovery measurements in the DOC test.
X = Average recovery for four recovery measurements in the DOC test.
P_1, P_2 = MS/MSD recovery.
RPD = MS/MSD relative percent difference.

Table adapted from EPA method 625.1

Table VII

Surrogate Standard Acceptance Limits - Method 625		
Surrogate	**Range for Surrogate Recovery (%) [1]**	
	Calibration verification	**Recovery from samples**
Benzo(a)pyrene-d12	32-194	32-194
Fluoranthene-d10	47-215	30-187

[1] Recovery from samples is the wider of the criteria in the CLP SOW for organics or in Method 1625

Q-EQA-FRM6869 Nonconformance Form
QA-SOP11178 Demonstrations of Capability
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
T-OE-SVOA-WI10925 Sonic Probe Extraction Procedure by EPA 3550C in Solids for the Determination of Semivolatiles by SIM
T-OE-SVOA-WI10928 Microwave Extraction by Method 3546 for Semivolatiles
T-OE-SVOA-WI10931 Separatory Funnel Extraction by Method 3510C for BNAs by 8270 SIM in Wastewater
T-OE-SVOA-WI10947 Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1
T-SVOA-FRM9602 Dept 4026 Calculations
T-SVOA-WI11998 Semivolatile Spiking and Calibration Standards
T-SVOA-WI9594 GC/MS Semivolatile Audit Process
T-SVOA-WI9598 GC/MS Preventative and Corrective Maintenance
T-SVOA-WI9604 Monitoring GC/MS Semivolatile QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information
16	11.NOV.2019	
17	25.MAR.2020	
18	07.JUL.2020	

Eurofins Document Reference	EFAFS-T-AFS-SOP2807	**Revision**	12
Effective Date	04/11/2020	**Status**	Final
Historical/Local Document Number	FGS-066		
Local Document Level	Level 3		
Local Document Type	SOP		
Local Document Category	NA		

Prepared by	David Wunderlich
Reviewed and Approved by	David Wunderlich and Patrick Garcia-Strickland

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1 Revision Log:

Revision: 12	Effective Date: This version	
Section	**Justification**	**Changes**
2.4	Required	Updated reference
3	Required	Added link to SOP5133
14.6	Required	Corrected the recipe for the preparation of 0.2N BrCl

2 Reference:

2.1 EPA Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, 2002.

2.2 Appendix to Method 1631 - Total Mercury in Tissue, Sludge, Sediment and Soil by Acid Digestion and BrCl Oxidation, 2001.

2.3 TNI Environmental Laboratory Sector, Vol 1, Management and Technical Requirements, ELV1-2016.

2.4 Department of Defense / Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, prepared by DoD Environmental Data Quality Workgroup (EDQW) and DOE Consolidate Audit Program (DOECAP) Data Quality Workgroup (DOE-DQW), Version 5.3, May 2019.

3 Cross Reference:

Document	Document Title
EFQA-Q-QM-QM5805	Quality Manual
EFHS-S-HS-12066	Chemical Hygiene Plan
EFAFS-T-AFS-SOP5133	Total Solids and Density Determination
EFQA-Q-QD-SOP10098	Procedures for Determining IDLs, MDLs, LODs, LOQs, OPRs, IQs, OQs, and PQs
EFQA-R-EQ-SOP2711	Pipette and volumetric dispenser Verification, Calibration and Maintenance
EFSR-S-CS-SOP2794	Ultra Clean Aqueous Sample Collection
EFQA-P-DR-SOP2801	Data Review and Validation
EFHS-S-HS-SOP2991	Waste Disposal Procedure for Client Sample Waste
EFAFS-T-AFS-SOP2821	HF/HNO_3 /HCl Bomb Digestion of Sediments, Soils, Rocks, and Other Solids for Mercury, followed by Repeated HNO_3 Evaporation for other Metals
EFAFS-T-AFS-SOP2822	Determination of Total Mercury in Various Matrices by Flow Injection Atomic Fluorescence Spectrometry (EPA Method 1631E)

4 Purpose:

4.1 The purpose of this Standard Operating Procedure (SOP) is to describe the method for digesting geological samples (sediments and soils) and carbon (coal) samples prior to analysis for total mercury.

5 Scope:

5.1 This is a strong acid digestion procedure for the preparation of sediments, soils, and other

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types of solid materials prior to analysis for total mercury. If other metals besides Hg are to be analyzed as well, the preferred digestion is the HF/HNO_3 bomb digestion method (SOP *EFAFS-T-AFS-SOP2821*, "HF/HNO_3 /HCl Bomb Digestion of Sediments, Soils, Rocks, and Other Solids for Mercury, followed by Repeated HNO_3 Evaporation for other Metals"). Modified aqua regia is particularly capable of solubilizing cinnabar (HgS).

6 Basic Principles:

6.1 Modified aqua regia is not simply a mixture of the two acids. Rather, the oxidizing action of concentrated HNO_3 on HCl results in the formation of nitrosyl chloride (NOCl) and free Cl_2, which are particularly strong oxidizers for noble metals and metal-sulfide minerals. Modified aqua regia only exists as a concentrated acid species—dilution of modified aqua regia with water destroys its unique oxidizing capability, rendering it a simple mixture of HNO_3 and HCl. Furthermore, modified aqua regia loses its strength rapidly after preparation because of the loss of Cl_2 to the atmosphere. Modified aqua regia must therefore always be prepared fresh at the time of use.

6.2 This method involves leaching the sample overnight with modified aqua regia (4:1 HCl/HNO_3) at room temperature.

6.3 This procedure must be performed in a fume hood due to the copious quantities of noxious fumes, including, but not limited to, Cl_2, which are generated during this process.

6.4 Prior to digestion, samples must be homogenized as thoroughly as possible.

6.5 If dry weight correction is required, a separate aliquot of the samples are accurately weighed into small aluminum foil weighing dishes, dried for at least 12 hours at 103-105℃, and then weighed again according to *EFAFS-T-AFS-SOP5133*.

7 Reference Modifications:

7.1 No significant modifications were made to this method.

8 Definitions:

8.1 Batch – no more than 20 client samples grouped for preparation. 3 Preparation Blanks, 1 CRM or 1 LCS/LCSD (or BS/BSD) set are prepared per every 20 samples; 1 MS/MSD set is prepared for every 10 samples.

8.2 Celsius (C), conversion of Celsius to Fahrenheit: (C * 1.8) + 32.

8.3 Fahrenheit (F), conversion of Fahrenheit to Celsius: (F - 32) * 5/9

8.4 Method Detection Limit (MDL) – the limit derived from an exercise as described in 40 CFR, Part 136, Appendix B. The exercise produces a defined value that is the minimum concentration that can be measured and reported with 99% confidence that the analyte concentration is greater than zero from a given matrix.

8.5 Certified Reference Material (CRM) – a standard of known composition that is certified by a recognized authority and representing a sample matrix. It is used to verify the accuracy of a method.

8.6 Blank Spike (BS) and Blank Spike Duplicate (BSD), is a QC sample containing known concentrations of the analytes of interest that is taken through the entire preparation and analysis process in the same manner as the samples to monitor complete method performance.

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8.7 Method or Preparation Blank (BLK) – Method blanks consist of the same reagents used to digest the samples, in the same volume or proportion, and are carried through the complete sample preparation and analytical procedure.

8.8 Matrix Spike (MS) and Matrix Spike Duplicate (MSD) – a representative sample is selected and should be spiked with a secondary source at *two* to five times the ambient concentration or at five times the MRL, whichever is greater These QC samples will indicate sample matrix effects on the analytes of interest.

8.9 May: This action, activity, or procedural step is optional.

8.10 May Not: This action, activity, or procedural step is prohibited.

8.11 Shall: This action, activity, or procedure is required.

8.12 Should: This action, activity, or procedure is suggested, but not required.

9 Interferences:

9.1 All free halogens in a sample must be reduced prior to purging onto gold traps, or the traps will be destroyed. For small aliquots of digest, this is accomplished by adding $SnCl_2$.

9.2 Low recoveries will result for carbon materials such as coal and iodated carbon traps unless the final solution contains > 40% acid, it remains oxidizing, and all carbon particles are settled out of the aliquot to be analyzed. Low recoveries result from re-adsorption of metals to the carbon particles, which can occur in the digest, after dilution. Following this SOP accurately will avoid this source of error.

9.3 Modified aqua regia is a leaching method and as such does not dissolve silicate minerals. Thus, crustal elements such as Fe, Al, Cr, Ba, and Si will not be quantitatively recovered in most media using this procedure.

10 Safety Precautions, Pollution Prevention and Waste Handling:

10.1 Personnel will don appropriate laboratory attire according to the Chemical Hygiene Plan (*EFHS-S-HS-12066*). This includes, but is not limited to, laboratory coat, eye protection, and protective gloves.

10.2 The toxicity or carcinogenicity of reagents used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable. Chemists should refer to the SDS (Safety Data Sheets) for each chemical they are working with.

10.2.1 Note: Use particular caution when preparing and using BrCl, as it releases extremely irritating, corrosive fumes similar in effect to free chlorine. Always handle this reagent in an approved fume hood.

10.2.2 Note: Modified aqua regia is very hazardous! Always work in fume hood wearing safety goggles and gloves while using this chemical.

CAUTION: THIS MIXTURE GETS HOT AND EMITS CAUSTIC FUMES.

10.3 All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against known disease-causative agents. Frontier will reimburse the expense of Hepatitis A and B immunizations for any laboratory staff member who desires this protection.

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10.4 Hydrochloric acid: Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion. Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. For more information see SDS.

10.5 Nitric acid (HNO_3): Corrosive. Strong oxidizer. Contact with other material may cause a fire. Causes eye and skin burns. May cause severe respiratory tract irritation with possible burns. For more information see SDS.

10.6 See Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP) for general information regarding employee safety, waste management, and pollution prevention.

10.7 Pollution prevention information can be found in the current Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP), which details and tracks various waste streams and disposal procedures.

10.8 All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations. Any waste generated by this procedure should be disposed of according to SOP *EFHS-S-HS-SOP2991* "Waste Disposal Procedures for Client Sample Waste," which provides instruction on dealing with laboratory and client waste.

11 Personnel Training and Qualifications:

11.1 An analyst and technician must perform an initial demonstration of capability (IDOC) that includes four replicates of a secondary source spiked at 8 ng/g before being qualified to analyze samples without supervision. Recoveries for the IDOC need to be 79-121% with an RSD of < 20%. Continuing DOC will be maintained and monitored via performance on CRMs and other QC samples, as well as obtaining acceptable results on proficiency testing exercises.

11.2 The analyst/laboratory technician must have read this SOP and other relevant SOPs and have the training documented on the applicable form(s). The analyst may be questioned on SOP by supervisor(s) and/or trainers.

11.3 Training is documented by the employee and supervisor, and is kept on file in the QA Office. The employee must read, understand, and by signing the training document, agree to perform the procedures as stated in all Standard Operating Procedures (SOPs) related to this method.

11.4 All employees must read the Quality Manual (QM) and complete annual Ethics training.

11.5 All training documents including IDOCs, CDOCs, Initial QA orientation, and Ethics training are stored by the Quality Assurance Manager in the employees training file for ten years after the employee is no longer working for Frontier Global Sciences.

11.6 Chemical Safety Training, Compressed Gas Training, Chemical Hygiene Plan documentation, and Shipping of Hazardous goods training, are stored by the Health and

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Safety Officer for ten years after the employee is no longer working for Frontier Global Sciences.

12 Sample Collection, Preservation, and Handling:

12.1 Sediment, soil, and other geological samples must be collected in accordance with established ultraclean sampling techniques (see e.g. *EFSR-S-CS-SOP2794* "Ultra Clean Aqueous Sample Collection"). Samples may be placed in commercially available clean glass containers with Teflon-lined caps (i.e., I-Chem glass jars), or 125-mL or 250-mL HDPE jars.

12.2 Soil and sediment samples must be frozen at < □11 □C. Maximum holding time is 180 days at < □11 □C.

12.3 For Wisconsin, sediment samples will be refrigerated upon receipt and then homogenized, prepared and analyzed within 28 days of collection.

13 Apparatus and Equipment:

13.1 Digestion Vials: In most cases, this digestion is performed in tested-cleaned (i.e., I-Chem series 300 or equivalent) 40.0-mL borosilicate glass vials with Teflon lined caps.

13.2 Pipettors: Hydrochloric and nitric acids are conveniently dispensed separately from all glass or glass and Teflon bottle-top repetitive pipettors (10-mL size Re-Pipette or equivalent). Pipettes are to be calibrated according to SOPs *EFQA-R-EQ-SOP2711*.

13.3 Clean hood.

13.4 Analytical Balance: A laboratory analytical balance capable of weighing to ± 1 mg, with documented calibration.

13.5 Sample Digestion Log (LOG-HG-013) logbook.

13.6 Plastic or glass tools for homogenization.

13.7 Tongue Depressors and/or paper scoops.

13.8 Teflon boiling chips.

13.9 Centrifuge operating at 2000 RPM.

13.10 0.45-□m disposable filters.

14 Reagents and Standards:

14.1 Reagent Water: 18 M□ ultra-pure deionized water starting from a pre-purified (distilled, R.O., etc.) source. As a final mercury and organic removal step, the activated carbon cartridge on the 18-M□ system is placed between the final ion exchange bed and the 0.2 µm filter.

14.2 Nitric Acid (HNO3): Several brands (Baker, Fisher, Omnitrace) have been found to have lots with acceptably low levels of trace metals. This reagent should be from a lot number that has been previously tested to be low for the analytes of interest. This reagent shall be entered into LIMS and the expiration date is set to the same as the manufacturer's expiration date.

14.3 Hydrochloric Acid (HCl): Trace metal purified reagent-grade HCl is pre-analyzed to < 50

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ng/L Hg and lot sequestered and before purchase. This solution shall be entered into LIMS and is considered stable until the expiration date on the bottle, 6 months from receipt.

14.4 Potassium Bromide (KBr), neat: This reagent is pre-certified by the vendor to be low in mercury. Reagent shall be entered into LIMS with a five year expiration date.

14.5 Potassium Bromate ($KBrO_3$), neat:

This reagent is pre-certified by the vendor to be low in mercury. Reagent shall be entered into LIMS with a five year expiration date.

14.6 0.2N Bromine Monochloride (BrCl):

14.6.1 27 g of KBr is added to a 2.5 L bottle of concentrated HCl (pre-analyzed and below 5 ng/L Hg). The bottle is inverted in a fume hood to mix the acid and KBr. The solution sits overnight, allowing the KBr to dissolve.

14.6.2 38 g of KBrO3 (certified to be low in Hg) is slowly added to the acid. As the KBrO3 is added, the solution should go from yellow to red to orange.

CAUTION: This process generates copious quantities of free halogens (Cl_2, Br_2, BrCl) which are released from the bottle. Add the $KBrO_3$ SLOWLY in a well operating fume hood.

14.6.3 Loosely cap the bottle and allow to sit for at least 1 hour in a fume hood before tightening. Once tightly capped, invert bottle to make sure all of the solids go into solution.

14.6.4 The BrCL solution must be tested by analyzing a prepared 0.5% solution. The result must be < 0.20ng/L.

14.6.5 The expiration time for this reagent is set by default to six months in LIMS. There is no suggested expiration date in EPA method 1631E, therefore it can be extended, as long as the primary reagent has not expired. The mercury concentration of the BrCl is monitored through the preparation of water preparation blanks.

14.7 0.07 N (35%) Bromine Monochloride. Dilute 330 ± 40 mL of the 0.2 N BrCl solution to 1.0 L with reagent water in a 1000-mL Teflon bottle.

14.7.1 Reagent shall be entered into LIMS with a six months expiration date.

14.8 5% (v/v) of 0.2N BrCl: 125 ± 40 mL of 0.2N BrCl is diluted up to 2.5 L with reagent water in a clean, empty HCl bottle. This bottle is fitted with a 50 mL repipettor.

14.8.1 Reagent shall be entered into LIMS with a six months expiration date.

15 Procedures:

15.1 Obtain samples from the designated refrigerator or freezer. All samples must be completely thawed before homogenizing and weighing out. All tools used for homogenization and weighing must be new, unused disposable tools or cleaned thoroughly between samples with one 10% HCl acid bath and one reagent bath.

15.2 Weigh a 0.5g to 1.0g aliquot for common, low-level or large-grain samples. Place the aliquot directly into a 40-mL digestion vial.

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15.2.1 Batch requirements for this digestion limit the number of samples to 20. In each batch, there must be three method blanks (BLKs), a Blank Spike and Blank Spike Duplicate (BS/BSD, liquid spike, prepared at 8 ng/g), and a Matrix Spike and Matrix Spike Duplicate (MS/MSD). The customary spiking volume used for the MS is 200 uL of 1000 ng/mL. A certified reference material should also be added to the batch if available and representative of the sample matrix.

15.3 Add 8 mL of concentrated HCl and swirl the sample to wet all particles. Next, add 2 mL of concentrated HNO_3, swirl, and LOOSELY cap the vials.

15.4 Allow the loosely capped samples to digest in the fume hood at room temperature for at least 4 hours, or preferably overnight. Tightening the caps or heating the samples can cause the vials to explode. At temperatures cooler than 18 □C the reaction is less vigorous so there may be a longer digestion time. At temperatures higher than 25℃, the reaction can generate much free chlorine, causing some samples to foam over.

15.5 After digestion is complete, dilute soil or sediment digestions by adding 30 mL of 5% solution of 0.2 N BrCl. Shake vigorously and allow settling until the supernatant is clear prior to analysis.

15.6 For coal and other carbon materials, dilute the samples with 0.07 N BrCl solution (35% v/v). This ensures that of Hg will not re-adsorb to the carbon particles, producing low recoveries. Be sure that all finely grained particles are completely settled prior to analysis. This settling can be hastened by centrifuging for 20 minutes at 2000 RPM or by pre-filtering the sample through 0.45-□m disposable filters.

Caution: when adding BrCl to modified aqua regia, be aware of possible rapid bubble formation and foaming out of the vial. This is particularly a problem with carbon media, warm digests, and samples that have only been digested for a few hours

15.7 Analysis for total mercury is according to Eurofins Frontier SOP *EFAFS-T-AFS-SOP2822.*

16 Calculations:

16.1 This preparation procedure does not involve calculations.

17 Statistical Information/Method Performance

17.1 Method Detections Limits (MDL) are determined during method development and then annually thereafter according to 40 CFR Part 136, Section B and and *EFQA-Q-QD-SOP10098.*

17.2 The Practical Quantitation Limit (PQL) is the reporting limit for this method and is included as the lowest calibration point (2003 NELAC regulation 5.5.5.2.2.1.h.3). The PQL is determined by running ten replicate samples with a concentration the will produce a recovery of 70-130% for most analytes, but the recovery requirements are analyte dependent. The PQL is referred to as the Method Reporting Limit (MRL) in LIMS.

17.3 The current values for THg in sediments prepared by a Cold Modified Aqua Regia Digestion are 0.11 ng/g for the MDL and 1.00 ng/g for the PQL.

17.4 Current MDLs and PQLs are stored at: \General and Admin\Quality Assurance\MDLs & PQLs.

18 Quality Assurance/Quality Control:

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18.1 Maximum Sample Batch Size: 20 samples.

18.2 Preparation Blanks: Minimum of three per batch. The preparation blanks are prepared with a similar mass of Teflon boiling chips as the samples, with the same reagents, and put through the same preparation process as the samples. The LIMS ID or lot # of the Teflon boiling chips is documented in the digestion logbook. Each preparation blank must be less than one-half the PQL for the method.

18.3 Certified Reference Material (CRM, representing the sample matrix when commercially available); One per batch if available.

18.4 Blank Spike (BS) and Blank Spike Duplicate (BSD): For every set of 20 samples or less, a blank spike and blank spike duplicate (BS1/BSD1) - made from spiking a liquid standard onto Teflon boiling chips - are digested. The LIMS ID or lot # of the Teflon boiling chips is documented in the digestion logbook.

18.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples: One set per 10 samples.

18.6 Follow the flow charts in SOP *EFQA-P-DR-SOP2801* "Data Review and Validation" to determine if any QC falling outside the established control limits can be qualified.

18.7 All of the quality control limits for the analysis method are included on the "Data Review Checklist."

18.7.1 The data review checklists are located at: \\cuprum\General and Admin\Quality Assurance\Data Review\Current Data Review Checklists.

19 Corrective Action:

19.1 A failing QC point does not necessary fail the entire dataset. If upon analysis a QC sample is out of control, some investigation must be performed to assess if the difficulties are related to matrix effects. The cause and method of determining the set's failure must be documented on the checklist and in the MMO notes, and the Group Supervisor shall be informed. See SOP *EFQA-P-DR-SOP2801* "Data Review and Validation" for flow charts regarding analytical issues.

19.2 If there is any question as to the completeness of the digestion procedure, the samples must be allowed to react for an additional amount of time. If there is no change in the sample, the digestion is considered complete and can be diluted.

EFAFS-T-AFS-SOP2822 Determination of Total Mercury in Various Matrices by FI-AFS
EFAFS-T-AFS-SOP5133 Total Solids and Density Determination
EFHS-S-HS-12066.0004 Chemical Hygiene Plan
EFHS-S-HS-SOP2991 Waste Disposal Procedures for Client Sample Waste
EFQA-P-DR-SOP2801 Data Review and Validation and Monthly Logbook Reviews
EFQA-Q-QD-SOP10098 Procedures for Determining IDLs, MDLs, LODs, PQLs, LOQs, OPRs, IQs, OQs and PQs
EFQA-Q-QM-QM5805 Quality Manual
EFQA-R-EQ-SOP2711 Pipette and Dispenser: Operation, Calibration & Maintenance
EFSR-S-CS-SOP2794 Ultra-Clean Aqueous Sample Collection
EFTM-T-TM-SOP2821 HF/HNO3/ HCl Bomb Digestion of Solids for Total Mercury Followed by Repeated HNO3 Evaporation for Other Metals

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End of document

Version history

Version	Approval	Revision information
10	09.NOV.2016	
11	08.MAR.2018	
12	21.FEB.2020	

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Eurofins Document Reference	EFAFS-T-AFS-SOP2822	**Revision**	7
Effective Date	11/6/2020	**Status**	Final
Historical/Local Document Number	FGS-2822		
Local Document Level	Level 3		
Local Document Type	SOP		
Local Document Category	NA		

Prepared by	Bryn Fada
Reviewed and Approved by	Terri Torres and Patrick Garcia-Strickland

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1 Revision Log:

Revision: 07	Effective Date: This version	
Section	**Justification**	**Changes**
2.13	Required	Updated reference
3	Undated	Added link to Standard SOP
8.13	Update	Added clarification to definition of IPR
8.17	Update	Updated LOD definition
14.2-12.8	Update	Removed info regarding the receipt, prep, and storage of standards and added link to new standard SOP. Reorganized and renumbered sections
14.4	Required	Corrected the recipe for the preparation of 0.2N BrCl
14.7.11	Required	Updated NIST 1641 standard (d to e)
16.2.7, 16.2.8	Required	Deleted these sections since they weren't used
16.8.3.1.2	Required	Added note about carryover prevention
18.1	Required	referenced new MDL requirements
19.4	Required	Reworded to clarify MD's aren't required
19.15	Required	Added carryover section. Blank now required after samples over 200 ng/L only.

2 Reference:

2.1 EPA Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, 2002.

2.2 Method 1669, "Method for Sampling Ambient Water for Determination of Metals at EPA Ambient Criteria Levels," U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Engineering and Analysis Division (4303), 401 M Street SW, Washington, DC 20460, April 1995 with January 1996 revisions.

2.3 Bloom, N.S.; Ultra-Clean Sample Handling, Environmental Lab 1995, March/April, 20.

2.4 Bloom, N.S.; Horvat M., and Watras C.J. Results of the International Mercury Speciation Intercomparison Exercise. Wat. Air Soil Pollut. 1995, 80, 1257.

2.5 Bloom, N.S.; Crecelius, E.A. Determination of Mercury in Seawater at Sub-nanogram per Liter Levels.Mar.Chem.1983, 14, 49.

2.6 Bloom, N.S.; Crecelius, E.A. Distribution of Silver, Lead, Mercury, Copper, and Cadmium in Central Puget Sound Sediments Mar. Chem 1987, 21, 377-390.

2.7 Bloom, N.S.; Fitzgerald, W.F. Determination of Volatile Mercury Species at the Picogram Level by Low-Temperature Gas Chromatography with Cold-Vapor Atomic Fluorescence Detection. Anal. Chem. Acta. 1988, 208, 151.

2.8 Cossa, D.; Couran, P. An International Intercomparison Exercise for Total Mercury in Seawater. App.Organomet. Chem.1990, 4, 49.

2.9 Fitzgerald, W.F.; Gill, G.A. Sub-Nanogram Determination of Mercury by Two-Stage Gold

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Amalgamation and Gas Phase Detection Applied to Atmospheric Analysis. Anal. Chem. 1979, 15, 1714.

2.10 Gill, G.A.; Fitzgerald, W.F. Mercury Sampling of Open Ocean Waters at the Picogram Level Deep Sea Res.1985, 32, 287.

2.11 Chapter NR 149, Lab Certification and Registration, Wisconsin Administrative Code.

2.12 TNI Environmental Laboratory Sector, Vol 1, Management and Technical Requirements, ELV1-2016.

2.13 Department of Defense / Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, prepared by DoD Environmental Data Quality Workgroup (EDQW) and DOE Consolidate Audit Program (DOECAP) Data Quality Workgroup (DOE-DQW), Version 5.3, May 2019.

3 Cross Reference:

Document	Document Title
EFQA-Q-QM-QM5805	*QA Manual*
EFQA-Q-QD-SOP10098	*Procedures for Determining IDLs, MDLs, LODs, PQLs, LOQs, OPRs, IQs, OQs, and PQs*
EFQA-R-MT-SOP2710	Balance Verification, Calibration and Maintenance
EFQA-R-EQ-SOP2711	Pipette and Volumetric Dispenser Verification, Calibration and Maintenance
EFAFS-S-SB-SOP5132	Cleaning of Sampling Equipment and Bottles
EFSR-S-CS-SOP2794	Ultra Clean Aqueous Sample Collection
EFTM-T-TM-SOP2839	*Stock and Prepared Standards*
EFAFS-T-AFS-SOP2985	Digestion of Gas/Air Samples Collected on FSTM Traps
EFAFS-T-AFS-SOP2800	Digestion of KCL Traps for Total Mercury
EFAFS-T-AFS-SOP2795	Digestion of Tissues for Total Mercury Analysis Using Nitric and Sulfuric Acids (70:30)
EFQA-P-DR-SOP2801	Data Review and Validation and Monthly Logbooks Reviews
EFTM-T-TM-SOP2837	Total Metals Digestion for Animal or Plant Tissues
EFAFS-T-AFS-SOP2807	Preparation of Solid Samples for Total Mercury Analysis by Modified Cold Aqua-Regia Digestion
EFHS-S-HS-SOP2991	Waste Disposal Procedures for Client Sample Waste
EFAFS-T-AFS-SOP2821	HF/HNO3/HCl Bomb Digestion of Sediments, Soils, Rocks, and Bayer Process Solids and Slurries for Mercury, followed by Repeated HNO3 Evaporation

4 Purpose:

4.1 This standard operating procedure (SOP) describes a method for the determination of total mercury (Hg) in a wide range of matrices including, but not limited to, aqueous, biological, and geological media. Total mercury is measured by Flow Injection Atomic Fluorescence Spectrometry and is calculated on a concentration (ppt) basis by comparing the instrument response of samples to the instrument response of standards.

4.2 This SOP is designed to ensure that reproducible traceable procedures are followed in the standardization of the total mercury analyzers and in the analysis of samples for total mercury, as well as to establish the limits wherein data will be considered acceptable.

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5 Scope:

5.1 This method is designed for the determination of mercury in the typical range of 0.5-40ng/L (ppt). Application may be extended to higher levels by sample dilution, as long as the instrument value (intensity) remains within the calibration curve.

5.2 This SOP describes a method of the determination of mercury species in aqueous and solid matrices (biological tissue, plant tissue, nutraceutical, etc.).

6 Basic Principles:

6.1 Total mercury analyses are split into two categories: waters and solids. For analysis of aqueous samples, a dilution (up to 1x) of oxidized sample is added to a 50mL vial. If less than 30mL of sample is used, the sample is diluted to a final volume of at least 30mL with 1% BrCl. For solids, a dilution is made of the digested sample by pipetting into a 50mL vial and diluting it to 50mL with 1% BrCl. In the case of waters and solids, the final volume is neutralized with 25uL of 25% hydroxylamine-hydrochloride (NH_2OH-HCl). Approximately 25mL of sample is drawn into the system by an auto sampler. (Please refer to Figure 1. for a detailed system flow diagram of the Tekran 2600 analysis system.) Sample is then mixed with 3% stannous chloride ($SnCl_2$) reducing Hg^{2+} to Hg^0 before entering the phase separator.

6.2 As sample travels down the phase separator Hg0 is liberated by a counter flow of ultra pure argon (or nitrogen). Mercury then travels through a soda-lime acid vapor trap, a switching valve (V2), and amalgamates onto the fixed "sample trap". Following primary amalgamation V2 is triggered, switching on the flow of pure argon through the sample trap. At the same time the sample trap is heated, and mercury is released into the pure argon gas stream, passing through a second switching valve (V1) and amalgamating onto the "analytical trap". The analytical trap is then heated releasing mercury into the AFS detector. All event timing and peak integration is carried out via a PC running TekMDS-2 software running the EPA 1631 event timing file (ETF). NOTE: This method may also be run using 15ml vials and selecting the appropriate ETF with in the TekMDS-2 software. Sample must fill the vial up to the 15ml mark. All other procedures, reagent concentrations, and dilutions should be kept the same.

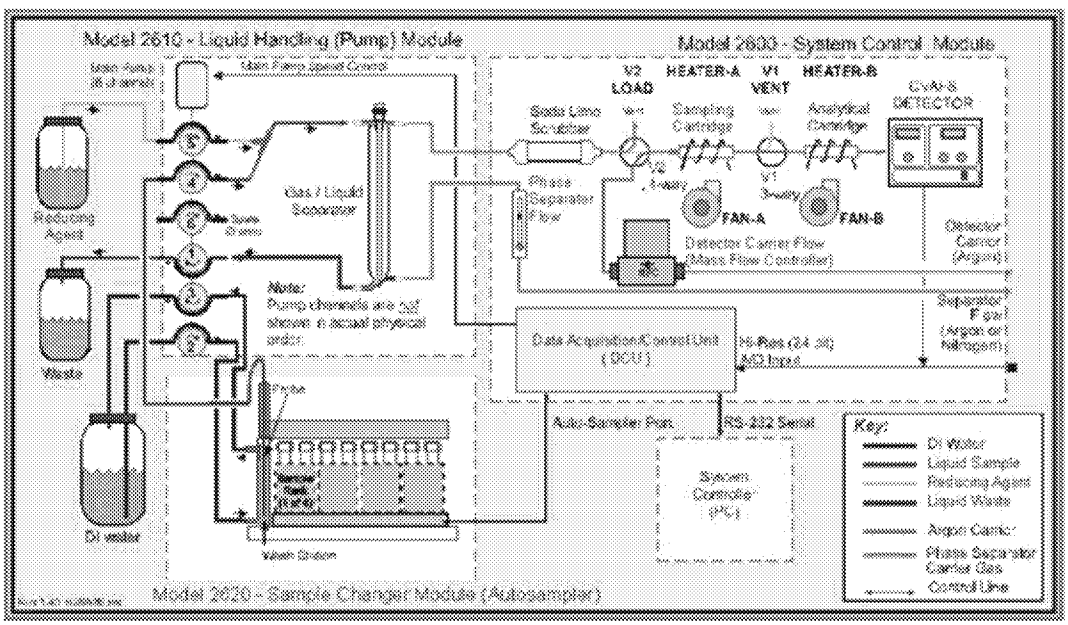

Figure 1 – Tekran 2600 Flow Diagram

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7 Reference Modifications:

7.1 There were no significant modifications made to this method.

8 Definitions:

8.1 Analytical Duplicate (AD): A representative sample (that yielded a result within the calibration curve) is analyzed a second time during the analytical run. The second analysis should be at the same aliquot as the original.

8.2 Analytical Run – The continuous analysis of one or more batches during the same 12 hour-shift. Each analytical day requires 3 IBLs, a minimum five-point calibration curve, ICV, and CCV/CCB every ten runs. An analytical day must conclude with a CCV/CCB.

8.3 Analytical Spike and Analytical Spike Duplicate (AS/ASD): A representative sample is selected and spiked, with a dilution of the primary source, during the analytical run, at a target concentration of 1-5X the ambient concentration of the sample. These QC samples are used to indicate sample matrix effects on the analyte of interest. Non-detectable samples are spiked at 5x the MRL/PQL.

8.4 Batch: 20 client samples or less grouped for preparation. See Quality Assurance Section for batch requirements.

8.5 Calibration Standards (CAL) – a series of non-zero standards that will be used to calibrate the instrument, made from a primary source stock standard. Three calibration blanks plus at least five different concentrations are required, beginning with one at PQL concentration or lower.

8.6 Certified Reference Material (CRM) – a standard of known composition that is certified by a recognized authority and representing a sample matrix. It is used to verify the accuracy of a method.

8.7 Continuing Calibration Verification (CCV): A dilution of the OPR standard resulting in an instrumental concentration of 5.0ng/L. This standard is analyzed every 10 analyses after the ICV, and determines whether the instrument is maintaining calibration.

8.8 Continuing Demonstration of Capability (CDOC): Acceptable performance on a PT sample or a new IDOC or a set of four (4) consecutive blank spike or laboratory control sample aliquots [prepared according to a method by an analyst or technician that are analyzed by the same or different analyst or technician according to a method] that meet established and documented criteria for precision and accuracy to assess the ongoing proficiency of the analysts or technicians.

8.9 Control Limit (CL) – the limit of the range of acceptability for the quality control samples

8.10 Equipment Blank (EB): Reagent water processed through the sampling devices and placed in a sample container prior to using the equipment to collect samples and used to demonstrate that the sampling equipment is free from contamination.

8.11 Field Blanks (FB): A sample of reagent water placed in a sample container in the field and used to demonstrate that samples have not been contaminated by sample collection or transport activities. EPA-1631E recommends the analysis of at least one field blank per 10 samples collected at the same site at the same time. Analyze the blank immediately before analyzing the samples in the batch.

8.12 Initial Calibration Verification (ICV) –A dilution of the OPR standard resulting in an instrumental concentration of 5.0 ng/L. This standard is run immediately following the calibration curve and verifies instrument calibration.

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8.13 Initial Precision and Recovery (IPR) – A dilution or digestion of a secondary source resulting in an instrumental concentration of 5.0 ng/L mercury. (8 ng/g mercury for 70/30 and Cold AR digestions)

8.14 Instrument Blank Level and Continuing Calibration Blank (IBL and CCB) for evaluation of instrument drift, sensitivity and contamination. At least 3 IBLs must be analyzed before the first calibration standard, and the CCBs every 10 samples immediately after CCVs.

8.15 Initial Demonstration of Capability (IDOC): A set of four (4) blank spike or laboratory control sample aliquots prepared according to a method by an analyst or technician at the concentration specified by the group manager (or if unspecified, to a concentration of one (1) to four (4) times the limit of quantitation) that are analyzed by the same or a different analyst or technician according to a method. The mean and standard deviation of the four results are calculated and compared to established and documented criteria for precision and accuracy to assess the initial proficiency of the analysts or technicians before they independently process client samples.

8.16 Laboratory Control Sample (LCS and LCSD) or Quality Control Sample (QCS): A sample (and duplicate) containing a known concentration of mercury that is used to monitor complete method performance. The preferred LCS is a matrix matched Certified Reference Material (CRM), but a blank spike meets the requirement also. In LIMS, the LCS is always referred to as a Blank Spike (BS), whether it is matrix matched or not.

8.17 Limit of Detection (LOD) – The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. The LOD shall be at least 2 times but no greater than 4 times the DL for multiple analyte methods or 2 times but no greater than 3 times the DL for single analyte methods.

8.18 Limit of Quantitation (LOQ) – equal to PQL and verified on a quarterly/annual basis, depending on the preparation, by spiking within 2 times the LOQ and showing a recovery between 70 – 130%.

8.19 LIMS: Laboratory Information Management System. Computer software used for managing samples, standards, and other laboratory functions.

8.20 May: This action, activity, or procedural step is optional.

8.21 May Not: This action, activity, or procedural step is prohibited.

8.22 Matrix Spike (MS) and Matrix Spike Duplicate (MSD): A representative sample is selected and spiked with a dilution of the primary source at a known concentration. The MS and MSD are run through the entire analytical process just as the samples are. These QC samples will indicate sample matrix effects on the analyte of interest.

8.23 Method Blank (MBLK) or Preparation Blank (PB): For waters, reagent water that is prepared and analyzed in a manner identical to that of samples. For digested solids, preparations blanks consist of the same reagents used to digest the samples, in the same volume or proportion and are carried through the complete sample preparation and analytical procedure. Boiling chips are used as a blank matrix for solids. Preparation blanks are referred to as BLK in LIMS.

8.24 Method Detection Limit (MDL): A limit derived from 40 CFR, Part 136, Appendix B. This method produces a defined value that is the minimum concentration that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero from a given matrix.

8.25 Method Duplicates/Method Triplicates (MD/MT): A second or third separate sample dilution, taken from the same source sample, prepared and analyzed in the laboratory separately. An MSD may

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be used as a duplicate.

8.26 Reagent water: 18 MO minimum, reagent water starting from a pre-purified (distilled, Reverse Osmosis, etc.) source.

8.27 Must: This action, activity, or procedural step is required.

8.28 Ongoing Precision and Recovery (OPR): A dilution of a secondary source resulting in an instrumental concentration of 5.0 ng/L mercury.

8.29 PM: Project Manager.

8.30 Practical Quantitation Limit (PQL), Method Reporting Limit (MRL): The minimum concentration that can be reported quantitatively. The PQL is often described as 1-10 times higher than MDL. Eurofins Frontier defines the PQL as the lowest concentration that can achieve 70-130% recovery for 10 replicate sample preparations. In LIMS, the PQL is referred to as the MRL.

8.31 Primary Source: The stock standard used to make the calibration standard. Procedural Method: A method where standards and samples are run through the analytical procedure exactly the same. By NELAC definition, this SOP is a procedural method.

8.32 Secondary Source: The stock standard used to make the OPR standard

8.33 Shall: This action, activity, or procedure is required.

8.34 Should: This action, activity, or procedure is suggested, but not required.

8.35 Stock Standard Solution (SSS) – a standard of analyte that is purchased from a certified source for the preparation of working standards.

8.36 Total mercury: As defined by this method, all bromine monochloride-oxidizable mercury forms and species found in aqueous solutions. This includes, but is not limited to, Hg(II), Hg(0), strongly organo-complexed Hg(II) compounds, adsorbed particulate Hg(P), and several tested covalently bound organomercurials (i.e. CH_3HgCl, $(CH_3)_2Hg$, and $C_6H_5HgOOCCH_3$). The recovery of mercury bound within microbial cells may require additional preparation steps (i.e. UV oxidation, or oven digestion).

8.37 Travel or Trip Blank (TB): A sample of reagent water placed in a sample container in the laboratory and used to demonstrate that samples have not been contaminated by transport activities.

8.38 Wash Station Blank (WSB) – a “blank” that is drawn from the wash station (0.5% BrCl). At least three WSBs are used at the beginning of analysis to assess overall cleanliness of the system/reagents. WSBs may also be used mid-run to flush the system after running a high level sample, or check the mercury levels in the wash station.

9 Interferences

9.1 Due to high levels of acid and halogens (i.e. bromide) in digested solids, it is recommended that aliquots of no more than 5.0mL of the digestates be analyzed.

9.2 Only BrCl tested to be low in mercury should be used for the sample dilutions.

9.3 Prep blank correction is very important for this instrument.

9.4 Improperly adjusted pump tubing can cause the phase separator to fill with sample. In extreme situations, the overflow can back up into instrument causing damage to the traps and switching valves. Care must be taken to insure the pump tubing tension is properly set. DO NOT OVER TIGHTEN.

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9.5 No more than 1.0mL should be analyzed if HF acid, FSTM material, or coal is present in significant concentrations. Samples prepared according to *EFAFS-T-AFS-SOP2821* "HF/HNO3/HCl Bomb Digestion of Sediments, Soils, Rocks, and Bayer Process Solids and Slurries for Mercury, followed by Repeated HNO_3 Evaporation" are diluted before analysis, therefore 5.0 mL is the maximum.

9.6 Water vapor has the potential to create recovery interferences. To prevent interference from water, ensure that soda-lime pre-traps and gold traps remain dry.

9.7 The presence of high concentrations of silver and/or gold can cause $SnCl_2$ to precipitate out of solution and adhere to the tubing and/or phase separator walls. High concentrations of these metals can sometimes be found in the matrix spike samples from the digestion sets that are shared with the trace metals group.

9.8 Analysis of samples containing high concentrations of strong acids (>2%) can cause passivation of the sample trap and lead to low bias/recoveries. When analyzing samples containing >2% strong acid (at the instrument), the analyst should verify that passivation is not an issue by running a Hg spike into MQ water containing a similar concentration of acid. If the spike recovers low (<90%) passivation may be an issue and the sample may need to be diluted.

10 Safety Precautions, Pollution Prevention and Waste Handling:

10.1 Personnel will don appropriate laboratory attire according to the Chemical Hygiene Plan *(EFHS-S-HS-QP12066). This includes, but is not limited to, laboratory coat, eye protection and protective gloves.*

10.2 The toxicity or carcinogenicity of reagents used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable. Chemists should refer to the SDS (Safety Data Sheets) *located at https://msdsmanagement.msdsonline.com/company/5c1df5b3-747d-4789-8104-42457dc3a3e5/* for each chemical they are working with.

10.2.1 Note: Use particular caution when preparing and using BrCl, as it releases extremely irritating, corrosive fumes similar in effect to free chlorine. Always handle this reagent in an approved fume hood.

10.3 All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against known disease-causative agents. Eurofins Frontier will reimburse the expense of Hepatitis A and B immunizations for any laboratory staff member who desires this protection.

10.4 Hydrochloric acid: Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion. Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. For more information see SDS.

10.5 See Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP) for general information regarding employee safety, waste management, and pollution prevention.

10.6 Pollution prevention information can be found in the current Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP), which details and tracks various waste streams and disposal

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procedures.

10.7 All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations. Any waste generated by this procedure should be disposed of according to SOP *EFHS-S-HS-SOP2991* "Waste Disposal Procedure for Client Sample Waste," which provides instruction on dealing with laboratory and client waste

11 Personnel Training and Qualifications:

11.1 An analyst must perform an initial demonstration of capability (IDOC) that includes four replicates of a secondary source before being qualified to analyze samples without supervision. Continuing DOC will be maintained and monitored via performance on CRMs and other QC samples, as well as obtaining acceptable results on proficiency testing exercises.

11.2 The analyst/laboratory technician must have read this SOP and other relevant SOPs and have the training documented on the applicable form(s). The analysis may be questioned on SOP by supervisor(s) and/or trainers.

11.3 Training is documented by the employee and supervisor, and is kept on file in the QA Office. The employee must read, understand, and by signing the training document, agree to perform the procedures as stated in all Standard Operating Procedures (SOPs) related to this method.

11.4 All employees must read the Quality Manual *(EFQA-Q-QM-QM5805)* and complete annual Ethics training.

11.5 All training documents including IDOCs, CDOCs, Initial QA orientation, and Ethics training are stored by the Quality Assurance Manager in the employees training file for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

11.6 Chemical Safety Training, Compressed Gas Training, Chemical Hygiene Plan documentation, and Shipping of Hazardous goods, are stored by the Health and Safety Officer for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

12 Sample Collection, Preservation, and Handling:

12.1 Aqueous samples are collected in rigorously cleaned fluoropolymer (e.g. Teflon) bottles and caps (as described in FGS-007 "Cleaning of Sampling Equipment and Bottles for Mercury Analysis"). Certified clean glass bottles with fluoropolymer lids may be used if mercury is the only analyte of interest.

12.1.1 Aqueous samples are preserved upon receipt with 0.2N BrCl that has tested low in mercury. Samples are typically preserved to 1% BrCl v/v, but may require further oxidation due to high levels of organic matter or mercury. Refer to *EFSR-P-SP-SOP2796* "Oxidation of Aqueous Samples for Total Mercury Analysis".

12.2 Solid samples may be collected in glass, high density polyethylene, or fluoropolymer jars.

12.2.1 Solid samples are preserved by freezing upon receipt.

12.3 Impinger solutions preserved with nitric acid or containing potassium permangante (this category includes proficiency testing samples) need to be preserved with BrCl to insure the complete oxidation of organic species.

12.4 All samples should be collected utilizing clean techniques, so as not to cross-contaminate samples with mercury. See *EFSR-S-CS-SOP2794* "Ultra Clean Aqueous Sample Collection" and EPA Method 1669 for aqueous sample techniques.

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13 Apparatus and Equipment:

13.1 LIMS – Element, version 6 or higher; Computer – Windows 7 or 8

13.2 Tekran Operating System, see instrument software log *EFQA-S-IT-WI7061*

13.3 Model 2600 System Control Module – manufactured by Tekran, this module contains dual stage pre-concentration/desorption units, a high resolution analogue to digital converter, and a high sensitivity AFS Detector (IDL<1pg).

13.4 Model 2610 Pump Unit – manufactured by Tekran, this module contains a precision 6 channel peristaltic pump with optical speed feedback. Speed may be varied manually or under computer control. The pump head has three four-roller channels to providing high pumping rates for wash station circulation and waste removal, and three eight-roller channels to providing slower/low pulse delivery of $SnCl_2$ and sample (one extra channel).

13.5 Model 2620 Auto-Sampler – a specially modified Gilson Model 223 auto-sampler, includes reticulating wash station and allows for automatic sample handling with the 2600 analysis system.

13.6 50mL Polypropylene Vials with screw caps, manufactured by Environmental Express (Item No: SC475), or equivalent pre-cleaned and/or tested vials, graduated to 50mL.

13.7 Three-stop tubing, various inner diameters of Marprene for $SnCl_2$ (1.02mm), for wash station fill (2.38mm), wash station drain (2.79mm), and phase separator drain (2.79mm) Three stop silicone tubing (2.05mm) is used for sample feed.

13.8 Teflon Fittings and FEP tubing – of various sizes and lengths. Tubing from sample probe, $SnCl_2$, rinse water, phase separator, to and from wash station, and between gold traps is 1/16 inch (inner diameter) FEP.

13.9 Soda-Lime trap – a 14cm x 1.1cm diameter glass tube containing 12-14g of reagent grade, non-indicating 8-14 mesh soda-lime ($Ca(OH)_2$+NaOH) aggregates, packed between portions of silanized glass wool. This trap is purged of mercury by placing it on the output of the phase separator and purging it to air with a 0.5% BrCl rinse solution and 3% $SnCl_2$ for approximately 20 minutes with Ar (or N_2)at 400 mL/min.

13.10 Phase separator – manufactured by Tekran, the phase separator utilizes laminar fluid flow of sample over a frosted rod counter current to a stream of argon gas at 400mL/min.

13.11 Gold Coated Quartz Sand Trap ("sample trap") – manufactured by Tekran or made in house, heated from 0% to 100%, 8 Amp maximum.

13.12 Pure Gold Bead Trap ("analytical trap") – manufactured by Tekran, heated from 0% to 100%, 8 Amp maximum.

13.13 Pipettes: Calibrated variable pipettes with a range of 5 µL – 10 mL. Used to make solutions and sample dilutions. Pipettes are to be calibrated weekly according to SOP *EFQA-R-EQ-SOP2711* and EFGS-155.

13.14 Analytical Balance – capable of accurately weighing to the nearest 0.1mg, and able to tare at least one gram. The analytical balances are verified for accuracy on a daily basis according to *EFQA-R-MT-SOP2710*, "Balance Verification, Calibration and Maintenance."

14 Reagents and Standards:

14.1 Reagent Water: 18-MO ultra pure deionized water starting from a pre-purified (distilled, R.O., etc.) source is used. To remove any remaining trace metals and organics, an activated carbon cartridge is placed between the final ion exchange bed and the 0.2-µm filter. Reagent water used

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in the mercury lab is checked weekly for total mercury concentrations, and must test below 0.25ng/L.

14.2 Hydrochloric Acid (HCl): Concentrated (36-38% weight basis). Trace metal purified reagent-grade HCl. HCl is lot- tested by removing a small amount (20mL) of acid from a bottle of the new lot. To test the HCl, add 0.5 mL, using a calibrated pipette, of the HCl to a 50mL vial and dilute to 50mL with reagent water. Place into correct position in auto sampler and run like any sample. This reagent must test below 0.25ng/L. Do not prep blank correct.

14.2.1 HCl is lot- tested by removing a small amount (20mL) of acid from a bottle of the new lot. To test the HCl, add 0.5 mL, using a calibrated pipette, of the HCl to a 50mL vial and dilute to 50mL with reagent water. Place into correct position in auto sampler and run like any sample. This reagent must test below 0.25ng/L. Do not prep blank correct.

14.2.2 5% HCl Shutdown Rinse Solution: 200mL concentrated low-level mercury HCl into 4,000mL of reagent water.

14.3 Nitric Acid (HNO3): concentrated (69%-70% weight basis). Trace metal purified reagent-grade HNO3 is pre-analyzed and lot sequestered. Several brands (Baker, Fisher, Omnitrace) have been found to have lots with acceptably low levels of trace metals. This reagent should be from a lot number that has been previously tested to be low for the analytes of interest. This reagent shall be entered into LIMS and the expiration date is set to the same as the manufacturer's expiration date.

14.3.1 Nitric Acid, 5%

14.3.1.1 Rinse bottle labelled:

Metals Rinse, 5% HNO3

To be used for CV-AFS (THg only) and ICPMS preps/analysis.

14.4 0.2N Bromine Monochloride (BrCl):

14.4.1 *27* g of KBr is added to a 2.5-L bottle of concentrated HCl (pre-analyzed and found to be below 5 ng/L Hg). The bottle is then inverted in a fume hood to mix the acid and KBr. The solution then sits overnight allowing for the KBr to be dissolved .

14.4.2 *38* g of KBrO3 (certified to be low in Hg) is slowly added to the acid. When all of the KBrO3 is added, the solution should go from yellow to red to orange.

CAUTION: This process generates copious quantities of free halogens (Cl_2, Br_2, BrCl) which are released from the bottle. Add the $KBrO_3$ SLOWLY in a well operating fume hood.

14.4.3 Loosely cap the bottle and allow to sit for *1 hour* in a fume hood before tightening. Once *tightly* capped, invert bottle to make sure all of the solids goes into solution.

14.4.3.1 The expiration time for this reagent is set by default to six months in LIMS. There is no suggested holding time in EPA method 1631E, therefore the holding time can be extended, as long as the primary reagent has not expired. The mercury concentration of the BrCl is monitored through the preparation of water preparation blanks.

14.4.3.2 To test the BrCl, add 0.5 mL, using a calibrated pipette, of the BrCl to a 50mL vial and dilute to 50mL with reagent water. Add 25 µL Hydroxylamine-HCl to the vial; and place into correct

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position in auto sampler. Assume a 100 mL aliquot in the Excel spreadsheet. This reagent must test below 0.25ng/L. Do not prep blank correct. Analyze one replicate per bottle.

14.4.3.3 *0.5% BrCl Rinse Solution: 30mL concentrated low-level mercury BrCl into 6,000mL of reagent water.*

14.5 Hydroxylamine hydrochloride: dissolve 500g of NH_2OH-HCl in reagent water and bring the volume up to 1L. This solution may be purified by the addition of 1mL $SnCl_2$ solution and purging overnight at 500mL/min with mercury-free N_2. The working reagent is a 25% solution that is made by adding one part reagent water to one part 50% hydroxylamine hydrochloride. This reagent must test below 0.25ng/L.

14.5.1 To test the Hydroxylamine-HCl (NH_2OH-HCl), add 0.1 mL of the 50% reagent, using a calibrated pipette, to a 50mL vial and dilute to 50mL with reagent water. Place into correct position in auto sampler. Assume a 50mL aliquot in the Excel spreadsheet. This reagent must test below 0.25 ng/L. Do not prep blank correct. Analyze one replicate per bottle.

14.6 Stannous Chloride ($SnCl_2$): dissolve 500g $SnCl_2$ with three 100mL additions of concentrated HCl to original bottle and transfer (after each addition of HCl) to a 1L glass bottle. Bring this solution up to 1L of volume with reagent water and purge overnight with mercury-free N_2 at 500mL/min to remove all traces of mercury. Store tightly capped. The working reagent is a 3% solution that is made by diluting 150mL of 50% ScCl2 and 30-50mL of HCl to 2.5L with reagent water. The working reagent is continuously purged with nitrogen to prevent contamination. The 50% $SnCl_2$ reagent must test below 0.25ng/L.

14.6.1 To test the Stannous Chloride ($SnCl_2$), add 0.3 mL of the 50% reagent, using a calibrated pipette, to approximately 50 mL of purged bubbler water. Assume a 50 mL aliquot in the spreadsheet. This reagent must test below 0.25 ng/L. Do not prep blank correct. Analyze one replicate per bottle.

14.6.2 The expiration time for this reagent by default is set to six months in LIMS. There is no suggested holding time in EPA method 1631E; therefore the holding time can be extended, as long as the primary reagent has not expired.

14.7 Total Mercury *Stock and Prepared* Standards:

14.7.1 See SOP EFTM-T-TM-SOP2839 for information regarding the receipt, documentation, preparation, and storage of purchased and prepared standards used by EFGS.

14.7.2 Total Mercury Stock Standard Solution (Stock): Certified mercury standard purchased from High Purity Standards (1000 µg/mL (1 000 000 ng/mL) primary source) or Absolute Standards (100 µg/mL (100 000 ng/mL) secondary source), or any equivalent standard.

14.7.3 100,000 ng/mL Spiking Standard*: If* made from the Primary Stock Standard (High Purity, or equivalent vendor). Dilute 10 mL of the stock standard to 100 mL RO water containing 2 % BrCl. (Can also be made by preserving Secondary Stock Standard to 2% BrCl). *Expiration date is currently set at 6 months or when the stock standard expires, whichever is shorter.*

14.7.4 10,000 ng/mL Spiking Standard: If made from the Primary Stock Standard (High Purity, or equivalent vendor). Dilute 1.0 mL of the stock standard to 100 mL RO water containing 2 % BrCl. If made from Secondary Stock Standard dilute 10mL of stock standard to 100mL with RO water containing 2% BrCl. *Expiration date is currently set at 6 months or when the stock standard expires, whichever is shorter.*

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14.7.5 1,000 ng/mL Spiking Standard: If made from the Primary Stock Standard. Dilute 0.250 mL of the stock standard to 250 mL RO water containing 2 % BrCl. If made from Secondary Stock Standard, dilute 2.5mL of stock standard to 250mL with RO water containing 2% BrCl. *Expiration date is currently set at 6 months or when the stock standard expires, whichever is shorter.*

14.7.6 100 ng/mL Spiking Standard: Made from a stock standard or dilution of a stock standard with a concentration of 100,000 ng/mL. Dilute 0.100 mL of the 100,000 ng/mL dilution to 100 mL RO water containing 2 % BrCl. Expiration date is currently set at 3 months or when the stock standard expires, whichever is shorter.

14.7.7 Calibration Standard (10 ng/mL): Must be made from a dilution of the Primary Stock Standard. Typically made by diluting 0.5mL of a 10,000 ng/mL Primary Spiking Standard to 500 mL of RO water containing 2 % BrCl. Transfer to one 1000 mL glass or Teflon bottle. The calibration standard is considered stable for three months or until the stock standard expires.

14.7.8 Calibration Standard (1 ng/mL): Must be made from a dilution of a Primary Stock Standard. Typically made by diluting 1.0mL of a 100 ng/mL Primary Spiking Standard to 100mL with RO water containing 2% BrCl.

14.7.9 Initial Calibration Verification (ICV): ICV analysis, use 25µL of the OPR Standard (documented in LIMS as "THg ICV/OPR for 2600s"). The True value is 5.0 ng/L.

14.7.10 Continuing Calibration Verification (CCV): For CCV analysis, use 25µL of the OPR Standard (documented in LIMS as "THg ICV/OPR for 2600s"). The True value is 5.0 ng/L.

14.7.11 *Certified Reference Material (CRM) for Total Mercury in Water: A 0.00367 mg/L solution is prepared by adding a 9.0 mL of CRM NIST 1641e (from ampoule) into a 250 mL flask containing RO water. This solution is diluted to 250 mL, and an additional 5 mL of 0.2N BrCl is added, resulting in a final volume of 255 mL. Preparing the solution in this manner makes a 1:28 dilution of the stock CRM. This solution is considered stable for one year, or until the stock standard expires. Results are corrected for the additional 1 % BrCl in the analysis Excel spreadsheet and in LIMS.*

14.7.12 OPR Standard (10 ng/mL): Must be made from a dilution of a Secondary Spiking Standard.Typically made by diluting 1.0mL of a 1000ng/mL Secondary Spiking standard to 100mL with RO water containing 2% BrCl.

14.7.13 Argon Grade 4.7 or better (ultra high-purity grade) – argon that has been further purified by the removal of mercury using a gold trap that is located in line between the gas output and the analyzer gas input.

14.7.14 *Nitrogen Grade 4.5 (standard laboratory grade) – nitrogen that can be further purified of mercury using a gold trap that is located in line between the gas output and analyzer gas input.*

15 Calibration:

15.1 The calibration sequence consists of three IBLs followed by a minimum 5-point calibration curve. Usual concentrations are 0.5ppt, 1.0ppt, 5.0ppt, 20.0ppt, and 40.0ppt. Standards are analyzed from lowest to highest. Immediately following the standard curve an ICV/OPR (5.0ppt) is analyzed. All standards (and samples) are added to a 50mL vial and diluted to 50mL with 1.0% BrCl.

15.1.1 Three IBLs are prepared by adding 50mL 1.0% BrCl to the sample vial.

15.1.2 Using the 1.0 ng/mL calibration standard, 25µL and 50µL are added to vials for the lowest two

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calibration points. Using the 10ng/mL calibration standard, 25µL, 100µL, and 200µL are added to vials for the upper three calibration points.

15.1.3 Using the OPR Standard: 25µL is diluted to 50mL with 1.0% BrCl for the ICV/OPR (5.0ng/L).

15.2 Once the instrument is calibrated and the ICV/OPR and three IBLs are analyzed and passing, the instrument is operational. The sample concentrations must fall within the range of the calibration standards or be diluted and reanalyzed.

15.3 Additional calibration standards (linearity standards) may be added to the curve to prove instrument linearity at higher levels. This is acceptable only when there is no more client sample available, otherwise a dilution must be performed to bring the sample within calibration range.

15.4 The calibration of this system and calculation of sample results are performed using units of concentration (ppt or ng/L).

16 Procedure:

16.1 Pre-analysis and Organization:

16.1.1 Prior to analyzing samples it is imperative to reference LIMS for all project specific information, such as QC requirements, suggested dilutions, project manager information, and specifics regarding spike levels.

16.1.2 The analyst should then locate samples and check the work order in LIMS for notes about specific project requirements.

16.1.3 The analyst should compare the sample IDs to the work order and see that the samples are accounted for, and notify the project manager of any discrepancies in analysis required, sample identification, etc.

16.1.4 All mercury analyses receive a unique dataset identifier and LIMS assigned sequence number. The dataset ID is comprised of the instrument type and number, the date and the calibration number for that day. The format is as follows: THg26001-130216-1, where "THg "refers to a total mercury analysis; "26001" refers to Tekran 2600 instrument number 1; 130216 refers to the date (February 16, 2013 in the YYMMDD format); and "1" refers to the first calibration of the day. The sequence number is assigned by LIMS when the data gets imported into LIMS. The alpha-numeric code is based on the following format: 3B02001, where the 3 refers to the year (2013), the "B" is the month (A= January, B=February…L=December), "02" is the day of the month (February 2nd) and the final 3 digits is the nth sequence created on that particular year/month/day combination.

16.1.5 In general the analyst should organize their samples in the order listed on the bench sheet. The first samples analyzed should be the preparation blanks, then the LCS if analyzing solid samples, followed by actual samples. If possible, run total and dissolved samples side by side to facilitate verification that total concentration is greater than dissolved concentration. See QA section.

16.2 Instrument Start Up:

16.2.1 If necessary, prepare the soda-lime trap. The soda-lime trap should be changed, at least, every three analytical days.

16.2.2 Start the TekMDS software and check to make sure the computer is communicating with the instrument and the autosampler. Load a new work sheet and begin to enter the sample IDs into the run. Take care to insure that the appropriate autosampler position and dilution are entered correctly into the worksheet.

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16.2.3 Empty the waste carboy in accordance with *EFHS-S-HS-SOP2991* "Waste Dumping Procedure for Client Sample Waste.

16.2.4 Fill rinse basin with a fresh solution of 0.5% BrCl and refill 3% $SnCl_2$ container.

16.2.5 Check tubing for wear and re-index or replace as needed. Clamp all tubing/cassettes onto pump head and adjust tension.

16.2.5.1 Insure that there are no kinks in reagent or waste lines.

16.2.6 Turn the pump on to "local" and check flow of all reagents, including flow through the sample probe from the wash station and flow of SnCl2 into phase separator. Adjust tension on tubing, if necessary. Be sure that the waste line is flowing well and waste does not back-up into the phase separator! This can often be prevented by loosening the tension on the tubing for both the phase separator drain and the wash station drain. *Allow it to run with reagents for 20 minutes.*

16.2.7 All analytical runs should begin with at least two "clean" cycle to "blank" the gold traps, followed by three wash station blanks (WSB) to assure that the system is free of mercury.

16.2.8 Set pump back to "remote" to start the run.

16.2.9 Note: It is important to check the flow, reagent levels, and waste carboy level throughout the analytical run. If a reagent is low in volume, it can be refilled mid-run. Similarly, the waste carboy should be emptied mid-run, if necessary. The SnCl2 and sample flow (tension on tubing) cannot be changed mid-run as it may affect instrument response. For this reason, it is important to verify proper sample/reagent flow prior to beginning analysis.

16.3 Batching and Analyzing Aqueous Samples:

16.3.1 All analysts will show Initial Precision and Recovery (IPR) by analyzing four secondary spikes at 5.0ng/L. The spikes need to recover between 79-121% with an RSD < 21%.

16.3.2 All aqueous samples should be preserved with BrCl at least 24 hours prior to analysis. In the event a sample requires further oxidation prior to analysis, additional BrCl is added and the sample is not analyzed for at least 12 additional hours. In special cases where rush turn-around-time is required and an oxidation period of less than 24 hours may be used, the analyst should consult a supervisor for approval. The supervisor must be able to confirm (based on past experience) that the particular matrix type is completely oxidized before analysis.

16.3.2.1 When setting up a batch of aqueous sample in LIMS, it's necessary to account for the amount of BrCl that was added to the samples and blanks. Adjust the final volume in the batch to account for the amount of BrCl that was added. For instance, 100 mL of sample is preserved with 3% (v/v) BrCl. The final volume should be 103 mL in the benchsheet.

16.3.3 While the standard curve is being analyzed, the analyst should prepare three 1% BrCl and any additional water preparation blanks (PBW). Add 0.5mL BrCl (for additional PBW's add an additional 0.5mL of BrCl for each percent above 1%) and 25µL hydroxylamine hydrochloride (NH_2OH-HCl) to each vial. Dilute to 50mL with reagent water. Upon request (e.g., WI DNR samples), batch QC blanks can be created at the time of preservation and will be used as the blanks for the batch; the date of preservation will be entered as the prep date in the LIMS batch sheet).

16.3.4 It is recommended that all known field, equipment, and trip blanks should be analyzed before any other sample types.

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16.3.5 For all waters, select the appropriate dilution (refer to LIMS, historical data, etc.).

16.3.6 When preparing dilutions, use calibrated pipettes to dispense the aliquots into the 50mL vials. Dilute the sample to a final volume between 25mL to 50mL with 1% BrCl. Neutralize BrCl with 25µL of 25% NH_2OH-HCl. The sample should turn from a yellowish color to a clear/cloudy solution, depending on the matrix. Be sure to note any sample dilutions onto the bench sheet for cross referencing during peer review. NOTE: If using 1x dilution, water samples should be thoroughly homogenized and poured directly into 50mL vial with 25 µL of 25% NH_2OH-HCl. Sample amounts of no less than 30 mL should be analyzed provided there is adequate collected sample volume.

16.3.7 For sample aliquots greater than 10mL, you may gravimetrically weigh out the selected volume (±0.2g) into a 50mL vial. Dilute the sample to a final volume of 50mL with 1% BrCl. Neutralize BrCl with 25µL 25% NH_2OH-HCl.

16.3.8 Load sample vials into the auto sampler. Verify that the correct vial is in the proper position relative to the analysis worksheet entry in TekMDS software for that sample.

16.3.9 For each sample, the sample ID, BrCl percentage, and a dilution based on 50mL is entered into the TekMDS software. Unless otherwise stated (e.g., all WI DNR samples, PRASA), all aqueous samples should be PB corrected. Note: prep blank correction takes place after analysis in the Excel spreadsheet, not in the TekMDS software.

16.3.10 The analyst should continue preparing and adding samples to the run in the same fashion to maximize efficiency. Positions on the autosampler can be used more than one time throughout the analysis run by removing a previously analyzed sample vial and replacing it with a new sample.

16.4 Analysis of Digested Solids:

16.4.1 All analysts will show Initial Precision and Recovery (IPR) by analyzing four secondary spikes at 8.0ng/g. The spikes need to recover between 75-125% with an RSD < 20% for EFAFS-T-AFS-2795 and 2807. All other Frontier preps will be covered by the IPR performed for waters.

16.4.2 With this method it is possible to determine the concentration of total mercury in solid samples following proper digestion. The following highlight the majority of total mercury prep techniques for solids and their matrix specific SOPs.

16.4.2.1 For tissues, refer to *EFAFS-T-AFS-SOP2795* "Digestion of Tissues for Total Mercury Analysis Using Nitric and Sulfuric Acids (70:30)" for the nitric acid/sulfuric acid digestion and *EFTM-T-TM-SOP2837* "Total Metals Digestion for Animal or Plant Tissues" for the concentrated nitric acid digest.

16.4.2.2 For soils/sediments, refer to *EFAFS-T-AFS-SOP2807* "Preparation of Solid Samples for Total Mercury Analysis by Modified Cold Aqua-Regia Digestion" for the cold aqua regia digestion, *EFAFS-T-AFS-SOP2795* for the nitric acid/sulfuric acid digestion, and *EFAFS-T-AFS-SOP2821* "HF/HNO3/HCl Bomb Digestion of Sediments, Soils, Rocks, and Bayer Process Solids and Slurries for Mercury, followed by Repeated HNO3 Evaporation" for the hydrofluoric acid/nitric acid bomb digestion.

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16.4.2.3 For coal and ash, refer to *EFAFS-T-AFS-SOP2807* Preparation of Solid Samples for Total Mercury Analysis by Modified Cold Aqua-Regia Digestion for the cold aqua regia digestion. For FSTM, refer to *EFAFS-T-AFS-SOP2985* "Mercury Digest for Gas/Air Samples Collected on KCl/Quartz or KCl/Lime trap" for the digestion of traps.

16.4.3 After the instrument calibration sequence, preparation blanks and the digested CRM(s) are analyzed. The analyst should use the minimum dilution allowed for each preparation blank and diluting to 50mL with reagent water preserved to 1% BrCl. Analysts are to calculate the appropriate dilution for the digested CRM, ensuring that the sample concentration stays within the calibration curve.

16.4.4 Begin analyzing samples by the order of the digestion sheet, with the exception of the sample that has separate QC digested for MD/MS/MSD. It is appropriate to analyze this sample, and any associated QC, out of bench sheet order. The analyst should review any relevant project notes, historical data, or information given by client to the PM to help determine proper dilutions that will allow samples to recover within calibration curve.

16.4.5 The procedure for analysis is similar to that of the calibration:

16.4.5.1 Selected digest samples are pipetted into a 50mL vial (one sample per vial) and diluted to 50mL with reagent water preserved to 1% BrCl.

16.4.5.2 For each sample, the sample ID and dilution based on 50mL is entered into the TekMDS software. The dilution should also be noted on the digestion bench sheet for cross referencing in peer review. Unless otherwise stated, all solid samples should be PB corrected. Note: Prep blank correction takes place after analysis in the Excel spreadsheet, not in the TekMDS software.

16.4.5.3 After loading one set of samples, the analyst should begin preparing the next round of digested solid samples in the same fashion to maximize efficiency.

16.4.6 Quality Control Procedures for Digested Solid Samples:

16.4.6.1 Please refer to the appropriate SOP for each matrix's corresponding quality control samples. All quality control samples prepared for the batch should be run with its analysis unless stated otherwise by the project manager. Please see Table 1 for acceptance criteria.

16.4.6.2 Spiking standard LIMS ID and the amount used for the MS/MSD must be noted on the digestion bench sheet for cross referencing in peer review.

16.4.6.3 The analytical day must close with a CCV(OPR) /CCB.

16.5 Analysis of Fluegas Sorbent for Total Mercury (FSTM)/KCl Traps and Particulate Filter:

16.5.1 The IPR for waters will also cover *EFAFS-T-AFS-SOP2985* and *EFAFS-T-AFS-SOP2800* digestions.

16.5.2 With a few exceptions FSTM traps and particulate filters are digested and analyzed as if they were solids.

16.5.3 FSTM traps or particulate filters should be digested according to *EFAFS-T-AFS-SOP2985* "Digestion for Gas/Air Samples Collected on Fluegas Sorbent for Total Mercury TM Traps."

16.5.4 KCl traps should be digested according to *EFAFS-T-AFS-SOP2800* "Mercury Digest for Gas/Air

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Samples Collected on KCl/Quartz or KCl/Lime trap."

16.5.5 The maximum amount of sample used for analysis should be 0.5mL for FSTM and 2.5 mL for KCL or less diluted to a final volume of 50mL with reagent water preserved to 1%BrCl . 5mL may be used at PM request, but is not recommended. To avoid any potential matrix interference it is recommended that the smallest reasonable aliquot sizes be used for this matrix. All blanks and low level/non-detect samples must be analyzed at the same dilution. Dilution should also be noted on the digestion bench sheet for cross referencing in peer review.

16.5.6 Quality Control Requirements for FSTM Traps and Particulate Filters:

16.5.6.1 Please refer to the appropriate SOP for each matrix's corresponding quality control samples. All quality control samples prepared for the batch should be run with its analysis unless stated otherwise by the project manager. Please see Table 1 for acceptance criteria.

16.5.6.2 The amount of spiking standard used, it's LIMS ID and dilution used for the MS/MSD as well the sample(s) used for MS/MSD/MD, must be noted on the digestion bench sheet for cross referencing in peer review.

16.6 End of analysis close-down procedure:

16.6.1 The gas flow to the phase separator automatically shuts off.

16.6.2 Move reagent lines to rinse carboy.

16.6.3 With pump set to "Local", rinse system for 5-minutes.

16.6.4 Release pump tubing for all but the "Sample" and "Waste" lines. Allow lines to drain.

16.6.5 Set pump to "Off".

16.6.6 Slowly release the "Sample" and" Waste" line. Carefully monitor the Wash station over the next 5 minutes, making sure it is not siphoning, or overflows.

16.6.7 Carryout all end of day cleaning and restocking tasks.

16.7 Analytical data is exported from the TekMDS software to an Excel file. The data is then copied and pasted into an Excel template that is LIMS compatible.

16.8 Tekran 2600 Mercury Analysis System Troubleshooting

The following is a summary of common troubleshooting techniques. This is not an all-inclusive list of what may be done to deal with analytical issues. Consultation with the group leader is preferred when performing these corrective actions. Analysts are encouraged not to rely on this guideline. Instead, this document should be used as a learning tool. Analysts should be actively striving to learn about troubleshooting as well as creative, productive ways of dealing with analytical issues.

16.8.1 ISSUE: No peaks at all

16.8.1.1 Ensure that the system is powered.

16.8.1.2 Make sure that the base line is approximately 0.1 V.

16.8.1.3 Make sure that you are running the right event table file (ETF).

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16.8.1.4 Ensure that the carrier gas fitting is properly connected to the Argon source. (See System components, User guides, Section 2-3 for details).

16.8.1.5 Ensure that the phase separator gas fitting is properly connected to the Argon/Nitrogen source. (See System components, User guides, Section 2-3 for details)

16.8.1.6 Check operation of heater B. (Refer to Heater B Test)

16.8.1.7 Check operation of heater A. (Refer to Heater A Test)

16.8.1.8 Check that V2 is working properly. (Refer to V2 Test)

16.8.1.9 Check that V1 is switching properly. (Refer to V1 Tests)

16.8.2 ISSUE: Low sensitivity

16.8.2.1 Make sure that all "No peaks detected" samples are checked.

16.8.2.2 Check all connections to V2 and V1 and tighten all friction fittings up and downstream the Cartridges A and B.

16.8.2.3 Make sure that you have freshly changed soda lime in the soda lime trap, and that it is from a good source.

16.8.2.4 Check and tighten all gas Teflon lines up and downstream of the soda lime trap and P/S.

16.8.2.5 Check the sample tubing following introduction of $SnCl_2$ at the "Y" fitting for clogs. This line should also be the proper length.

16.8.2.6 Check that the frosted P/S rod is evenly wet. (Refer to P/S glass rod test).

16.8.2.7 Check that the tubing sizes in the main pump are correct. Also make sure that the tubing occlusion is set at the 12 o'clock position. Check the sample uptake (should be between 12 and 16 mL/min) and the $SnCl_2$ uptake (should be between 3 and 5 mL/min).

16.8.2.8 Do not use old calibration standards to calibrate the system.

16.8.2.9 Make sure you are running fresh $SnCl_2$ solution.

16.8.2.10 Make sure that your stock Hg standard has not expired and is from a reliable source and that it is not compromised.

16.8.2.11 Check and tighten both sides of the ¼" straight Teflon union on the cuvette.

16.8.2.12 Check the cuvette (Refer to the System Component, User Guides Cuvette Removal and Cleaning, Section 4-3 and Cuvette cleaning procedure).

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16.8.2.13 Check the lamp voltage. If the voltage is low, increase to required values (refer to System Component, User Guides Lamp voltage adjustment, Note 4-7).

16.8.2.14 Check both cartridges for failures

16.8.2.14.1 Check if Cartridge A is having problems. (Refer to Cartridge A test procedure).

16.8.2.14.2 Check if Cartridge B is having problems. (Refer to Cartridge B test procedure

16.8.3 ISSUE:HighBlanks

High blanks could be due to:

Contamination in the system (liquid and/or gas lines)

Water high in Hg

Poor quality of the reagents (KBr, $KBrO_3$, $SnCl_2$, Hydroxylamine, HCl etc).

16.8.3.1 Contamination in the system (liquid and/or gas lines), caused by:

16.8.3.1.1 System left without operating for an extended period of time (e.g. a month) and not shut down properly.

16.8.3.1.2 System not flushed and cleaned after running samples (especially high level samples). *Note: Any sample over 200 ng/L requires a blank be ran after to check for carryover.*

16.8.3.1.3 Following analysis of samples high in organics and not flushing properly after the run.

Sudden contamination when an extremely high in Hg concentration sample is run through the system: From past experience this type of contamination is very dependent on the type of samples the analyst was running in the system more so than the exact concentration of Hg within the sample. There are cases when even after analysis of a very high sample (~1.0 ppb) the blanks will come back to normal very quickly. In other cases, effort will need to be made to lower the blanks. Basically the methods of cleaning are the same as those described below.

16.8.3.1.4 Not following normal and necessary maintenance procedures.

16.8.3.1.4.1 Addressing contamination in gas lines:

16.8.3.1.4.1.1 Bypass the P/S. (Refer to P/S bypassing procedure).

16.8.3.1.4.1.2 Continue by running some CLEAN cycles. If high peaks result, clean Cartridge B. (Refer to Cleaning the Cartridge B procedure).

16.8.3.1.4.1.3 Continue running dry (Sample cycle). If at this point you still get high peak areas, clean Cartridge A (Refer to Cleaning the Cartridge A procedure).

16.8.3.1.3.1.5 Once again continue running dry. If you still get high peak areas, clean V2. (Refer to cleaning V2 procedure).

16.8.3.1.4.1.5 If high blank are still present, clean/replace the gas phase Teflon lines. (Refer to cleaning of the gas phase Teflon lines).

16.8.3.1.4.2 Addressing contamination in liquid lines:

16.8.3.1.4.2.1 Check/replace the silicone sample line.

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16.8.3.1.4.2.2 Check/replace the sample/$SnCl_2$ line to the P/S.

16.8.3.1.4.2.3 Check/clean the P/S. (Refer to Analytical Methods, *Tekran Guide,* Method 1631, section 5-1).

16.8.3.1.4.2.4 Clean system while running (Refer to clean while running procedure).

16.8.3.2 Poor water Quality

16.8.3.2.1 Refer to Analytical Methods, *Tekran Guide,* Method 1631, section 3-4

16.8.3.3 Poor quality of the reagents (KBr, $KBrO_3$, $SnCl_2$, Hydroxylamine, HCl etc)

16.8.3.3.1 Refer to Analytical Methods, Tekran Guide, Method 1631, section 3-4, 3-5.

16.8.4 ISSUE: Nonlinearity of the calibration curve

There are a few different types of non-linearity and factors causing them:

16.8.4.1 Cal. Factors which are very low for the low calibration points (0.5 and 1 ng/L) but better for the higher standards.

16.8.3.1.4 This is probably due to high Calblank values that cause lowest points of calibration to be affected during blank correction. Stop the run and go through the procedure for investigating High Blanks.

16.8.4.2 Cal. Factors are very erratic (no clear increasing or decreasing tendency

16.8.4.2.1 Dry spots on the glass rod of the P/S. (Refer to P/S glass rod test).

16.8.4.2.2 Check that you are running with fresh soda lime.

16.8.4.2.3 Check the heaters (Refer to Heater B test and Heater A test).

16.8.4.2.4 Check the silicone sample tubing for any twisting, pinching, or bubbles.

16.8.4.2.5 Check and tighten all liquid and gas phase connections.

16.8.4.2.6 Make sure your calibration standards are fresh and properly prepared.

16.8.4.3 Poor results for high calibration standards

16.8.4.3.1 Previously run samples with difficult matrixes or high acid vapor content could be a potential cause for this. Such matrixes, in very rare cases, could cause temporary passivation of Cartridge A, as well as temporarily poison the liquid lines. After running such difficult samples, the system needs a very thorough cleaning (see at the procedures High blanks). Running overnight in "dry" mode with the P/S flow between 50-100mL/min can also help.

16.8.4.4 Cal. Factors decrease moving up in concentration through the calibration curve

16.8.4.4.1 Improper preparation of the standards. Check and prepare fresh calibration standards.

16.8.4.4.2 Contaminated and expired soda lime. Change soda lime.

16.8.4.4.3 Loose P/S friction fittings: tighten them.

16.8.4.4.4 Loose Soda lime trap fittings: tighten them.

16.8.4.4.5 Loose gold trap friction fittings: tighten/replace them.

16.8.4.4.6 Loose connection of the ¼" nuts on V1 and V2. Tighten them.

16.8.4.4.7 Loose connection on both sides of ¼" straight Teflon union to the cuvette. Tighten both

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sides.

16.8.4.4.8 Open and examine the cuvette (Refer to the System Component, User Guides Cuvette Removal and Cleaning, Section 4-3 and Cuvette cleaning procedure)

17 Calculations:

17.1 Average all instrument blanks (PH_X) using the peak area values from the TekMDS software. Subtract the average (IB) from the peak area for each standard and sample.

17.2 Calculate the calibration factor (CF_x) for mercury in each of the five standards using the mean instrument-blank-subtracted peak area and the following equation:

$CF_x = PA_x - IB / C_x$

Where:

17.2.1 PAx=peak area for mercury in standard

17.2.2 IB=mean peak area for mercury in instrument blank

17.2.3 C_x=mass in standard analyzed (ng/L)

17.2.4 CF_x=Response Factor of each concentration

17.2.4.1 Average the five response factors to establish mean value: CF(Avg) (units/ng/L).

17.3 Sample results are then corrected for the average peak area values of at least three preparation blanks (PBs), unless otherwise requested or for samples originating from Wisconsin (Wisconsin does not permit method blank subtraction). This result is shown as the Initial Result on the Excel spreadsheet and in LIMS.

17.4 Total Mercury in Water:

Hg / Initial Result (ng/L) = ((((Peak Area - IB) / $CF_{(Avg)}$) x D_s)– (PB_x x D_b)) / D_s

THg Final Result (ng/L) = (THg / Initial Result) x (D_s x V_f) / V_i

Where:

17.4.1 $CF_{(avg)}$ = average response factor (in units/ng/L).

17.4.2 IB = average instrument blank peak area (in units)

17.4.3 V_f = final volume of sample analyzed in mL. The final volume should account for the added volume of BrCl needed for preservation. For instance, 100 mL of sample is preserved with 3% (v/v) BrCl. The final volume should be 103 mL.

17.4.4 V_i = initial volume of sample analyzed in mL prior to addition of BrCl.

17.4.5 D_s = final dilution factor of sample.

17.4.6 D_b = final dilution factor of corresponding blank results. All preparation blanks at the same preservation level must be analyzed at the same dilution.

17.4.7 PB_X= initial average (on instrument) of the preparation blanks in ng/L related to the preservation level of the samples (i.e., X=2 for a sample which is preserved at 2% BrCl), thus accounting for the extra contribution of mercury from the BrCl. Sample results are corrected for the average blank concentration of only the corresponding blanks preserved at the same BrCl preservation level. For example, if a sample is preserved at 2% and one PB was run at 2%, the sample is

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corrected using the results from that blank.

17.5 Total Mercury in Solids:

THg / Initial Result (ng/L) = ((((Peak Area - IB) / $CF_{(Avg)}$) x D_s)– (PB x D_b)) / D_s

THg Final Result (ng/g) = (THg / Initial Result) x (D_s x V_f) / (m x 1000)

Where:

17.5.1 $CF_{(avg)}$ = average response factor (in units/ng/L).

17.5.2 IB = average instrument blank peak area (in units)

17.5.3 V_f = final volume of the digested sample in mL.

17.5.4 m = initial mass of the digested sample in g.

17.5.5 D_s = final dilution factor of sample.

17.5.6 D_b = final dilution factor of corresponding blank results. All preparation blanks must be analyzed at the same dilution.

17.5.7 PB = initial average (on instrument) of the preparation blanks found in the digest in ng/L. The initial mass of the digestion blanks must be the default mass specific to the preparation.

18 Statistical Information/Method Performance:

18.1 Method Detections Limits (MDL) are determined during method development and then annually thereafter according to 40 CFR Part 136, Section B and and EFQA-Q-QD-SOP10098.

18.2 The Practical Quantitation Limit (PQL) is the reporting limit for this method and is included as the lowest calibration point (2003 NELAC regulation 5.5.5.2.2.1.h.3). The PQL is determined by running ten samples with a concentration that will produce a recovery of 70-130 % for most analytes, but the recovery requirements are analyte dependent. The PQL is referred to as the Method Reporting Limit (MRL) in LIMS.

18.3 Current LODs, LOQs, MDLs and PQLs are stored at: *\\us34fivp002\General and Admin\Quality Assurance\Method-Limits-MDLs-IDLs\MDLs & PQLs*

19 Quality Assurance/Quality control:

19.1 A minimum of three preparation blanks and one LCS/LCSD *(preferably NIST 1641e),* must be analyzed per preparation batch. The upper control limit for each preparation blank is equal to the PQL.

19.2 Initial Precision and Recovery test for water must be four spikes (at 5.0 ng/L) recovering between 79-121% with an RSD < 21%; the IPR for soil must be four spikes (at 8.0 ng/g) recovering between 75-125% with an RSD < 20%.

19.3 Matrix Spikes: One Matrix Spike/Matrix Spike Duplicate (MS/MSD) must be performed for every 10 samples. The recovery of the MS/MSD must be between 71%-125% recovery, and the Relative Percent Difference (RPD) below 24%. If an MS/MSD is out of control, the analyst should investigate to identify the source of the failure. The MS and MSD may be used as duplicates. Some failures may be qualified using QA Qualification Flow Charts (Appendix A).

19.3.1 For aqueous samples, the MS/MSD is spiked at 1 to 5 times the ambient concentration, with 0.25 ng being the minimum spiking level. Sample dilutions for the MS/MSD should be the same as the ambient sample dilution, if sufficient sample volume exists. NEVER ADD SPIKE

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DIRECTLY TO THE ORIGINAL SAMPLE CONTAINER UNLESS OTHERWISE INSTRUCTED.

19.3.2 Matrix Duplicates – Not required. A Matrix Duplicate (MD) or Matrix Triplicate (MT) may be analyzed for every batch of 20 samples upon client request. The MSD may serve as the MD if necessary. The Relative Percent Difference (RPD) and the Relative Standard Deviation (RSD) of duplicate samples must be less than 24%. Some failures may be qualified using QA Qualification Flow Charts.For aqueous samples, analyze the parent, duplicate and triplicate at the same dilution.

19.3.3 For aqueous samples, analyze the parent, duplicate and triplicate at the same dilution.

19.4 Laboratory Control Standard (LCS) or Quality Control Sample (QCS): For every batch of samples, at least one LCS is processed and analyzed. The recovery of the LCS must be within 80-120% for the aqueous *NIST 1641e*. An LCS Duplicate (LCSD) should accompany the LCS.

19.4.1 A Certified Reference Material (CRM) is the preferred LCS, but a Blank Spike may serve as an LCS if an appropriate CRM does not exist. The spiking level is based on client request, historical data, or a default of mid-curve. A duplicate blank spike must also be prepared as an LCSD. Recoveries need to be 75-125% with an RPD < 24%.

19.5 Ongoing Precision and Recovery (OPR): An OPR must be analyzed at the beginning and end of each analytical batch, or at the end of each 12-hour shift. The recovery of the OPR must be within 77-123% to be considered in control.

19.6 All calibration standards must be traceable to the original standard source. The calibration curve must be established at the beginning of the analytical run. It must include at least five different concentrations, with the lowest concentration equal to the PQL. The average response factor of each calibration standard is used to calculate the sample values. The RSD of the response factors must be less than 15% of the mean or the calibration fails.

19.7 ICV control limit is 79-121%, while the CCV control limit is 77-123%. The CCV is analyzed every 10 analyses, and at the end of an analytical run. CCBs are always analyzed after the CCVs.

19.8 Field Blanks: To be compliant with EPA 1631, clients must submit a field blank for each set of samples (samples collected from the same site at the same time, to a maximum of 10 samples).

19.8.1 If no field blanks are submitted by the client, their data will be flagged with "FB-1631." "Required equipment/field/filter blank not submitted by the client. The sample has been analyzed according to 1631E, but does not meet 1631E criteria."

19.9 Method or Preparation Blanks (BLK): Method blanks are used to demonstrate that the analytical system is free from contamination that could otherwise compromise sample results. Method blanks are prepared and analyzed using sample containers, labware, reagents, and analytical procedures identical to those used to prepare and analyze the samples.

19.9.1 A minimum of three 1 % BrCl method blanks per analytical batch are required. Any sample requiring an increased amount of reagent must be accompanied by at least one method blank that includes an identical amount of reagent.

19.9.2 If the result for any 1 % BrCl method blank is found to contain =0.50 ng/L Hg (0.25 ng/L for DOD), the system is out of control. Mercury in the analytical system must be reduced until a method blank is free of contamination at the 0.50 ng/L level.

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19.9.2.1 For WI DNR samples, the method blank results need to be assessed to 0.15 ng/L or ten percent of the measured concentration in the sample. The results must be qualified if the method blank exceeds the highest of either of these values.

19.9.3 For method blanks containing more than 1% BrCl, the control limit is equal to 0.50 ng/L multiplied by the final preservation percentage of BrCl. For example, for a method blank preserved to 2 % BrCl, the control limit for the blank is 0.50 ng/L * (102/101), or 0.50 ng/L. For 3% BrCl the control limit is (103/101)*0.50ng/L, or 0.51ng/L.

19.10 Instrument Blanks (IBL): A minimum of three instrument blanks must be analyzed with each analytical batch (before the first calibration standard). To analyze an instrument blank, analyze a sample of reagent water preserved to 1% BrCl.

19.10.1 If the instrument blank is found to contain more than 0.50ng/L, the system is out of control. The problem must be investigated and remedied before proceeding, and any samples run must be reanalyzed.

19.10.1.1 The mean result for all instrument blanks must be ≤ 0.25ng/L with a standard deviation of 0.10 ng/L.

19.10.1.2 For WI DNR samples, the ICB and CCB results need to be assessed to 0.15 ng/L or ten percent of the measured concentration in the sample. The results must be qualified or the affected samples re-analyzed if an ICB/CCB exceeds the highest of either of these values.

19.11 The analytical day must close with a CCV/OPR/CCB.

19.12 Since the method is done in real-time, it is EFGS' position that a single non-compliant QC sample result does not automatically invalidate a data set. All data points that can be explained and rerun with a passing result can be qualified. If the source of error cannot be corrected for a QC standard that day, none of the data can be validated. In the event that the system becomes out of control during the analysis day, all results bracketed between valid QC data points shall still be considered valid (CCV, OPR, CCB, etc).

19.13 The Control Limits are established from EPA 1631E.

19.14 *Carryover: In 2020 a carryover study was completed monitoring Hg levels up to five times the top calibration point (200 ng/L). No carryover was detected during this study. Any sample ran with a concentration of Hg over 200 ng/L requires a blank be ran directly after to ensure there is no carryover. Additional samples may only be ran after the blank shows a concentration below 0.50 ng/L.*

20 Corrective Action:

20.1 The data is reviewed as in the QC section (or matrix specific QC section) for all parameters that pass specific requirements. If the data does not meet QC requirements for waters, it is reanalyzed for confirmation; if the failing MD/MS/MSD results confirm, another sample is used for the batch. For all digestions, it is qualified or submitted for reruns. Data may be qualified (based on scientific peer review) by the Group Supervisor, Project Manager, Lab Manager, or QA Officer.

20.1.1 Continuing Calibration Verification (CCV): If a recovery falls outside acceptance criteria, recalibrate the instrument and reanalyze all affected samples since the last acceptable CCV or immediately analyze two additional CCVs. If both CCVs are within acceptance criteria, the samples may be reported without reanalysis and the analysis of the next bracket may continue beginning with a CCB.

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20.1.1.1 If either of the two CCVs fails, the analysis must be terminated, the problem resolved, the instrument recalibrated and then all of the affected samples since the last acceptable CCV reanalyzed.

20.2 Control Chart data is generated through LIMS to monitor the performance of the CCV, LCS, MS, and MSD. This is done by the QA department.

20.3 Due to the real-time nature of the CVAFS method, failures must be investigated as they happen. If the source of the problem can be identified, and corrected, the samples may be rerun. If source of problem cannot be isolated, see the Senior Analyst, Group Supervisor, or Laboratory Manager for instructions.

20.4 The Senior Analyst, Group Supervisor, Laboratory Manager, or QA Officer must be informed if QC fails. It is also advisable to always alert the Project Managers.

21 List of Attachments

Table 1: QC Requirements for Total Mercury

Table 2: Troubleshooting Flow Chart

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Table 1: QC Requirements for Total Mercury

QC Parameter	Acceptance Criteria
Initial Calibration Verification (ICV)	79-121% Recovery
Continuing Calibration Verification (CCV)	77-123% Recovery
Ongoing Precision and Recovery (OPR)	77-123% Recovery
Initial Calibration Blank (ICB)/ Continuing Calibration Blank (CCB)	Individually, IBL and CCB ≤ 0.50ng/L, but the mean of all the IBLs shall be ≤ 0.25ng/L with a standard deviation of ≤ 0.10ng/L. For WI DNR, IBL and CCB individually must be ≤ 0.15 ng/L.
Laboratory Control Standard (LCS) or Quality Control Standard (QCS)	80-120% Recovery RSD ≤ 24%
Certified Reference Material	75-125% *Recovery* RPD ≤ 24%
Calibration Curve RSD (Referred to as "Corr. RSD CF" in Excel spreadsheet).	RSD of Calibration Response Factor ≤ 15%
Lowest Calibration Point	75-125%
1% BrCl Method Blank (BLK)	≤ 0.50ng/L (≤ 0.25ng/L for DOD projects, ≤ 0.15 ng/L for WI DNR) (individually)
Matrix Duplicate (MD) and Analytical Duplicate (AD)	≤ 24% RPD
Matrix Spike and Matrix Spike Duplicate (MS/MSD) ; Analytical Spike (AS) and Analytical Spike Duplicate (ASD)	71-125% Recovery ≤ 24% RPD

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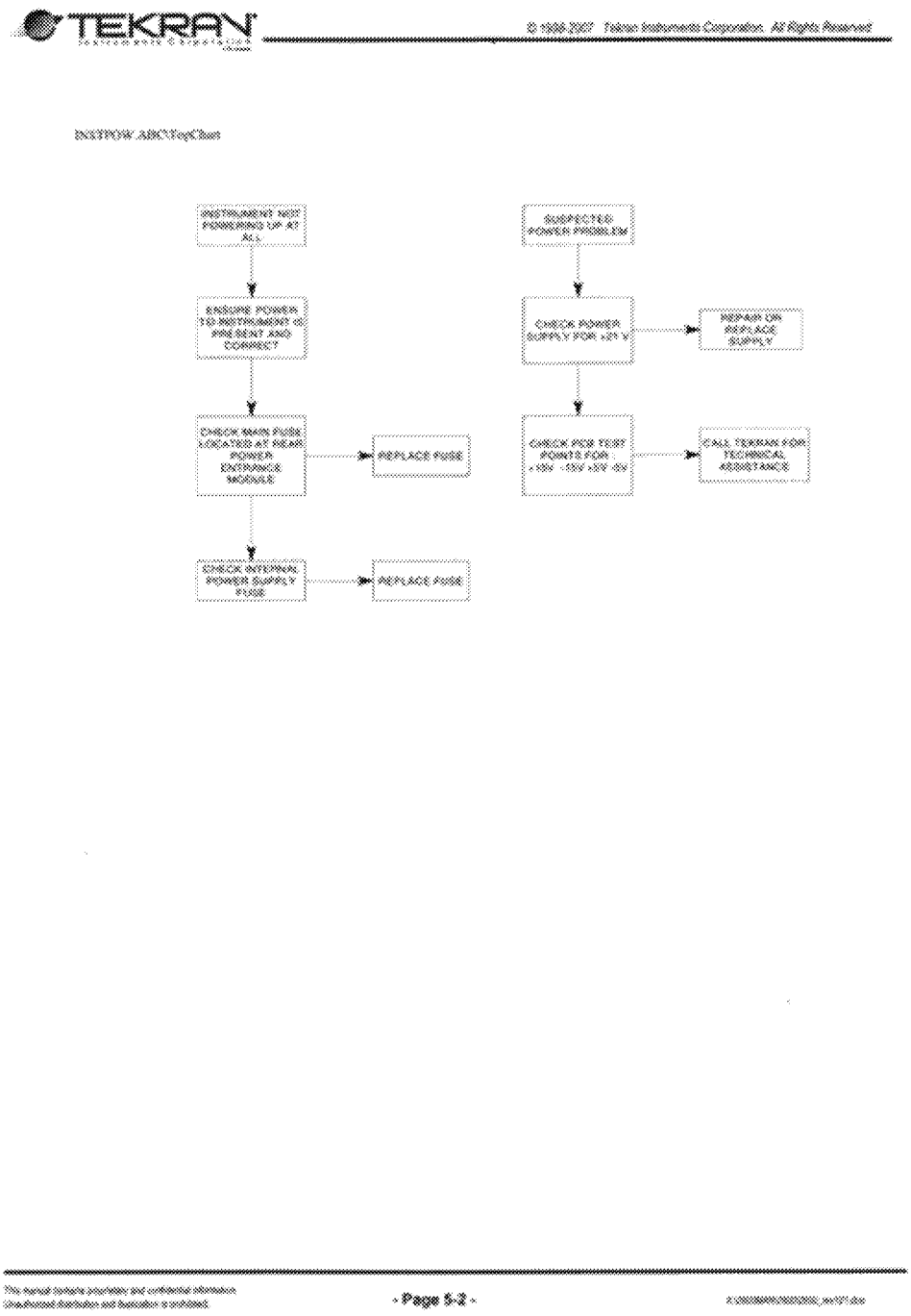
Table 2: Troubleshooting Flow Chart



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LOWRESP.ABC\TopChart

NOTES: 1) Most problems with low responses can be traced to chemical/physical problems with auxiliary equipment.

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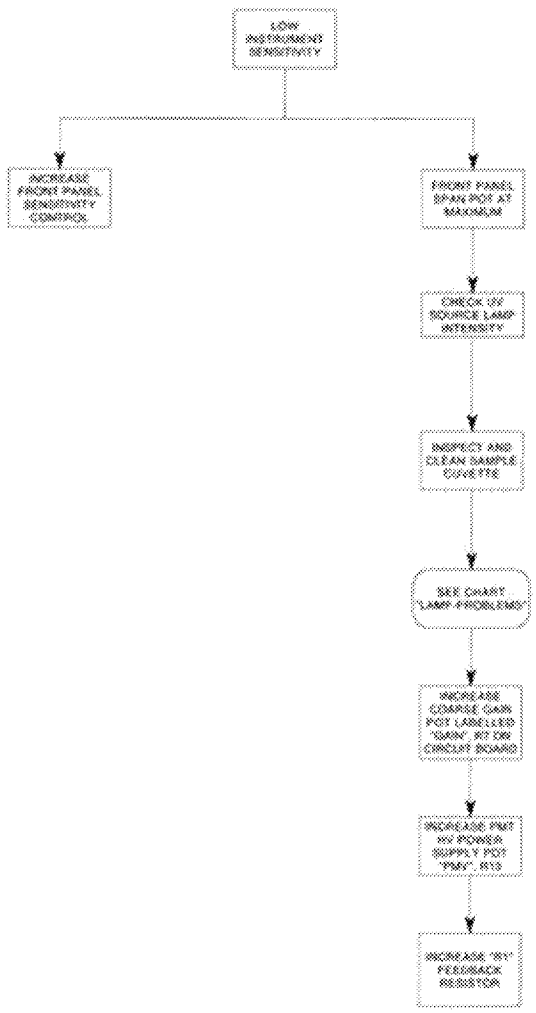
INSTLOW.ABC\TopChart



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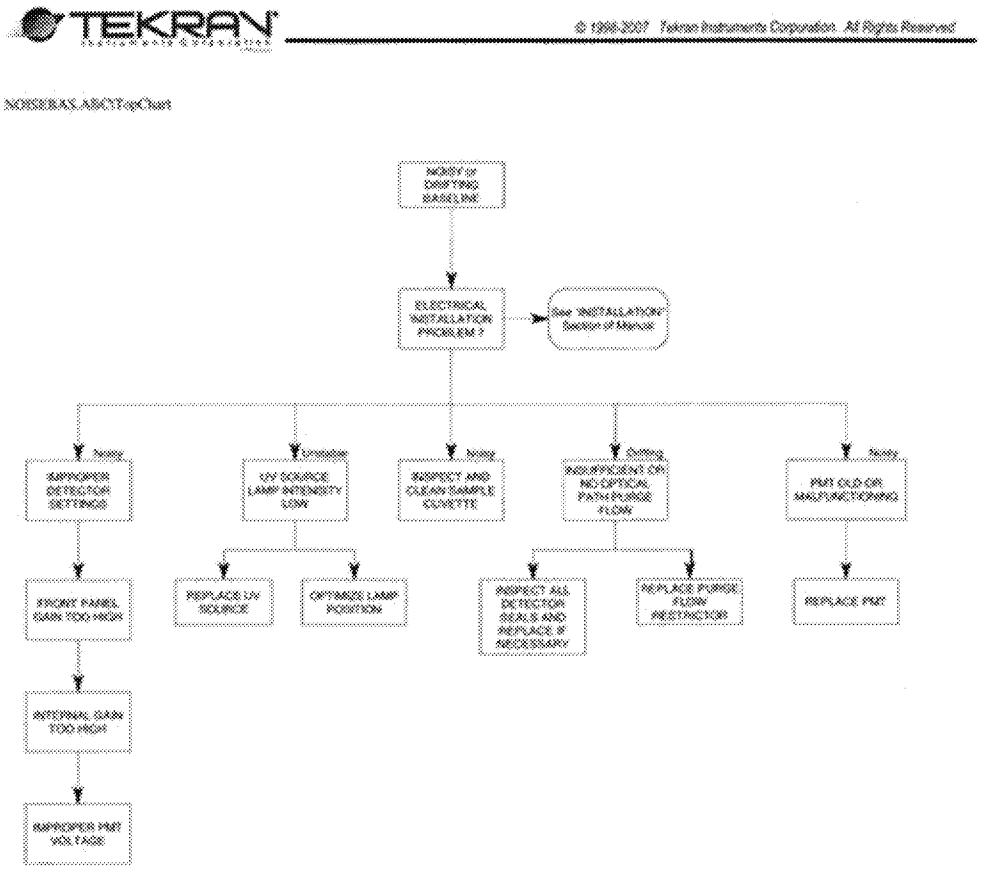

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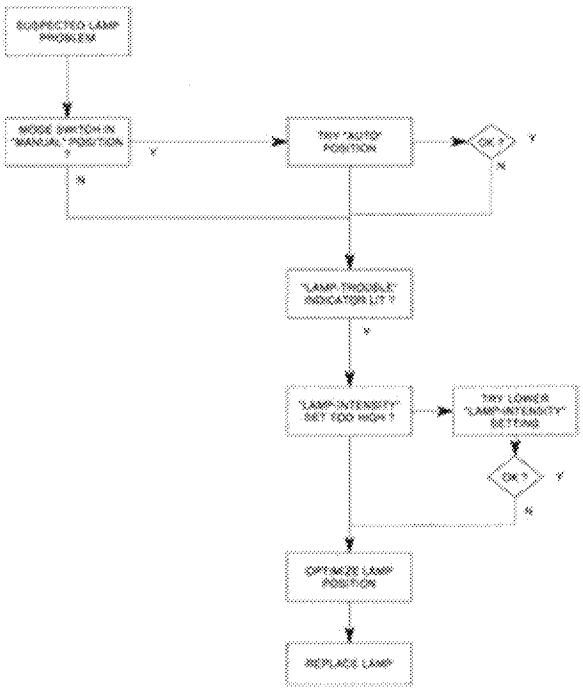
LAMPPROB.ABC\TopChart



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Version history

Version	Approval	Revision information
4	03.NOV.2015	
5	19.MAY.2016	
6	09.MAY.2017	
7	03.NOV.2020	

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DOCUMENT IS NOT CONTROLLED WHEN PRINTED

1) Revision Log:
2) Reference:
3) Cross Reference:
4) Purpose:
5) Scope:
6) Basic Principles:
7) Reference Modifications:
8) Definitions:
9) Interferences:
10) Safety Precautions, Pollution Prevention and Waste Handling:
11) Personnel Training and Qualifications:
12) Sample Collection, Preservation, and Handling:
13) Apparatus and Equipment:
14) Procedure:
15) Calculations:
16) Statistical Information/Method Performance:
17) Quality Assurance/Quality Control:
18) Corrective Action:

1) Revision Log:

Revision: 9	**Effective Date:**	This version
Section	**Justification**	**Changes**
13.13, 14.1.5	Required	Desiccator was incorporated in the procedure
14.1.2.2	Correction	Fixed grammatical error
14.1.4	Correction	Fixed grammatical error
14.1.6	Correction	Fixed grammatical error

2) Reference:

2.1 Chemical Hygiene Plan, Eurofins Frontier Global Sciences, current version.

2.2 National Environmental Laboratory Accreditation Conference, NELAC Standard September 8, 2009.

2.3 Department of Defense / Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, prepared by DoD Environmental Data Quality Workgroup (EDQW) and DOE Consolidate Audit Program (DOECAP) Operations Team, DOD Version 5.0, July 2013; DOE Version 3.0, July 2013

2.4 Method 2540B-1997 (3), Total Solids Dried at 103-105C, Standard Methods for the Examination for the Examination of Water and Wastewaters, 1997

3) Cross Reference:

Document	Document Title
EFSR-S-CS-SOP2794	Ultra Clean Aqueous Sample Collection
EFHS-S-HS-SOP2991	Waste Disposal Procedure for Client Samples

4) Purpose:

4.1 The purpose of this Standard Operating Procedure (SOP) is to describe the determination of total solids (also known as dry material fraction or dry weight) in sediments, tissues, sludges, and slurries as well the density of liquids, a measurement of mass per unit volume of a substance.

5) Scope:

5.1 This SOP applies to all samples requiring total solids and density testing.

6) Basic Principles:

6.1 For total solids determination, samples are accurately weighed into small aluminum foil weighing dishes, dried for at least 12 hours at 103-105°C, and then weighed again.

> Note: Trace metals concentrations should not be determined on the residues of this method, as losses by volatilization (Hg, CH_3Hg, As, Se) and/or contamination by the trays, oven, etc. (Al, Fe) may occur. Trace metal concentrations (especially mercury) should be measured on a homogenous wet aliquot of the sample, and then the results corrected by these dry or organic-free fractions.

6.2 For the determination of density, samples are accurately measured out into a known volume and weighed.

7) Reference Modifications:

7.1 No significant modifications were made to these methods.

8) Definitions:

8.1 Batch – no more than 20 client samples grouped for preparation. 1 MD (for total solids or density) per 10 client samples

8.2 Celsius (C), conversion of Celsius to Fahrenheit: (C * 1.8) + 32.

8.3 Fahrenheit (F), conversion of Fahrenheit to Celsius: (F - 32) / 1.8.

8.4 Certified Reference Material (CRM) – a standard of known composition that is certified by a recognized authority and representing a sample matrix. It is used to verify the accuracy of a method.

8.5 Matrix Duplicate (MD) – a second representative sample is selected from a sample designated as the source sample. It's processed in the same manner as the source sample. This QC sample will assess method precision for a particular matrix.

8.6 Control Limit (CL) – the limit of the range of acceptability for the quality control samples.

8.7 May: This action, activity or procedure is optional.

8.8 May Not: This action, activity or procedure is prohibited.

8.9 Shall: This action, activity or procedure is required.

8.10 Should: This action, activity or procedure is suggested, but is not required.

9) Interferences:

9.1 This method relies purely on weight and volume. Therefore, the analytical balance must be accurately calibrated daily before initial use and all volumetric equipment should all be Class A certified and calibrated "to contain" marked as TC.

9.2 Drafts, gusts, winds, or any other type of significant air flow could potentially remove dry sample from the aluminum dish, causing an inaccurate weight, which would yield an inaccurate result. All attempts must be made to avoid significant air flow, such as placing the aluminum foil dishes into glass trays that are covered with clean bench liners.

9.3 Total Solids: After heating, the samples should not be exposed to ambient air for more than thirty minutes prior to weighing. This is to reduce the chance for the samples to absorb moisture from the air resulting in an inaccurate final mass.

10) Safety Precautions, Pollution Prevention and Waste Handling:

10.1 Personnel will don appropriate laboratory attire according to the Chemical Hygiene Plan. This includes, but is not limited to, laboratory coat, safety goggles, and nitrile gloves under clean gloves.

10.2 All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against known disease-causative agents. Eurofins Frontier will reimburse the expense of Hepatitis A and B immunizations for any laboratory staff member who desires this protection.

10.3 See Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP) for general information regarding employee safety, waste management, and pollution prevention.

10.4 Pollution prevention information can be found in the current Eurofins Frontier Global Sciences Chemical Hygiene Plan (CHP), which details and tracks various waste streams and disposal procedures.

10.5 All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations. Any waste generated by this procedure should be disposed of according to *EFHS-S-HS-SOP2991*, which provides instruction on dealing with laboratory and client waste.

11) Personnel Training and Qualifications:

11.1 The analyst/laboratory technician must have read this SOP and other relevant SOPs and have the training documented on the applicable form(s). The analyst may be questioned on SOP by supervisor(s) and/or trainers.

11.2 Training is documented by the employee and supervisor, and is kept on file in the QA Office. The employee must read, understand, and by signing the training document, agree to perform the procedures as stated in all Standard Operating Procedures (SOPs) related to this method.

11.5 All employees must also, on a yearly basis, read the Quality Manual (QM), and complete the yearly Ethics training.

11.6 All training documents including IDOCs, CDOCs, SOP reading, Initial QA orientation, and Ethics training are stored by the Quality Assurance Manager in the employees training file for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

11.7 Chemical Safety Training, Compressed Gas Training, Chemical Hygiene Plan documentation, and Shipping of Hazardous goods, are stored by the Health and Safety Officer for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

12) Sample Collection, Preservation, and Handling:

12.1 Not applicable

13) Apparatus and Equipment:

13.1 LIMS – Element, version 6.11 or higher; Computer – Windows XP, 7 or 8

13.2 Excel – Microsoft Office 2003 or later versions

13.3 Weighing Dishes: 45-60 mm outer diameter (o.d.) disposable aluminum foil weighing dishes.

13.4 Drying Oven. A standard stainless steel laboratory oven, with documented calibration, operating at a temperature of 103-105 °C. For the drying of sediments, which could be high in mercury and release volatile Hg to the surrounding air, the oven should be placed in an outside exhausting hood or in an area outside of the laboratory building.

13.5 Analytical Balance: A laboratory analytical balance capable of weighing to ± 1 mg, with documented calibration.

13.6 Calibrated thermometer.

13.7 Total Solids logbook

13.8 Microwave Digestion Logbook

13.9 Bomb Digestion Logbook

13.10 Stainless steel tools for homogenization

13.11 Disposable spatula

13.12 1mL graduated Class A TC volumetric flasks, an alternate volume can be used if the volumetric flask is Class A TC.

13.13 Desiccator

14) Procedure:

14.1 Total Solids

14.1.1 Total solids should be performed when possible along with the digestion prep associated with the work order, in order to provide the most accurate dry mass correction.

14.1.2 Number the weighing dish with an engraving tool or marking pen and weigh to the nearest milligram. Record the dish ID and weight in the Total Solids Logbook.

14.1.2.1 If multiple batches are to be digested, the first batch of weigh pans shall be labeled as "A1, A2, A3, etc.", batch 2 "B1, B2, B3, etc". The corresponding number shall be found in the logbook.

14.1.2.2 If possible, all sample weigh-outs should be performed on the same balance.

14.1.3 Place an aliquot of well-homogenized sample (1-10 grams for samples, 0.5-1.0 gram for CRMs) into the dish and record the total mass (dish + wet sample) to the nearest milligram.

14.1.4 Place the sample into the drying oven and dry at 103-105°C for at least 12 hours.

14.1.5 Samples must be transferred to a desiccator and cooled to room temperature prior to weighing. The samples should not remain in the desiccator for more than 30 minutes.

14.1.6 After cooling, weigh each sample (dish + dry sample) and record in the logbook.

14.1.6.1 If possible, all sample weigh-outs should be performed on the same balance.

14.1.7 Transfer the information from the Total Solids Logbook into the total solids Excel template.

14.1.7.1 Save this file as TS-YearMonthDate-number of batch in the Total Solids data folder found under the AL Group Folder in the Work on Cuprum File. (Example of name for the second total solids batch prepped on April 5th, 2011 would be TS-110405-02).

14.1.7.2 The total solids template is a locked excel file. It will calculate the weight of the wet sample, the weight of the dry sample, the total solids percentage and the sample duplicate RPD using the values entered for the pan weight, the wet sample and pan weight, and the dry sample and pan weight.

14.1.8 Using the values calculated from the total solids excel template, enter the total solids percentage into LIMS in the data Review Section.

14.1.8.1 It is not necessary to include the initial and final weights in LIMS, only the % total solid is needed.

14.1.9 Data should be reviewed in LIMS. Reviewer should verify all masses and sample ID's in the excel file from the Total Solids logbook and verify the % total solids are correct in LIMS.

14.2 Density

14.2.1 Density should be performed when possible along with the digestion prep associated with the work order.

14.2.2 Record sample ID, sample container, the flask ID, balance ID in the appropriate digestion logbook (microwave or bomb digestion book).

14.2.3 Take the weight of your 1mL volumetric flask.

14.2.4 Remove the flask from the balance and transfer sample using an eyedropper to the etched ring graduation marking. The volume must be read from the lowest point of the curved surface of the liquid known as the meniscus.

14.2.5 Take the weight of your 1mL volumetric flask plus sample.

14.2.6 Analysis: Subtract the mass of the empty cylinder from the combined mass measurement to obtain the mass of the sample. The difference shall represent the density of the sample.

14.2.6.1 If an alternate volume is used, see section 15.2.1.1.

14.2.7 Enter the density values into LIMS under batch in the data Review Section.

14.2.7.1 It is not necessary to include the initial and final weights in LIMS, only the density is needed.

14.2.8 Data should be reviewed in LIMS. Reviewer should verify all masses, sample ID's and calculations in the logbook and verify the density value entered is correct in LIMS.

15) Calculations:

15.1 Total solids calculations are performed in a secured excel spreadsheet.

15.1.1 Total Solids Percentage = [(Pan weight + Dry sample weight)-(Pan weight)]/[(Pan weight + Wet Weight)-(Pan Weight)]

15.2 Density Calculation

15.2.1 Density (g/mL) = (1mL Volumetric Flask + Sample Weight)-(1mL Volumetric Flask Weight)

15.2.1.1 The above calculation is assuming 1mL of sample transferred over. If a larger volumetric flask is used the difference would further be divided by the volume of flask used. For example, if a 5mL Class A TC volumetric flask were used, the calculation would be as follows:

Density (g/mL) = [(5mL Volumetric Flask + Sample Weight)-(5mL Volumetric Flask Weight)] / 5mL

16) Statistical Information/Method Performance:

16.1 There is no statistical information or method performance related to this procedure.

17) Quality Assurance/Quality Control:

17.1 Total Solids: For every 10 samples analyzed, one matrix duplicate (MD) sample is required. The relative percent difference (RPD) between the duplicates should be = 10%. Duplicates for density are not required, since clients tend to submit limited sample volume.

17.2 The balance should be calibrated at the milligram level daily using certified standard weights.

18) Corrective Action:

18.1 Total Solids: If the RPD for the MD is above 10%, all samples should be re-homogenized and the procedure for total solids must be repeated. Exceptions to the RPD limit may be permitted by the QA Manager when the total solids content is less than 25%.

18.2 If a result for total solids analysis on a sample is above 100%, but no higher than 101%, value must be rounded down to 100%.

18.3 If the result is higher than 101%, sample must be re-homogenized, and retested.

18.4 If the result for the MD and/or its parent sample is higher than 101%, all samples must be reanalyzed.

18.5 Due to the constraints of LIMS, a total solids value from a reanalysis cannot be entered into the LIMS as a RE. If total solids has to be preformed again due to failing QC or any other issues, you must document in the MMO notes of the work order the date and excel file name of the original prep. Then you will enter the total solids value from the reprep for the sample into LIMS by overwriting the original value.

EFHS-S-HS-SOP2991 Waste Disposal Procedures for Client Sample Waste
EFQA-Q-QD-SOP2814 Personnel Training Procedures
EFSR-S-CS-SOP2794 Ultra-Clean Aqueous Sample Collection

End of document

Version history

Version	Approval	Revision information
7	19.MAY.2016	
8	09.NOV.2016	
9	08.DEC.2016	

eurofins	Always check on-line for validity. **Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS**	Level: **Work Instruction**
Document number: **T-MET-WI8636**		
Old Reference: **1-P-QM-WI-9015160**		
Version: **25**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **08-MAR-2019**	Document users: **6_EUUSLA_Metals_ICP Prep, 6_EUUSLA_Metals_ICP Prep Verifiers, 6_EUUSLA_Metals_ICP-MS Prep, 6_EUUSLA_Metals_ICP-MS Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log

Revision 25		**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
LIMS ID	Follow current procedure		Added analysis number for sieving
Apparatus and Equipment	Follow current procedure		Added sieves and changed temperature to 90C-100C
Procedure	Follow Current Procedure		Clarified if sample is not split
Procedure	Follow current procedure		Added section on how to dry and sieve samples
Procedure	Update to Method		Updated 90C-95C to be 90C-100C
LIMS ID	Follow Current Procedure		Removed old analysis numbers
Quality Assurance/Quality Control	Clarification		Added sentence about sample and batch QC must be the same

Revision: 24		**Effective Date:**	27-FEB-2018
Section	**Justification**		**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356		Removed revision logs up to the previous version
Cross Reference	Reference to Level 2 documents is not necessary		Removed reference to Demonstration of Capability SOP

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3050B, December 1996.
2. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI11933	Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A (aqueous, solid, tissue) and EPA 200.8 (aqueous)
T-MET-WI11931	Metals by Inductively Coupled Plasma Atomic Emissions Spectroscopy for SW-846 Methods 6010B/C (aqueous, solid, tissue) and EPA 200.7(aqueous)
T-MET-WI9082	Working Instructions for Prep Solutions and Standards

Purpose

This digestion procedure is for the preparation of solid samples for analysis by ICP and ICP/MS following SW-846 protocol.

Scope

This method is used for preparation of metals in solid samples for analysis by ICP and ICP/MS.

Basic Principles
A representative sample is digested with repeated additions of nitric acid (HNO_3) and hydrogen peroxide (H_2O_2). Hydrochloric acid (HCl) is added to the initial digestate and the sample is refluxed. The resultant digestate is diluted and analyzed.

This method is not a total digestion technique for most samples; it is a very strong acid digestion that dissolves almost all elements that could become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure.

Definitions

1. ACS – American Chemical Society
2. D – Sample Duplicate
3. DOC – Demonstration of Capability
4. IDOC – Initial Demonstration of Capability
5. LCS/LCSD – Laboratory Control Sample/ Laboratory Control Sample Duplicate
6. LCSW– Laboratory Control Sample Water
7. LLENS - the computer program that integrates a PC with an analytical balance to collect data directly from the balance. The program organizes the data and transmits the readings to the LIMS.
8. LIMS – Laboratory Information Management Systems
9. Sample ID – unique 7-digit number assigned to a client sample.
10. LOQ – Limit of Quantitation
11. MDL – Method Detection Limit
12. MS (R) – Matrix Spike
13. MSD (M) – Matrix spike duplicate
14. PB/PBW–Preparation Blank/ Preparation Blank Water
15. QC – Quality Control
16. Method Blank - equivalent to a Preparation Blank. A designated sample designed to monitor for sample contamination during the analysis process. A volume of reagent laboratory water is typically used to monitor water sample analysis, while solids blanks consist of a purified solid matrix or just the reagents used in the test. The blank demonstrates that no artifacts were introduced during the analysis process.
17. SOP- Standard Operating Procedure
18. U or US – unspiked background sample

Interferences
When analyzing sample by ICP-MS using this digestion procedure we follow the instrument manufacturer's guidelines to eliminate polyatomic interferences typically caused by Chlorine. The process we follow involves the use of a collision/reaction cell on the ICP-MS. Below is a description of how the collision/reaction cell works.

Reaction Process - The primary method of interference removal is through a reaction event. When using a reaction gas, either the target interference is more reactive than the target analyte, leading to preferential removal of the interferent or (less commonly) the target analyte is more reactive and is converted to a new species at a different mass which is free from any existing or newly-formed overlap.

Collision Process - The primary method of interference removal is through a non-reactive event. This process of interference removal is kinetic energy discrimination (KED). Energy Discrimination is most commonly used with an inert gas, which means the interference removal process is not affected by reactions in the cell.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO_3) – This acid can cause skin burns. Add nitric acid to samples in a hood or use the designated dispensing equipment to avoid exposure to toxic fumes.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCl with concentrated H_2SO_4 to avoid a violent reaction. Always use in a fume hood or use the designated dispensing equipment.

Hydrogen peroxide (H_2O_2) - This is a strong oxidizing agent and causes severe burns. Avoid contact with skin.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds. Samples that contain dust may be hazardous. Open in a fume hood.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water. Spill pillows and SPILL-X-A are stored on the prep room shelf.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each employee performing this digestion procedure must work with an experienced employee for a period of time until they can independently set up batches and perform the necessary steps outlined in this procedure. Proficiency is measured through documentation of the critical steps in this procedure, over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four LCSs that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four LCSs or one blind sample.

Sample Collection, Preservation, and Handling

Solid samples require no chemical preservation.

Samples must be submitted in glass or plastic containers and stored at 0° to 6°C, not frozen, prior to digestion. Samples must be analyzed within 6 months of sample collection.

Digested samples are stored in polypropylene bottles at room temperature.

Apparatus and Equipment

1. Polypropylene containers and covers (digestion vessels) - certified clean and Class A equivalent
2. Whatman No. 41 filter paper or equivalent
3. Funnels
4. Environmental Express HotBlock (block digestor) - adjustable and capable of maintaining a temperature of 90 to 100°C
5. Balance capable of reading 0.01 g
6. Chemware Ultra-Pure PTFE boiling stones, or equivalent.
7. Computer and software LLENS (Lancaster Laboratories Electronic Notebook System)
8. Sieves size depending upon client request

Reagents and Standards

For reagent preparation, shelf life, and storage conditions, see Form *T-MET-WI9082*.

1. Nitric acid (HNO_3) – Fisher, Trace Metal Grade, or equivalent. Store at room temperature. Re-evaluate annually.
2. Nitric acid (1:1) – Add 500 mL of HNO_3 to 500 mL of reagent water. Store in polypropylene at room temperature. Expires 6 months from date of preparation. (Different volumes are acceptable but ratios must stay the same.)
3. Hydrogen peroxide, 30% (H_2O_2) – Fisher, Certified ACS or equivalent. Store at room temperature. Re-evaluate annually.
4. Hydrochloric acid (HCl) – Baker Instra-Analyzed, or equivalent. Store at room temperature. Re-evaluate annually.

NOTE: It is acceptable to prepare using multiples of indicated weights and volumes if ratios are maintained.

Procedure

A. Soil Sample Digestion

1. Turn block digestor on and allow block to reach the Control Point setting that provides 90° to 95°C sample temperature. (The block temperature setting is not necessarily the sample temperature.) See below for **Block Digestor Instructions** section.

2. If sample is not located in split bin weigh 1.00 to 1.50 g (to the nearest 0.01 g) of a well mixed sample into a polypropylene digestion vessel. (If the sample is watery use 5.00 to 5.50 grams for analysis. Additional information on non-standard matrices is found at the end of the procedure section.) Add 1.00 to 1.49 g of Chemware Ultra-Pure PTFE boiling stones to the digestion vessel for the blank and LCS. Enter the blank and LCS weight as 1.0000 to 100.0000 final volume in the LLENS. For sample batch spiking procedures see *T-MET-WI9082*. All spiking must be performed prior to starting the digestion procedure.

3. Add 10 mL of (1:1) HNO_3, swirl to mix, and cover with a polypropylene cover.

4. Place sample vessel in block digestor. Heat (reflux) the sample at 90° to 100°C for 10 to 15 minutes without boiling.

5. Remove vessel from digestion block and allow sample to cool.

6. Add 5 mL of concentrated HNO_3. Add 20 mL of reagent water. Replace cover, return vessel to digestion block and heat for 30 minutes.

NOTE: If brown fumes are generated (indicating oxidation of the sample by HNO_3) continue the process of adding 5 mL HNO_3 and heating until no brown fumes are given off by the sample. This indicates that the reaction with HNO_3 is complete. Add the same amount of HNO_3 to the entire digestion batch.

7. With cover on, heat at 90° to 100°C without boiling for 2 hours. Maintain a covering of solution over the bottom of the vessel at all times (add reagent water if necessary).

8. Remove vessel from digestion block and allow sample to cool.

9. Add 2 mL of reagent water and 3 mL of 30% H2O2. With cover on, return vessel to digestion block and heat until effervescence subsides. Care must be taken to ensure that losses do not occur due to excessively vigorous effervescence.

10. Continue to add 30% H2O2 in 1-mL aliquots with warming until the effervescence is minimal or until the general sample appearance is unchanged.

NOTE: Do not add more than a total of 10 mL 30% H2O2.

11. With cover on, continue heating the acid-peroxide digestate at 90° to 100°C without boiling for 2 hours. Maintain a covering of solution over the bottom of the vessel at all times (add reagent water if necessary).

12. Remove sample vessel from digestion block and allow to cool.

13. Add 10 mL of HCl. With the cover on, return vessel to digestion block and heat at 90° to 100°C for 15 minutes.

14. Remove sample vessel from digesti on block.

15. If floating particulate is evident after digestion, the sample must be filtered.

    a. Filter through Whatman No. 41 filter paper into a polypropylene container.

    b. Wash sample vessel, residue, and paper thoroughly with reagent water.

    c. If any samples are filtered, the prep blank and LCS must also be filtered.

16. Adjust volume to the 100mL mark on the digestion vessel with reagent water and mix. Seal vessel with a screw cap. The sample is now ready for analysis.

NOTE: When special limits of quantitation are required by the client, use more sample weight.

B. For wipe samples:

When wipes are digested by this method, one blank media each must be used for the batch preparation blank, the LCS, and the LCSD. Refer to Form *T-MET-WI9082* for the spiking of the LCS and LCSD. Digest wipes in their own batch. Use reagent water to rinse any particulate matter from the wipe container into the vessel containing the wipe before digesting. If brown fumes are evolved during wipe sample digestion, perform only two 5 mL HNO3 additions with 30-minute refluxing each; add the same amount of HNO3 to the entire batch. Proceed with digestion.

C. For tissue samples:

When fish tissues, or other tissue samples are digested by this method, refer to Form *T-MET-WI9082* for the spiking of the LCS, LCSD (if needed), R (matrix spike), and M (matrix spike duplicate). Add 1.00 to 1.49 g of Chemware Ultra-Pure PTFE boiling stones to the digestion vessel for the blank and LCS. Digest tissue samples in their own batch.

D. For soil samples that need to be dried and sieve prior to digestion Analysis #10681

1. Lay out sample on a clean surface of either glass or aluminum foil
2. Allow sample to dry. When sample is done drying, but is dried in a large chunk take appropriate clean tools to break down the large chunk in order to sieve the sediment.

3. Pour entire sample that has been laid out to dry into the appropriate sieve size defined by client and shake sieve to get sample to fall through.

4. Take the sieved sample and place into the appropriate bottle code needed for analysis.

5. Rinse the sieve and the sieve filter with reagent water until no particulate is left on sieve.

6. Dry sieve in open air or in an oven until no reagent water is present.

Block Digestor Instructions

1. Turn block digestor on by pressing rocker switch located on the cord.

2. Wait about 8 seconds until controller display indicates current block temperature.

3. PRESS and hold STAR (*) key.

4. The display shows Control Point temperature.

5. The digits can be changed to the desired value by pressing the up and down arrow keys while holding the (*) key.

6. Confirm Control Point temperature is set to the block temperature that provides 90° to 95°C.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used. If necessary, adjust Control Point temperature to the proper setting as instructed below.

NOTE: Polypropylene containers must not be heated above 130°C.

Calculations
Not applicable.

Statistical Information/Method Performance
Not applicable to this procedure. See analysis method.

Quality Assurance/Quality Control
For sample batch spiking instructions see form *T-MET-WI9082*. Refer to ICP section when prepping ICP analysis. Refer to ICP/MS section when prepping ICP/MS analysis. Prepare a method blank, sample duplicate, MS, MSD, and LCS with every digestion batch (20 samples or less). Each piece of batch QC is digested following the procedure in this SOP. If any samples are filtered the prep blank and LCS must also be filtered.

Any extra digestion step done on one sample in a batch must be done to batch QC as well. Example if 1 mL of H202 is added to a sample it must also be added to the batch QC.

Refer to ICP Analysis *T-MET-WI11931* for sample batch quality control requirements, acceptance criteria and corrective action.

Refer to ICP/MS Analysis *T-MET-WI11933* for sample batch quality control requirements, acceptance criteria and corrective action.

T-MET-WI11931 Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)
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)
T-MET-WI9082 Working Instructions for Prep Solutions and Standards

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End of document

Version history

Version	Approval	Revision information
23	23.DEC.2015	
24	13.FEB.2018	
25	06.MAR.2019	

eurofins	Always check on-line for validity. **VOCs and GRO by GC/MS in Soils and Solids by EPA 8260C/D**	Level: **Work Instruction**
Document number: **T-VOA-WI8236**		
Old Reference: **1-P-QM-WI-9013077**		
Version: **8**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **26-MAR-2020**	Document users: **6_EUUSLA_GC/MS Volatiles_GC/MS Auditors/Verifiers, 6_EUUSLA_GC/MS Volatiles_Management, 6_EUUSLA_GC/MS Volatiles_SW846 8260B/C Soil**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

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Revision Log

	Revision: 8	**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version
Sample Collection, Preservation and Handling	Clarification	Re-worded entire section to clarify differences between low level and high level.
Calibration C.8	Requirement	Added statement concerning quadratic regressions and SC compliance samples.
Quality Assurance/ Quality Control	Clarification	Added information concerning SC requirements regarding batch QC

	Revision: 7	**Effective Date:** 17.FEB.2020
Section	**Justification**	**Changes**

	Revision: 7	**Effective Date:** 17.FEB.2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version
Attachments	Current practice	Updated Figures 1-5 to most current versions

Reference

1. Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), SW-846 Method 8260C, August 2006.

2. Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), SW-846 Method 8260D, June 2018.

3. Determinative Chromatographic Separations, SW-846 Method 8000D, March 2018.

4. Test Methods for Evaluating Solid Wastes, SW-846 Method 5030B, December 1996.

5. Test Methods for Evaluating Solid Wastes, SW-846 Method 5030C, May 2003.

6. Test Methods for Evaluating Solid Wastes, SW-846 Method 5035, Revision 0, December 1996.

7. Test Methods for Evaluating Solid Waste, SW-846, Method 5035A, July 2002.

8. *Total Petroleum Hydrocarbons Analysis-Gasoline Method*, California Department of Health Services, LUFT Task Force.

9. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
S-SS-WI10682	GC/MS - Bulk Solid Matrix Sample Preparation
S-SS-WI11170	Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035
T-VOA-WI7619	GC and GC/MS Instrumentation Maintenance
T-VOA-WI7629	GC/MS Volatile Standards Traceability
T-VOA-WI7692	Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
T-VOA-WI8373	GC/MS Volatiles Audit Process

Scope

This method is suitable for the determination of target compounds listed and maintained in the Laboratory Information Management System (LIMS) for soil and solid matrices. Samples consist of soils/solids collected or submitted in bulk in glass containers with Teflon-lined screw-caps or in field core sampling/storage containers (i.e., EnCore or equivalent). Associated MDLs/LOQs are listed in the LIMS under the analysis numbers and/or Project Information lists. Theoretical Standard Calibration (TSC) Sheets are included in the Appendix (Figures 1-6). These TSC sheets are to serve as examples only and may not reflect most current version in use. Non-target volatile compounds in the sample can be tentatively identified (TIC) using a mass spectral reference library comparison. This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by purge and trap GC/MS methodologies and skilled in mass spectral interpretation. Using this method, the TICs are quantitated with an estimated concentration.

Compounds other than those listed in the LIMS for this group of master scans may be analyzed using USEPA SW-846 Method 8260C. Selected Ion Monitoring (SIM) parameters can be used to detect, identify and quantitate volatile

organic compounds in methanol extracts of soils/solids, if lower quantitation limits are required (project- or client-specified) and/or matrix interferences are anticipated. Attachment I describes the proper analysis procedure for Gasoline Range Organics in soils and solids. Due to poor purging efficiency or poor chromatography, some analytes require calibration at higher levels and/or higher practical quantitation limits (PQLs). Any additional compounds must be added to the theoretical standard concentrations (TSC) sheet. Standards containing additional analytes must be prepared as described in the Standards section of this document. Both secondary stock solutions and matrix spike solutions must be prepared for use in analyzing additional compounds.

Basic Principles

The soil sample is prepared according to analysis *S-SS-WI10682* and *S-SS-WI11170* for 8260C. The sample is purged with an inert gas and the effluent gas passed through a sorbent trap where the volatile organics are trapped. After purging, the sorbent trap is rapidly heated and backflushed onto the head of a gas chromatographic column held at the appropriate initial temperature for the column in use. The gas chromatographic column is temperature programmed to separate the volatile compounds, which are subsequently detected and identified using mass spectrometric techniques.

When a compound reaches the MS, it is bombarded by high energy electrons (70 eV). This causes the compound to fragment and form ions. The positive ions are focused into a quadrupole mass analyzer, where the ions are separated according to their mass/charge ratios during rapid repetitive scans. These ions are then amplified and detected with an electron multiplier.

The resulting time/intensity/mass spectra data are stored and processed by a computer. Target compounds are identified on the basis of relative retention times and mass spectral matches to standards, which are injected every 12 hours on the same system. The internal standard method is used for quantitation.

The GRO analysis is typically performed in conjunction with the analysis of other volatile target compounds by SW-846 Method 8260C. The GRO quantitation range is 0.1 minutes before the peak apex of C6 (hexane) to 0.2 minutes after the peak apex of C12 (dodecane); however, other ranges can be established. By establishing a (C12) GRO window to 0.2 minutes following the elution of dodecane, the areas from a trio of unresolved peaks eluting near to the upper limit of the range must consistently be included in the total GRO area. In addition, the range remains tight enough to ensure that no C13 or greater compounds can be included in the total GRO area. The C4 range retention time is determined by selecting the first peak after the air and/or artifact peak minus 0.1 minutes in the first level of standard analyzed with the ICAL. The C5 range retention time is 0.1 minutes before the peak apex of pentane.This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by GC/MS purge and trap methodologies. The area of the total ion chromatogram for the GRO range is determined. The area of the internal standards and surrogate standards are found and subtracted from the total area of the chromatogram within the desired time range. The resulting area is then quantitated versus the internal standard, fluorobenzene.

Interferences

Contaminant sources are volatile compounds in the laboratory environment, impurities in the inert purging gas, carryover from samples containing high concentrations of volatile organic compounds and dirty glassware. The analyst must demonstrate that the system is free from interferences (by producing acceptable method blank data) before analyzing a batch of samples. Matrix effects from heavily contaminated soils and solids can interfere with the internal standard responses, target analytes and surrogate recoveries, thereby hindering accurate quantitation. See Section 4.0 of SW-846 Method 8260C for further discussion.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity of each reagent used has not been precisely determined. However, each reagent must be treated as a potential health hazard. Safety measures would include the use of fume hoods, safety glasses, lab coats, and gloves when working directly with reagents. Refer to the *Chemical Hygiene Plan* for specific details.

Personnel Training and Qualifications

Education Requirement: A 4–year Baccalaureate Degree from an accredited College or University in one of the physical sciences and/or 1 – 3 years of relevant gas chromatography experience.

Analysts must be trained in the proper method of volatile organic sample preparation and analysis as determined by the supervisor(s). All training and education relating to volatile organic sample preparation and analysis must be documented by each analyst in their training record. Specifically, each new chemist must train with an experienced chemist for the first 12 weeks depending on the individual and their previous experience. The first 12 weeks are spent working one-on-one with the trainer. This time may be less if the new chemist has prior relevant experience in GC/MS and analytical chemistry background.

During the training period, the new chemist must learn daily maintenance, calibration techniques, data and library search review, and forms generation. They are also required to read all relevant SOPs and EPA methods. All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP. Each analyst must perform an Initial Demonstration of Capability to measure proficiency. Thereafter, an annual Demonstration of Capability is performed and maintained in the analyst's training records.

NOTE: A separate Demonstration of Capability for GRO is required.

Sample Collection, Preservation, and Handling

Soils are either collected/submitted in bulk in glass containers with Teflon-lined screw-caps, in field core sampling/storage containers (i.e., EnCore or equivalent), or preserved in the field before submittal to the laboratory. Samples for low level volatiles analysis are frozen with reagent water at ≤ 10 °C, and may be preserved with sodium bisulfate. Samples for high level volatiles analysis are preserved in methanol. Refer to the volatiles preservation SOPs *S-SS-WI10682* and *S-SS-WI11170* for further information. All samples must be analyzed within 14 days of collection.

Apparatus and Equipment

1. Gastight micro syringes – 10-µL and larger
2. 5-mL gastight syringes
3. Analytical balance, capable of accurately weighing ±0.0001 g
4. Top-loading balance capable of weighing ±0.01 g
5. Glassware
   a. Class A Volumetric flasks with ground-glass stopper
   b. Vials, 1.5-mL, 15-mL, and 40-mL screw cap, with Teflon/silicone septa
   c. Mininert vials, 1-mL, 2-mL, and 5-mL

6. Purge and trap device – Consisting of the sample purger, the trap, and desorber; the OI Analytical 4560, OI Analytical 4660, or equivalent meets the requirements of this method. The purging chamber must have the purge gas passing through the sample as finely divided bubbles and minimize the headspace between the sample and the trap to <15 mL.

7. Autosampler – OI Analytical 4551, Archon, or equivalent meets the requirements of this method. The Archon has the capability to purge solid samples directly in the 40-mL vial (needed for samples prepared by analysis 8389).

8. Spiker units (optional) – OI Analytical Model 4551 SIM/Spiker or equivalent. One or two automated syringe spikers can be added to the OI Analytical Model 4551 autosampler to automatically introduce 10 µL of internal standard (ISTD), surrogate standard, and/or matrix spiking solutions to the sample as it is being transferred to the sparge vessel. The Archon has a groove that can deliver 1 µL of appropriate standards.

9. GC/MS system – The HP 5890GC/5972 MSD, HP 6890GC/5973MSD, HP 6890GC/5975MSD, and Shimadzu GC/MS QP5000 meet the requirements for this method.

10. Data System/Computer/Software– this is interfaced to the GC/MS system, which continuously acquires and stores data during the analysis, and can process/reduce data to generate the appropriate forms and supporting data. The software used for acquisition is HP Chemstation®, and data reduction is accomplished using Target® software.

11. GC Columns

a. Column 1 – 30M × 0.25 mm ID DB624 capillary column with a 1.4-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

b. Column 2 – 20M × 0.18 mm ID DB624 capillary column with a 1.0-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

Different sampling/analysis combinations are used based on how the sample was collected, expected level of VOCs in the sample, possible matrix interferences, list of target compounds, whether TICs were requested, the required quantitation limits and the type of equipment/instrumentation available.

NOTE: Refer to *T-VOA-WI7619* for instrumentation maintenance and troubleshooting.

Reagents and Standards

A. Reagents

1. Reagent water is defined as water in which an interferant is not observed at or above the reporting limit for parameters of interest. In general, the deionized water supplied at the taps in the laboratory must meet these criteria. If the reagent water does not meet the requirements, see your supervisor for further instructions.

2. Purge and Trap grade Methanol or equivalent

3. Sodium bisulfate – ACS grade

4. Sand- Ottawa Standard

B. Standards

See *T-VOA-WI7629* for standards traceability.

1. Stock standard solutions – Stock solutions must be prepared in methanol. Standards are prepared from ampulated and neat compounds obtained from suppliers that indicate the purity of the compound. No correction for purity is made if the purity is listed as ≥96%. Pre-made solutions can be used if the supplier documents the concentrations of the solutions. All ampulated standards are stored at ≤-10°C until the expiration date indicated by the vendor or for 1 year if no expiration date is provided.

NOTE: For most of the target compounds, the stock standard solutions are purchased from a vendor as custom mixes (V for calibration and Q for separate source quality control). The internal and surrogate standards are purchased from a vendor, as well as the target compounds that are gases at room temperature. These gaseous standards have a 1-week expiration date, starting from the date they are opened.

2. Surrogate stock standard solution (for high level soils) – a 2500 µg/mL stock standard solution of dibromofluoromethane, toluene-d8, 4-bromofluorobenzene, and 1,2-dichloroethane-d4 is prepared in methanol by a commercial supplier

3. 8260A Internal standard spiking solution (8260IS) – a 2500 µg/mL stock standard solution of fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4, and 12500 µg/mL deuterated tertiary butyl alcohol (tBA-d10) is prepared in methanol by a commercial supplier. Deuterated tertiary butyl alcohol (tBA-d10) is used sometimes as an auxiliary ISTD. If an autosampler is used, dilute the stock to 250 µg/mL (1250 µg/mL for tBA-d10) in methanol. This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained (50 µg/kg).

4. GRO calibration standard – a 5500-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier.

5. GRO QC standard – a 20,000-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier

6. To prepare stock standards from neat compounds:

a. Place about 9.8 mL methanol or an equivalent solvent into a tared 10.0-mL glass-stoppered volumetric flask. Weigh the flask to the nearest 0.1 mg.

b. Add the liquids using a syringe or pipette by adding 2 or more drops of the assayed material to the flask, being careful that no drop hits the side of the flask. Reweigh the flask, record/note the amount, dilute to volume, stopper, and mix by inverting the flask at least 3 times. Calculate the concentration of the standard.

c. The stock standard solutions are stored in Teflon-sealed screw-capped vials at ≤-10°C. The compound name, concentration, date prepared, expiration date, preparer name and storage conditions must appear on the bottle.

d. Replace in house prepared stock standard solutions every 6 months.

7. Secondary dilution standards – Using the stock standard solutions, prepare secondary stock solutions in methanol containing the desired compounds. These standards are prepared by calculating the volume of each stock standard required producing a given volume of a mixed working standard with a known concentration of each analyte. When custom mixes are used, these may be diluted down individually, or combined together with other mixes. The working standard is tested according to *T-VOA-WI7629*. The verified working standard is poured into Teflon-lined screw-capped GC vials or mininert vials and stored at ≤-10°C. A designator indicating the standard, month, and preparation date must be on the standard vials. The designator and all data pertaining to the working standard preparation are to be recorded in the standards logbook. Replace secondary dilution standards every 2-4 weeks (1 week for standards containing gases) unless otherwise indicated.

a. 1,4-Bromofluorobenzene (BFB) standard – Prepare a 50-µg/mL solution of BFB in methanol by diluting the stock standard (prepared from neat material) with methanol to a final volume of 100 mL. The volume of stock standard used varies, depending on the actual stock concentration.

b. Surrogate standard spiking solution (high level only) – Prepare the surrogate standard spiking solution from the stock standard solutions at a concentration of 25 or 250 µg/mL in methanol. The requested soil preparation method dictates what concentration of surrogates are required for analysis.

c. Internal standard (IS) solution (high level only) – fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4, and tert-Butyl Alcohol-d10. One mL of 8260IS is diluted with methanol to a total volume of 10 mL to give a final concentration of 250 µg/mL (1250 µg/mL for tBA-d10). This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained (50 µg/kg).

d. IS/SS spiking solution (low level only)– Dilute 1 mL of 8260IS and 1 mL of 8260SS with methanol to 10-mL final volume (resulting in a concentration of 250 µg/mL, 1250 µg/mL for tBA-d10). This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained 50 µg/kg).

e. Calibration spiking solution – Prepare solutions in methanol that contain the compounds of interest at known concentrations. Suggested calibration levels are 4, 10, 20, 50, 100, and 300 (µg/kg). Replace the calibration spiking solution every 2-4 weeks (1 week for standards containing gases).

f. Matrix spiking solution – Prepare solutions in methanol that contain the compounds of interest at known concentrations. These solutions serve as both the matrix spiking solution and the laboratory control sample solutions. Matrix spikes also serve as duplicates; therefore, two aliquots of the same sample need to be spiked for analysis with these solutions. Replace the matrix spiking solution every 2-4 weeks (1 week for standards containing gases). See Figures 2-5 for preparation information.

g. Store all standard solutions at ≤-10°C and protected from light.

Calibration

A. Instrument Conditions:

1. The purge and trap device must have the trap conditioned for at least 10 minutes at 180° to 220°C at a flow rate of 20 to 60 mL/min prior to initial use.

2. An example of purge and trap conditions are listed below:

Purge gas	Helium
Purge flow	35 – 40 mL/min

Purge temperature	40°C for low level soils and ambient temp. for medium/high level soils
Purge time	11 min
Desorb temperature	190°-220°C
Desorb time	0.5 to 4 minutes **
Bake temperature	180°-220°C
Bake time	8 min (±3 min)

** - Range as suggested by the purge and trap instrument manufacturer

NOTE: Purge and trap conditions may be changed to optimize instrument operations. A record of actual purge and trap conditions for each instrument may be found in the appropriate instrument maintenance log.

3. The suggested gas chromatographic operating conditions are listed in the table below, depending on the column used:

	Column 1	Column 2
Column liquid phase	DB-624	DB-624
Carrier gas	Helium	Helium
Carrier gas flow	0.8 mL/min	0.6 mL/min
Make-up gas flow	None	None
Initial temperature	45°C	45°C
Initial hold time	4.5 min	2.5 min
Temperature ramp	12°/min to 100°C then 25°/min to 240°C	12°/min to 100°C then 25°/min to 235°C
Final temperature	240°C	235°C
Final hold time	None	.02 min

4. Recommended mass spectrometer (MS) operating conditions:

Ions	Positive
Electron energy	70 volts
Mass range	35 – 300 amu

H-P systems Scan time:

Number A/D Samples	22 (4)
Integration Time/Sample	50 microsec
Total Scan Time	0.6 sec

B. Tuning:

Tune the GC/MS system to meet the criteria in Table 1 following a 50-ng injection of BFB. The chromatographic conditions must be the same as those under which the samples are analyzed except that the temperature ramp may be increased and the initial temperature and flow rate may be different. The BFB tune must be verified every 12 hours.

The tune must be evaluated by taking the average of the three scans across the BFB peak apex with a background subtraction of a scan within 20 scans prior to the start of the BFB peak.

NOTE: All standards, samples, and associated quality control samples must be analyzed with the same mass spectrometer parameters as those used to obtain a successful tune.

C. Initial Calibration:

1. Perform the initial calibration by analyzing at least six distinct levels of analyte concentration. For high level soils, the surrogates are also analyzed at each distinct level. Response factors for each analyte are determined from these levels. Six levels are required if second order regression fits are used. Calibration for GRO consists of analyzing six distinct levels of GRO area in order to produce a response factor for the GRO quantitation range of interest using the internal standard, fluorobenzene. The relative standard deviation of the response factor determines the suitability of the average relative response factor for calculation of the GRO concentration. Refer to Figure 1 for the preparation of calibration standards and Figure 6 for preparation of GRO standards. The relative standard deviation of the response factors determines the suitability of the average relative response factor for calculation of the analyte or

GRO concentration. Prior to the analysis of any calibration level, retention time markers must be run for the GRO range of interest. The retention time markers are hexane (C6) and Dodecane (C12). Other markers can be used if different ranges are required by a project.

NOTE: 5 levels are required by the method.

2. A method detection limit (MDL) standard must be analyzed with each initial calibration. This standard is prepared at or near the departmental MDL and is not to be included in the calibration curve. All compounds must be detected at or below MDL standard.

3. For medium/high level soils, methanol is added to all calibration standards. For low-level soils prepared according to EPA Method 5035, 1 scoop (approximately .50 -.75 grams) of sodium bisulfate is added to all calibration standards.

4. When using an autosampler, blanks and standards are prepared and poured into 40-mL vials with Teflon-lined septa. For the high-level method, 5 mL is withdrawn from the vial and transferred to the sparge vessel along with the appropriate amount of the internal standard spiking solution. For the low-level method, the autosampler transfers 5 mL of reagent water along with the appropriate amount of IS/SS spiking solution to the 40-mL vial.

5. Purge and desorb according to conditions listed in Calibration A.2.

6. Collect GC/MS data until the end of the GC run.

7. Empty and rinse the purging chamber at least twice with reagent water prior to loading another sample into the vessel, to minimize the possibility of carryover contamination.

8. Each level is analyzed as described above. Next, tabulate the area response of the characteristic ions (Table 2) against concentration for each analyte, surrogate standard, and internal standard and calculate relative response factors (RRF) for each compound (see Calculation section). The following table describes the guidelines for an acceptable initial calibration:

Frequency	Acceptance Criteria	Corrective Action
Initially and then when analytes in the daily calibration standard fail criteria.	1. % RSD of ≤20% is required for all analytes. 10% of the analytes may fail this criteria. 2. All compounds of interest must be detected in the MDL standard. 3. The relative retention times of the target compounds must agree within 0.06 relative retention time (RRT) units. The exception would be in the case of system maintenance. 4. Minimum response factors must be met for select compounds. See Table 3.	1. Any target analyte with a %RSD of ≤20% must use the average RRF for quantitation. For any analyte in which the %RSD >20%, a first-degree linear regression can be used (providing that the correlation coefficient [CC] is ≥0.995). A quadratic fit ** (using 6 stds) can also be used (provided the coefficient of determination [CD] is >0.99). If the linear fit and quadratic fit pass the criteria for any given analyte, then use the line/curve with the smallest positive y-intercept. If the y-intercept quantifies to be greater than the LOQ, consult your supervisor immediately or recalibrate. If CC or CD is <0.995 for linear or <0.99 for quadratic, recalibrate. Supervisory approval is required for exceptions to these guidelines. If >10% target analytes fail, recalibration is required. If a linear or quadratic curve fit is used for a target analyte, the calibration data must be refit back into the calibration model for all calibration levels. Percent error between the calculated and expected amounts of an analyte should be ≤ 30% for all standards. For some data uses, ≤ 50% may be acceptable for the lowest calibration point. NOTE: Quadratic regression cannot be used for South Carolina compliance samples. 2. If a compound is not detected in the MDL standard, then report to the level of the lowest standard detected. 3,4. Perform system maintenance and recalibrate.

**Consult USEPA method 8000D for non-linear curve fitting techniques/guidelines

9. Each GRO level is analyzed as described above. Next, tabulate the area response for the GRO quantitation range minus the peak areas for the internal and surrogate standards that elute within the GRO range. Calculate the relative response factor (RRF) for GRO (see Calculation section) using the internal standard peak area for Fluorobenzene.

Although four internal standard compounds are spiked for the 8260C analysis, only Fluorobenzene, is used for the quantitation of the GRO result.

10. Calculate the average relative response factors for the GRO quantitation range of interest. The calibration levels are evaluated on the basis of the relative standard deviation of the RRF values (%RSD). The %RSD for the GRO range of interest must be ≤20%. If the calibration meets this requirement, then the average RRF is used to calculate sample concentrations. If the %RSD is >20% then re-analysis of one or more levels can be necessary before the calibration is valid.

D. Initial Calibration Verification:

Following the calibration, an Initial Calibration Verification (ICV) standard must be run. The ICV is prepared according to the TSC sheet in Figure 5. The ICV acts as a second source standard to check against the initial calibration. All analytes must meet ICV acceptance windows of 70%-130%. If the ICV does not meet the aforementioned criteria, a second ICV is analyzed before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken.

For the GRO analysis, the ICV is prepared according to the TSC sheet in Figure 6 (QC prep). The ICV acts as a second source standard to check against the initial calibration. Results must quantitate within the 70-130% window. If the ICV does not meet the aforementioned criteria, a second ICV can be run before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken.

E. Continuing Calibration:

Continuing Calibration Verification (CCV) – The CCV is performed by analyzing a 50-ppb calibration standard (prepared daily due to aqueous nature) in subsequent tune periods after an initial calibration. The CCV is considered valid when the criteria listed below are met:

Frequency	Acceptance Criteria	Corrective Action
Every 12 hours.	1. % Drift of ≤20% is required for all analytes. No more than 20% of analytes may fail this criteria if not detected in proceeding samples. 2. The relative retention times (RRT) of the target compounds must agree within 0.06 RRT units. The exception would be in the case of system maintenance. 3. The extracted ion current profile (EICP) area for each internal standard must fall within the window of −50 % to +100 % from the mid-level standard area produced during the last initial calibration. 4. Minimum response factors must be met for select compounds. See Table 3.	1. - 4. In the event that the continuing calibration verification (CCV) standard fails any of these criteria, sample analysis must be suspended and the CCV must be re-analyzed. If the re-analysis fails any of the criteria then adjustments are to be made to the analytical system to return it to its original condition, followed by the analyses of 2 consecutive CCVs at the same level that failed. If both CCVs pass the criteria, then sample analysis can continue. Otherwise, the system must be recalibrated and the samples reanalyzed, or the data can be qualified.

A 1100-ppb standard is analyzed for the GRO analysis. The calibration is considered valid if the percent drift is ≤20%. Also, the internal standard peak area of fluorobenzene for the CCV is monitored against the mid-point standard of the initial calibration and must be −50% to +100% of the area counts. If any criteria listed above fails, the CCV is considered invalid. In the case where two consecutive CCVs fail, corrective action must be taken which can include re-analysis of the calibration check, instrument maintenance, and/or recalibration. If the criteria are met, the selected quantitation method from the initial calibration is used for blank and sample calculations until the end of the 12-hour period.

F. MDL Sensitivity Check- A MDL Sensitivity Check must be analyzed in cases where compounds fail to meet the % drift criteria in the CCV and have decreased sensitivity (-20% drift or greater). Affected compounds can be reported as non-detects if it is demonstrated that there is adequate sensitivity to detect the compound at the MDL. If the failed compound is detected, the concentration must be reported as an estimated value.

Calibration Calculations

1. Calculation of the relative response factor (RRF):

$$RRF = \frac{[A(x) \times C(is)]}{[A(is) \times C(x)]}$$

Where:

A(x) = Characteristic ion area for the compound being measured

A(is) = Characteristic ion area for the specific internal standard

C(x) = Concentration of the compound being measured

C(is) = Concentration of specific internal standard

2. Regression equations:

1st Order (linear) regression: $Y = Mx + B$

2nd order (quadratic) regression: $Y = Cx2 + Mx + B$

Where:

x = Area(Std) /Area(Istd)

Y = Conc.(Std)/Conc.(Istd)

M = 1st degree slope

C = 2nd degree slope

B = Y-intercept

3. Percent relative standard deviation (%RSD):

$$\% \ RSD = \frac{Standard\ Deviation}{Mean} \times 100$$

4. Calculation of the percent drift:

$$\% \ Drift = \frac{C(i) - C(c)}{C(i)} \times 100$$

Where:

C(i) = Calibration check compound standard concentration
CI = Measured concentration using selected quantification method

Procedure

A. Method Blank:

Analyze the method blank as described above for the initial calibration standards using reagent water. Refer to table in QA/QC section for specific requirements. The method blank is examined for interfering peaks. Any target compound peaks are calculated as described under the Calculations section of this procedure. All compounds must be less than the reporting limit for the associated samples. If the blank values exceed these values, corrective action must be taken and the method blank reanalyzed until the criteria are met. The method blank must be analyzed before processing any samples.

B. Laboratory Control Sample/ Duplicate and Matrix Spike/Duplicate: Refer to table in QA/QC section for specific requirements.

C. Qualitative Analysis:

Sample analysis for soil, solids, and nonaqueous matrices proceeds as described in the Calibration section. The aqueous matrix is replaced by the soil sample, which is prepared according to *S-SS-WI10682* and *S-SS-WI11170*. A compound is identified by comparison of the following parameters with those of a standard of this target compound (standard reference spectra). In order to verify identification, the following criteria must be met:

1. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other.

2. The compound relative retention time must compare within ±0.06 RRT units of the RRT of the standard.

3. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

4. The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. Analyst discretion is used to determine compound identification. (Example: for an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

5. The above criteria apply to hits greater than or equal to the LOQ. For hits between the MDL and the LOQ, both the above criteria and analyst discretion are used to determine compound identification.

6. The analyst must account for peaks that are greater than 10% relative intensity in the sample mass spectrum, but not present in the standard mass spectrum. Also, if a compound fails any of the criteria listed above but in the judgment of the mass spectral interpretation specialist is a correct identification, the identification is used and the quantitation of the peak is performed. The primary and secondary ions can be found in Table 2.

7. For the GRO analysis, the Total Ion Chromatogram (TIC) is reviewed to insure proper integration around the 8260 surrogates and internal standards. Also the TIC is checked to make sure all major peaks are integrated.

D. Quantitative Analysis:

Once a compound has been identified, quantitation of identified priority pollutant compounds is performed using the equations listed in the Calculations section of this SOP. The primary ions listed in Table 2 are used for quantitation. A secondary ion may be used if there is interference with the primary ion. All calculations must report concentrations in values of µg/kg. Any analyte with a calculated concentration above the highest standard must be reanalyzed at a dilution that brings the concentration in the solution within the calibration curve. It is desirable to have the dilution fall within the top half of the calibration curve, but it is not required.

The quantitation of the GRO range is performed using the equations listed in the Calculations section of this procedure. All calculations must report concentrations in values of µg/L. In the case where the total GRO concentration exceeds the calibration range, the sample is re-analyzed at a dilution that brings the GRO concentration within the calibration range of the GC/MS system.

Calculations

A. Analyte Concentration

1. Low level

$$Concentration\ (\mu g/kg)\ \frac{(Ax)\,(Is)}{(Ais)\,(RRF)\,(Ws)}$$

Where:

Ax = Area of the quantitation ion peak for the compound to be measured
Ais = Area of the quantitation ion peak for the appropriate internal standard
Is = Amount of internal standard added in nanograms
Ws = Weight of sample purged
RRF = Relative response factor from the initial calibration

2. Medium/high level

$$Concentration\ (\mu g/kg)\ \frac{(Ax)\,(Is)\,(Vt)}{(Ais)\,(RRF)\,(Ws)\,(Vi)}$$

Where:

Ax = Area of the quantitation ion peak for the compound to be measured
Ais = Area of the quantitation ion peak for the appropriate internal standard
Is = Amount of internal standard added in nanograms
Vt = Volume of the total extract in microliters
Vi = Volume of the extract used for purging in microliters
Ws = Weight of sample extracted
RRF = Relative response factor from the initial calibration

B. QC Calculations:

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = Spiked sample result

SR = Sample result

SA = Spike added

C. Relative percent difference (RPD)

$$RPD = \frac{MSR - MSDR}{(1/2)\ (MSR + MSDR)} \times 100$$

Where:

MSR = Matrix spike measured concentration

MSDR = Matrix spike duplicate measured concentration

Statistical Information/Method Performance

The LCS must contain 80% to100% of the compounds in the calibration mix. LCS, MS, and surrogate recoveries and RPD are compared to the limits stored on the LIMS. These limits are statistically derived but must fall within 70% to 130% recovery for South Carolina compliance samples. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated on an annual basis in accordance with 40 CFR Part 136. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

Each analysis batch must contain a method blank, a laboratory control sample (LCS), and either an unspiked background sample (US), a matrix spike (MS), a matrix spike duplicate (MSD), or a laboratory control sample/laboratory control sample duplicate (LCS/LCSD). Additional QC samples may be required to meet project or state certification requirements. For South Carolina, an LCS duplicate (LCSD) is only necessary per client request, or when adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate (MS/MSD). It is not appropriate to prepare and analyze an LCSD with each batch of samples if adequate sample volume has been provided for a MS/DUP or MS/MSD. Every sample or QC analysis must contain internal standards and surrogate compounds.

The laboratory will establish the Lower Limit of Quantitation (LLOQ) at concentrations where both quantitative and qualitative requirements can consistently be met for 8000D. The LLOQ is the lowest concentration at which the laboratory has demonstrated target analytes can be reliably measured and reported with a certain degree of confidence, which must be ≥ the lowest point in the calibration curve. The LLOQ must be verified annually per instrument and is performed by the analysis of an LCS at 0.5-2 times the established LLOQ, using laboratory reagent water and following all preparation and analytical procedures as are used for environmental and QC samples. Acceptance criteria for target analytes in the LLOQ verification should be within established in-house limits or within other such project-specific acceptance limits. Until the laboratory has sufficient data to determine acceptance limits, the LCS criteria ± 20% may be used for the LLOQ acceptance criteria.

The GC/MS system must be tuned to meet the criteria in Table 1 following BFB injection. The chromatographic conditions must be the same as those under which the samples are analyzed except that the rate of temperature ramping may be increased and the initial temperature and column flow may be different. The BFB tune must be verified every 12 hours.

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards • Added to every sample, standard, method blank or QC sample	1. Peak areas within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then reanalyze samples. 2. If re-injecting meets the criteria, report this analysis. 3. If this reanalysis still shows the same problem, report results from first analysis and qualify data with a comment.
Surrogates • Added to every sample, standard, method blank or QC sample	All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis.	If non-compliant, check for calculation or preparation errors. If no errors are found, check system for problems and reanalyze. If this reanalysis still shows the same problem, report first analysis and qualify data with a comment. If recoveries are outside of specification high and no target compounds are detected then a reanalysis or comment is not required.

Quality Control Item	Acceptance Criteria	Corrective Action
Method Blank (MB) Performed during each tune period after the initial calibration or CCV (minimum of 1 MB per 20 samples) • 1 scoop of Sodium Bisulfate is added if the preservative was added to the initial calibration. • Approximately 5 grams of sand is required for low level analysis.	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. Quantitative results for all target compounds must be less than the reporting limit for the associated samples.	1,2. Inspect system for possible problems and reanalyze. 3. If the MB contains target analytes and the associated samples do not, then no corrective action is required. If the target compounds in the MB are also in the associated samples, then they must be reanalyzed after a clean MB is obtained (certain projects may allow some exceptions for common laboratory contaminants like methylene chloride and acetone up to 5X the LOQ)
Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) • LCS analyzed with each batch of ≤ 20 samples • LCSD analyzed if MS/MSD unavailable • Approximately 5 grams of sand is required for low level analysis. • 1 scoop of Sodium Bisulfate is added if the preservative was added to the initial calibration. • See Figures 2, 3 and 4 for preparation info.	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis.	1,2. If non-compliant, check for calculation or preparation errors. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD re-analysis still fails, perform appropriate system maintenance and restart the tune period. Only with an LCS % recovery failing high (for the requested target compounds) with targets non-detected in the sample, can the results be reported. Otherwise, the sample must be analyzed with a compliant LCS.
Matrix Spike/Matrix Spike Duplicate (MS/MSD) • MS/MSD analyzed with each batch of ≤ 20 samples (if sufficient sample volume available) • See Figures 2 and 3 for preparation info.	1. % Recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis 2. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries and/or RPDs outside of QC limits, consult the supervisor.

The method blank must meet all the above criteria for internal standard recoveries and surrogate recoveries. In addition, the method blank may not contain any target compound above the reporting limit for the associated samples. All method blanks must meet these criteria; otherwise, the system is considered out of control and corrective action must be taken.

If sufficient sample volume is not available to perform MS/MSD, LCS/LCSD are prepared and analyzed and must meet the above-mentioned criteria.

NOTE: Prior to release from the analytical laboratory, all data is reviewed in accordance with *T-VOA-WI8373*.

The sample is analyzed using the same instrumental conditions as the standard (whether ICAL or CCV), tune and method blank. If the QA criteria are satisfied and no target compounds are detected at concentrations above the calibration range, the results can be reported. To avoid possible matrix effects, sample carryover and re-analyses, an initial dilution may be performed if:

1. Prescreening indicates a high volatile organic content in the sample

2. Historical data (or lack thereof) and/or sample appearance indicate a need for dilution

If target compounds are detected in the sample at concentrations above the calibration range, a dilution must be performed (see *T-VOA-WI7692* for information on when cleaning blanks must be run). See method SW-846 8260C for the recommended dilution procedures.

Table 1

BFB Key Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15% to 40% of mass 95
75	30% to 60% of mass 95
95	base peak, 100% relative abundance
96	5% to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5% to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5% to 9% of mass 176

Table 2

Primary and Secondary Ions

Compound Name	Primary Ion	Secondary Ion
Chloromethane	50	52
Vinyl Chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
1,1-Dichloroethene	96	61, 63
Acetone	43	58
Carbon Disulfide	76	78
Methylene Chloride	84	49, 86
1,1-Dichloroethane	63	65, 83
trans-1,2-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 63
2-Butanone	43	72
Chloroform	83	85
1,2-Dichloroethane	62	98
1,1,1-Trichloroethane	97	61, 99
Carbon Tetrachloride	117	119
Benzene	78	
Trichloroethene	95	130, 132
1,2-Dichloropropane	63	76
Bromodichloromethane	83	85
cis-1,3-Dichloropropene	75	77, 110
trans-1,3-Dichloropropene	75	77, 110
1,1,2-Trichloroethane	97	83, 85
Dibromochloromethane	129	127
Bromoform	173	175
4-Methyl-2-pentanone	43	58
Toluene	92	91
Tetrachloroethene	166	131, 164
2-Hexanone	43	58
Chlorobenzene	112	77
Ethylbenzene	91	106
Xylene (total)	106	91
Styrene	104	78
1,1,2,2-Tetrachloroethane	83	85, 131
Dibromofluoromethane	113	111
1,2-Dichloroethane-d4	102	104

Compound Name	Primary Ion	Secondary Ion
Fluorobenzene	96	70
Toluene-d8	98	100
Chlorobenzene-d5	117	82
4-Bromofluorobenzene	95	174
1,4-Dichlorobenzen-d4	152	115

Continued
Primary and Secondary Ions

Compound Name	Primary Ion	Secondary Ion
Chloromethane	50	52
Vinyl Chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
1,1-Dichloroethene	96	61, 63
Acetone	43	58
Carbon Disulfide	76	78
Methylene Chloride	84	49, 86
1,1-Dichloroethane	63	65, 83
trans-1,2-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 63
2-Butanone	43	72
Chloroform	83	85
1,2-Dichloroethane	62	98
1,1,1-Trichloroethane	97	61, 99
Carbon Tetrachloride	117	119
Benzene	78	
Trichloroethene	95	130, 132
1,2-Dichloropropane	63	76
Bromodichloromethane	83	85
cis-1,3-Dichloropropene	75	77, 110
trans-1,3-Dichloropropene	75	77, 110
1,1,2-Trichloroethane	97	83, 85
Dibromochloromethane	129	127
Bromoform	173	175
4-Methyl-2-pentanone	43	58
Toluene	92	91
Tetrachloroethene	166	131, 164
2-Hexanone	43	58
Chlorobenzene	112	77
Ethylbenzene	91	106
Xylene (total)	106	91
Styrene	104	78
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Fluorobenzene	96	70
Toluene-d8	98	100
Chlorobenzene-d5	117	82
4-Bromofluorobenzene	95	174
1,4-Dichlorobenzene-d4	152	115

Table 3
Minimum Relative Response Factors For ICAL and CCV

Volatile Compounds	Minimum Response Factor
Dichlorodifluoromethane	0.100
Chloromethane	0.100
Vinyl Chloride	0.100
Bromomethane	0.100

Chloroethane	0.100
Trichlorofluoromethane	0.100
1,1-Dichloroethene	0.100
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100
Acetone	0.100
Carbon Disulfide	0.100
Methyl Acetate	0.100
Methylene Chloride	0.100
trans-1,2-Dichloroethene	0.100
cis-1,2-Dichloroethene	0.100
Methyl tert-Butyl Ether	0.100
1,1-Dichloroethane	0.200
2-Butanone	0.100
Chloroform	0.200
1,1,1-Trichloroethane	0.100
Cyclohexane	0.100
Carbon Tetrachloride	0.100
Benzene	0.500
1,2-Dichloroethane	0.100
Trichloroethene	0.200
Methylcyclohexane	0.100
1,2-Dichloropropane	0.100
Bromodichloromethane	0.200
cis-1,3-Dichloropropene	0.200
trans-1,3-Dichloropropene	0.100
4-Methyl-2-pentanone	0.100
Toluene	0.400
1,1,2-Trichloroethane	0.100
Tetrachloroethene	0.200
2-Hexanone	0.100
Dibromochloromethane	0.100
1,2-Dibromoethane	0.100
Chlorobenzene	0.500
Ethylbenzene	0.100

Table 3 Continued

Volatile Compounds	Minimum Response Factor
m&p-Xylene	0.100
o-Xylene	0.300
Styrene	0.300
Bromoform	0.100
Isopropylbenzene	0.100
1,1,2,2-Tetrachloroethane	0.300
1,3-Dichlorobenzene	0.600
1,4-Dichlorobenzene	0.500
1,2-Dichlorobenzene	0.400
1,2-Dibromo-3-chloropropane	0.050
1,2,4-Trichlorobenzene	0.200

Attachment:
Figure 1 (.doc)
Figure 2 (.doc)
Figure 3 (.doc)
Figure 4 (.doc)
Figure 5 (.doc)
Figure 6 (.doc)

T-VOA-WI10682 GC/MS - Bulk Solids Matrix Sample Preparation
T-VOA-WI11170 Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035 and Method 5035A
T-VOA-WI7619 GC and GC/MS Instrumentation Maintenance
T-VOA-WI7629 GC/MS Volatile Standards Traceability
T-VOA-WI7692 Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
T-VOA-WI8373 GC/MS Volatiles Audit Process

End of document

Version history

Version	Approval	Revision information
6	12.APR.2019	
7	17.FEB.2020	
8	26.MAR.2020	

eurofins	Always check on-line for validity. **Microwave Extraction Method 3546 for PCBs in a Solid Matrix**	Level: **Work Instruction**
Document number: **T-OE-PEST-WI10927**		
Old Reference: **1-P-QM-WI -9015104**		
Version: **9**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **31-OCT-2019**	Document users: **5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Pest/PCB Soils, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_PCB Chemist**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I

Revision Log

Revision 09		**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
LIMS ID	Reflects current practice		Added preps 13998, 14114, and 14652
Throughout procedure	Reflects current practice		Clarified weights to use for each prep number
Procedure 3	Reflects current practice		Added spiking procedure for prep 14652

Revision 8		**Effective Date:**	**01-MAY-2018**
Section	**Justification**		**Changes**

Revision 8		**Effective Date:** 01-MAY-2018
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Purpose	Removed section	Not required
Scope	Reflects current practice	Added tissues to matrix types
Apparatus and equipment	Reflects current practice	Removed graduated cylinder. Added glass vial inserts
Throughout Procedure	Clarification	Updated wording to clarify steps
Procedure 1	Reflects current practice	Added weights for tissue matrix and clarified the range
Procedure 15	Reflects current practice	Combined the copper and florisil steps as they are done together now.
Procedure 16	Reflects current practice	Updated the bottling requirements

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3546, Revision 0, February 2007.

2. *Chemical Hygiene Plan*, current version.

3. MARS Operation Manual, Revision 2, February 2006.

Cross Reference

Document	Document Title
Analysis *#0042, 1030, 6011, 7512, 10225, 10736, 10906, 12800, 13236*	Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes
Analysis *#2487*	Food and Tissue Preparation
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by method 3640A
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling

Scope

This procedure is applicable for the extraction of PCBs from soils, tissues, or solid wastes.

Basic Principles

A portion of sample to be analyzed is placed in an extraction vessel. Surrogate standards are added to each sample to monitor recovery. The vessel is then loaded into the microwave and extracted. The organic compounds present in the sample dissolve in the solvent, which is then removed. The sample is then concentrated and bottled.

Several cleanup procedures may be required to eliminate matrix interferences before the sample can be analyzed. They include: sulfuric acid treatment, florisil, copper, and gel-permeation cleanup (GPC).

Reference Modifications

The KD is not removed from the steam bath and cooled before adding hexane. The Snyder column is not removed for the solvent addition; therefore, the KD does not have to be cool.

Double volumes of surrogates and matrix spiking solutions are not added when a sample requires gel-permeation cleanup. Instead, the extract is concentrated to one-half the normal final volume after GPC to make up for the loss on GPC and maintain the limit of quantitation.

The Joint of the K-D is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Definitions

1. GPC – Gel Permeation Cleanup

2. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) – A sample of known composition analyzed with each batch of samples to demonstrate laboratory accuracy. The samples either naturally contain the analytes of interest or are clean samples fortified with known concentrations. Used to demonstrate laboratory accuracy. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

3. Matrix spike/matrix spike duplicate (MS/MSD) – A sample created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the accuracy of the method in light of the matrix analyzed. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

4. Surrogates – Organic compounds which are similar to the analytes of interest but are not naturally occurring in environmental samples. Surrogates are spiked into all standards and every field and QC sample prior to extraction and analysis to provide information regarding the effects of the sample

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.
Since the extracts are concentrated on a steam bath, caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or must be disposed of in the designated containers. These will then be transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the technicians training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass jars with PTFE-lined lids and stored under refrigeration at 0° to 6° C, not frozen, prior to extraction. Samples must be extracted within 14 days of collection. Extracts are stored in the freezer at -10° to -15°C.

Apparatus and Equipment

1. MARS Xpress – CEM Corp. or equivalent

2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during concentration

3. Steam bath, VWR/LLI Model #1127 or equivalent

4. N-Evap with nitrogen supply

5. Beakers – Stainless steel, assorted sizes

6. Pipettes – Class A, assorted sizes
7. Pipettes – Disposable

8. Balance – Capable of weighing to 0.01 g

9. Teflon®-wash bottles

10. Vials – Assorted sizes

11. Teflon®-boiling chips

12. Forceps

13. Scoop

14. TurboVap II concentration workstation w/appropriate concentration tubes – Zymark or equivalent

15. Funnels – stainless steel or Teflon®

16. Extraction vessels

17. Frits – Various

18. Sodium Sulfate Columns

19. glass vial inserts

Reagents and Standards

1. Hexane – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

2. Acetone – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

3. Methylene Chloride (CH_2Cl_2) – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

4. Sodium Sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at 400°C for a minimum of 4 hours in a shallow pan prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1 year.

5. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the standards database. Detailed instructions can be found in the corresponding Analysis #*0042, 1030, 6011, 7512, 10225, 10736, 10906, 12800, 13236.*

Preparation of Glassware

See *T-OE-GEN-WI10864*

Calibration

Not applicable to this procedure

Procedure

1. Sample aliquot

a. If Sample Registration has pre-weighed the sample into a glass jar, add 5g of sodium sulfate, mix and proceed to step 2.

b. If the sample is not pre-weighed:

(1) For preps 10497, 11140, 13100, 14652: weigh 30.0 - 30.5 g of sample into a labeled stainless steel beaker. (If matrix is tissue, weigh 15.0 - 15.5 g)

(2) For prep 13998: weigh 10.0 - 10.5 g of sample into a labeled stainless steel beaker.

(3) For prep 14114: weigh 3.0 - 3.5 g of sample into a labeled stainless steel beaker

(4) Record the initial weight and any comments about the sample in the extraction log.

(5) Alternative sample weights may be used to meet certain reporting limits. However, if sample weight greater than 30.5 is used, the sample must be divided among multiple vessels and the extracts combined.

c. If sample is a wipe: record "wipe" in the matrix type section of the extraction log and enter the amount as 1 g in both the extraction log and the extractables database.

(1) Remove wipe from the vial with clean forceps and place in a stainless steel beaker along with any solvent in the vial.

(2) Use a wash bottle to rinse the vial with a few mL of acetone/methylene chloride and add the rinseate to the beaker.

(3) Record any comments about the sample in the extraction log.

(4) Enter the final volume and surrogate/spike volumes in liters in the extractables database.

d. Process all tissues by Analysis #*2487* prior to extraction.

e. Add approximately 5 g of sodium sulfate to each sample and mix.

(1) If the sample has high water content or is a clay-like soil, add additional sodium sulfate until a free-flowing consistency is reached.

(2) Mix the sodium sulfate and sample until a free-flowing consistency is reached.

e. The Blank, LCS, and LCSD (if applicable) are prepared by:

(1) For preps 10497, 11140, 13100: filling a Teflon® extraction vessel with 30.0 - 30.5 g sodium sulfate. Record 30 g on the extraction log. (The sodium sulfate used for the QC samples is measured out as 35.0 grams to account for the 30 gram "sample" plus the 5 grams of sodium sulfate.) (If sample matrix is tissue, use 15.0-15.5 g tilapia and add approximately 5 g sodium sulfate. Then mix.)

(2) For prep 13998: filling a Teflon® extraction vessel with 10.0 - 10.5 g sodium sulfate. Record 10 g on the extraction log. (The sodium sulfate used for the QC samples is measured out as 15.0 grams to account for the 10 gram "sample" plus the 5 grams of sodium sulfate.)

(3) For prep 14114: filling a Teflon® extraction vessel with 3.0 - 3.5 g sodium sulfate. Record 3 g on the extraction log. (The sodium sulfate used for the QC samples is measured out as 8.0 grams to account for the 3 gram "sample" plus the 5 grams of sodium sulfate.)

2. Carefully place each sample into its clearly marked corresponding extraction vessel. A funnel is used to prevent spillage and loss of sample.

3. Use pipettes to add surrogate standards and spiking solutions.

a. Surrogates – 1.0 mL of SW846 surrogate is added to all samples (including QC).

b. Spiking solutions:

(1) For all analyses (except 14634): 1.0 mL of PCB spiking solution is added to the LCS, LCSD if applicable, MS, and MSD.

(2) For prep 14652, analysis 14634: 1.0 mL of 1242 spike is added to the LCS, LCSD if applicable, MS, MSD.

c. This may change to accommodate specific client requirements.

d. See *T-OE-GEN-WI10876* for storage and handling of spikes.

4. Add 30 mL of 50% acetone in methylene chloride to each vessel.

5. Cap each vessel according to manufacturer's guidelines.

6. Invert each vessel to ensure mixing of sample and solvent.

7. Place the vessels into the carousel. When all samples are loaded, place the carousel into the microwave.

8. Run Program "LL1". See Table I for Instrument conditions. Verify that the run reached 100°C and document on the batchlog.

9. Uncap the cooled vessel. Pour the extract and sample into a column filled with approximately 10cm of sodium sulfate on top of a Kuderna-Danish (K-D) assembly containing a Teflon®-boiling chip. Rinse the vessel with approximately 10 mL of methylene chloride from a wash bottle and pour through salt column. Rinse the column with approximately 10 mL of methylene chloride.

10. Place a 3-ball Snyder column on the K-D set-up and concentrate over a steam bath which is at 85° to 99°C.

This steam bath temperature ensures concentration in a reasonable length of time.

If the sample requires GPC, skip step 11.

11. When the apparent volume is 3 to 5 mL, using a bottle-top dispenser, add approximately 50 mL of hexane directly to the KD through the Snyder column.

Do not allow the ampule to go dry since loss of analytes will result.

12. When the apparent volume again reaches 3 to 5 mL, remove from the steam bath and allow to cool for approximately 10 minutes until the K-D setup reaches ambient temperature. Remove the ampule and, using a wash bottle, adjust the final volume to exactly 10 mL with hexane in a calibrated ampule.

NOTE: If the sample requires GPC, N-Evap to approximately 1 mL, then adjust the final volume to exactly 10 mL with methylene chloride instead of hexane. N-Evap if necessary.

Mix thoroughly with a disposable pipette.

13. If the sample requires GPC, perform GPC cleanup following *T-OE-PEST-WI11410*. When GPC cleanup is complete, concentrate the extract as described above including Step 11. However, in Step 12, adjust the final volume to exactly 5 mL with hexane instead of 10 mL.

14. Treat the 10 mL extract with sulfuric acid as described in *T-OE-PEST-WI10281*.

15. Perform the copper and florisil cleanup on the extract as described in *T-OE-PEST-WI10281*.

16. Bottle in three appropriately labeled crimp-top autosampler vials (one with an insert), and place the remaining extract in an appropriately labeled screw-cap vial.

17. All extracts are stored in the freezer.

Calculations
See analysis method.

Statistical Information/Method Performance
See analysis method.

Quality Assurance/Quality Control
A batch is defined as the samples to be extracted in any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared.

For each batch of samples extracted, a blank, LCS, MS, and MSD must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead.

If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Table I

Power:	1600W
Ramp Temperature:	100°C
Ramp Time:	30 minutes
Hold Time:	10 minutes
Cool Down Time:	20 minutes

T-OE-GEN-WI10864 Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876 Organic Extraction Standards Storage and Handling
T-OE-GEN-WI7154 Food and Tissue Preparation
T-OE-PEST-WI10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-PEST-WI11410 Pesticide Extract Cleanup Using GPC by Method 3640A
T-PEST-WI11972 Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes

End of document

Version history

Version	Approval	Revision information
7	03.DEC.2015	
8	17.APR.2018	
9	24.OCT.2019	

eurofins	Always check on-line for validity. **Microwave Extraction by Method 3546 for Semivolatiles**	Level: **Work Instruction**
Document number: **T-OE-SVOA-WI10928**		
Old Reference: **1-P-QM-WI -9015105**		
Version: **13**		Organisation level: **5-Sub-BU**
Approved by: **UKL3** Effective Date **20-MAR-2019**	Document users: **5_EUUSLA_GC/MS Semivolatiles_Manager, 5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Semivolatile Soils, 6_EUUSLA_GC/MS Semivolatiles_Analysts**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log

Revision 13		**Effective Date:**	**This version**
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
LIMS ID	Update		Removed "DOD"
Throughout procedure	Reflects current practice		Added amounts for tissue samples/QC
Apparatus and Equipment	Reflects current equipment		Added Rapid Vap evaporators and Rapid Vap evaporator tubes.
Procedure 1.b.2	Clarification		Replaced "less than" with "greater than"
Procedure 2, 2.a	Clarification		Added "approximately"
Procedure 13 through 18	Reflects current procedure		Added rapid vap concentration technique to replace steam bath.

Revision 12		**Effective Date:**	**14-JUN-2017**
Section	**Justification**		**Changes**
LIMS ID	Reflects current LIMS scan numbers		Added Analysis #10487
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Reflects current document numbers		Removed old document numbers and replaced with D4 document numbers
Procedure 6	Reflects current practice		Added spikes for Analysis #6397

Reference

1. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 3546, Revision 0, February 2007.

2. *MARS Operation Manual*, Revision 2, February 2006.

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
Analysis #0949, 1309, 1476, 1536, 1947, 1953, 2035, 2395, 4615, 4678, 4688, 6387, 6397, 7804, 7805, 10723, 10724, 10727, 10728, 13615, 13618	Semivolatile Organic Compounds, Including DRO/ORO, by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC-MS
Analysis #2487	Food and Tissue Preparation
Analysis #4220, 4221	Determination of Tetraethyl Lead (TEL) and Tetramethyl Lead (TML) by GC/MS Analysis
Analysis #8357, 0038, 0039, 10010, 10137, 10138, 10725, 11915, 11917, 12969, 12970, 12971	Semivolatiles by Methods 8270C/D SIM
Analysis 10242, 10262, 11305, 11597	Determination of Parent and Alkyl Substituted Polynuclear Aromatic Hydrocarbons (PAHs), Alkanes and Geochemical Biomarkers by Gas Chromatography/Mass Spectrometry (GC/MS-SIM)
Analysis #10461, 10462, 10726	Semivolatile Organic Compounds by Method 8270D in Aqueous and Non-Aqueous Matrices using GC-MS
Analysis #10962, 11622	Determination of N-Nitrosodimethylamine (NDMA) in Water and Soil by EPA 1625C
T-OE-SVOA-WI10554	Semivolatile Extract Cleanup Using Gel Permeation Chromatography
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling

Scope

This procedure is used to clearly outline the steps taken for the extraction of semivolatile compounds from soils or solid wastes using microwave technology.

Basic Principles

A portion of sample is placed in an extraction vessel. Surrogate standards are added to each sample to monitor recovery. The vessel is then loaded into the instrument and extracted. The organic compounds present in the sample dissolve in the solvent, which is then removed. The extract is concentrated to about 1 mL. At this time, it is determined if the sample requires gel-permeation cleanup (GPC). If needed, the extract is diluted to 10 mL, then cleaned using GPC and concentrated to 0.5 mL. If GPC is not necessary, the extract is brought to 1.0 mL and bottled. The extract is stored in an amber-autosampler vial in the freezer until analysis.

Reference Modifications

Base/Neutral and Acid compounds are added at a concentration of 50 ppm in the matrix spiking and LCS solutions so that the concentrations in the extract are within calibration range.

After Procedure Step 24, the joint of the K-D is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Interferences

Impurities in solvents, reagents, glassware, or other hardware used in sample processing can interfere with the method. All glassware must be rinsed with solvent before use. A method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

Extracts are concentrated on a steam bath; caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are then transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meet the defined acceptance criteria. The criteria for the LCSs include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation and Handling

Samples are collected in glass wide-mouth jars with PTFE-lined lids and stored under refrigeration at 0° to 6°C, not frozen, prior to extraction. Samples must be extracted within 14 days of sample collection. Extracts are stored in the freezer at ≤-10° C and must be analyzed within 40 days of the date extracted.

Apparatus and Equipment

1. MARS Xpress – CEM Corp. or equivalent
2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction
3. Steam bath, VWR/LLI Model #1127 or equivalent
4. Balance – Capable of weighing to 0.01 g
5. Beakers – Stainless steel – Assorted sizes
6. Scoop
7. Pipettes – Class A, assorted sizes
8. Wash bottles – Teflon®
9. Teflon®-boiling chips
10. Micro Snyder columns
11. Disposable pipettes
12. Autosampler vials – Amber, crimp top

13. Funnels – Stainless steel or Teflon®

14. Extraction vessels

15. Frits – Various

16. Sodium sulfate columns

17. Rapid-Vap Evaporators – Labconco model number 7910000 or equivalent.

18. Rapid-Vap Evaporator Tubes – Class A

Reagents and Standards

1. Methylene chloride (CH_2Cl_2) – Pesticide grade or equivalent. Store at room temperature for up to one year.

2. Acetone – Pesticide grade or equivalent. Store at room temperature for up to one year.

3. Sodium Sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at 400°C for a minimum of 4 hours in a shallow pan to remove contaminants. Store in a glass jar for up to 1 year after baking.

4. Ottawa sand - Bake at ~ 400° C for a minimum of 4 hours to remove organic contaminants. Store in a glass jar for up to 1 year after baking.

NOTE: All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the standards database. Detailed instructions can be found in the corresponding analytical analyses for scans 4221, 10242, 10723, 10724, 10725, 10726, 11622 and 11917.

Calibration

Not applicable to this procedure.

Preparation of Glassware

See *T-OE-GEN-WI10864*.

Procedure

1. Sample aliquot

   a. If Sample Registration has pre-weighed the sample into a glass jar, add 5g of sodium sulfate, mix and proceed.

   b. If the sample is not pre-weighed, weigh 30.0 - 30.5 g of sample into a labeled stainless steel beaker. If sample matrix is tissue, use 15.0 - 15.5 g.

      (1) Record the initial weight and any comments about the sample in the extraction log.

      (2) Alternative sample weights may be used to meet certain reporting limits. However, if sample weight greater than 30.5 g is used the sample must be divided among multiple vessels and the extracts combined.

   c. Process all tissues by *Analysis #2487* prior to extraction.

2. Add approximately 5 g of sodium sulfate to each sample and mix.

   a. If the sample has high water content or is a clay-like soil, add an additional 10 g (approximate) of sodium sulfate.

   b. Mix the sodium sulfate and sample until a free-flowing consistency is reached.

3. Perform the background, matrix spike (MS), and matrix spike duplicate (MSD) on three separate aliquots of a field sample.

4. Prepare the Blank, laboratory control sample (LCS), and laboratory control sample duplicate (LCSD) (if applicable) by filling a Teflon® extraction vessel with 35 g of sodium sulfate. Use 15.0 g tilapia if matrix is tissue.

NOTE: For samples from SC, use Ottawa Sand for the preparation of the Blank, LCS, and LCSD (if applicable).

Record 30.0 g on the extraction log (or 15.0 for tissue samples). (The sodium sulfate used for the QC samples is measured out as 35.0 g to account for the 30 g "sample" plus the 5g of sodium sulfate.)

5. Place each sample into its clearly marked corresponding extraction vessel. Use a funnel to prevent spillage and loss of sample.

6. Add surrogate standards and spiking solutions using pipettes. Add surrogates to all samples, blanks and spiked samples. Add spikes to the LCS, LCSD (if applicable), MS, and MSD samples. Typically they are as follows:

a. Analysis 10727 – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL of LCS spike.

b. Analysis 10725 – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL of SIM LCS spike.

c. Analysis 10728 – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL of LCS Spike. If required, spike 1.0 mL of Benzenthiol spike in a separate LCS/LCSD.

d. Analysis 10723, 10726, 1947 – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL each of LCS and AppIX Mix #1. If required, Spike 1.0 mL of AppIX Mix #2 in a separate LCS/LCSD.

e. Analysis 10724 – Surrogate: 1.0mL of BNA Surrogate. Spike: 1.0mL of LCS spike.

f. Analysis 4221 – Surrogate: 1.0mL of BNA Surrogate. Spike: 1.0mL of TEL/TML spike.

g. Analysis 10242 – Surrogate: 1.0 mL of BNA surrogate. Spike: 1.0 mL of "Client Specified" spike. If required, 1.0 mL of DPnB spike.

h. Analysis 11622 – Surrogate: 1.0 mL of NDMA Surrogate. Spike: 1.0 mL of NDMA spike

i. Analysis 11917 – Surrogate: 1.0 mL of BNA surrogate. Spike: 1.0mL of SIM LCS.

j. Analysis 06397 - Surrogate: 1.0 mL of BNA surrogate. Spike: 1.0 mL of LCS matrix spiking solution and 1.0 mL of the Appendix IX Mix #1 spike is added. If required, prep a separate LCS/LCSD with 1.0 mL of Appendix IX Mix #2

NOTE: If the sample is being analyzed for Benzoic Acid, a separate LCS/LCSD must be created with 1.0 mL of Appendix IX Mix#1 spike.

See *T-OE-GEN-WI10876* for storage and handling of spikes and *T-SVOA-WI11998* for SVOA spiking and calibration standards.

NOTE: If the sample is being divided among multiple vessels, the spike must be divided among the vessels as well.

7. Add 30 mL of 50% acetone in methylene chloride to each vessel.

8. Cap each vessel according to manufacturer's guidelines.

9. Invert each vessel to ensure mixing of sample and solvent.

10. Place the vessels into the carousel. When all samples are loaded, place the carousel into the microwave.

11. Run Program "LL Soils". See Table I for Instrument conditions. Verify that the run reaches the 100 °C temperature requirement and document on batch log.

12. Uncap the cooled vessel.

13. Pour the extract and sample from the vessel into a salt column filled with approximately 10 cm of sodium sulfate on top of an evaporator tube.

14. Rinse the microwave vessel with 10 to 20 mL of methylene chloride from a wash bottle and pour it into the salt column.

15. Allow the salt column to drip dry into the evaporator tube.

16. Place the evaporator tube containing the solvent extract into the pre-heated (approximately 90°C) Rapid-Vap Evaporator. Set the timer for 15 minutes and speed at 75%(the speed is the rotation within the unit while the sample is evaporating). Confirm that the nitrogen is set at 15 psi (this is adjusted on the regulator attached to the nitrogen line).

17. Allow the samples to concentrate to around 5.0 mL and rinse the sides of the evaporator tube down. This ensures that all the analytes sticking to the glassware are rinsed down into the evaporator tube.

Note: Failure to rinse down the sides of the evaporator tube may cause poor recoveries.

18. After rinsing down the sides of the evaporator tubes continue concentrating the extracts to just below 1.0 mL.

19. If GPC is not needed, go to Procedure Step 25.

a. For samples that require GPC bring the final volume to 10.0 mL with methylene chloride in a class A volumetric. Filter extracts into a 100 mm. screw cap tubes using a 10mL Luer-Lok glass syringe and a disposable 0.45-micron filter (Whatman catalog number 6874-2504 or equivalent).

b. Place the extract into the appropriate GPC queuing area for storage until the cleanup is performed. See *T-OE-SVOA-WI10554*.

c. Once the GPC clean up is completed, go to Step 20.

20. Place the extract in a Kuderna-Danish containing a Teflon®-boiling chip.

21. Place a 3-ball Snyder column on the set-up, wet the column with methylene chloride.

22. Concentrate over a steam bath at 80° to 90°C until the apparent volume reaches 1 to 2 mL.

23. Allow the sample to cool at least 10 minutes. Approximately 3 mL condenses into the ampule at this time.

24. Attach the ampule of the K-D to a micro-Snyder column, and concentrate the extract to below 0.5 mL. Allow the sample to cool.

25. Bring to a final volume of 1.0 mL (0.5 mL if GPC was performed) with methylene chloride in a labeled amber GC vial.

a. The final volume is determined by placing the extract into an amber-autosampler vial and comparing the level in the vial to a reference vial containing the exact targeted final volume.

b. The vials used for bottling must be the same lot number as the reference vial.

c. Methylene chloride is added to the extract using a disposable pipette until exactly the same level is in both vials.

d. If too much solvent is added to the sample vial, remove the extract from the vial and concentrate it by micro-snydering to slightly less than the targeted final volume and rebottle.

e. Cap the vial and store in the freezer until analysis.

f. Record the final volume in the extraction log.

Calculations
See analysis method.

Statistical Information/Method Performance
See analysis method.

Quality Assurance/Quality Control
For each batch of samples extracted, a method blank, an LCS, an unspiked background sample, an MS, and an MSD must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead.

A batch is defined as the samples to be extracted on any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Table I

Instrument Conditions

Power:	1600W
Ramp Temperature:	100°C
Ramp Time:	30 minutes
Hold Time:	10 minutes
Cool Down Time:	20 minutes

T-OE-GEN-WI10864 Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876 Organic Extraction Standards Storage and Handling
T-OE-GEN-WI7154 Food and Tissue Preparation
T-OE-SVOA-WI10554 Semivolatile Extract Cleanup Using GPC by Method 3640A
T-SSG-WI9553 Determination of N-Nitrosodimethylamine (NDMA) in Water and Soil by EPA 1625C
T-SVOA-WI11998 Semivolatile Spiking and Calibration Standards
T-SVOA-WI9252 Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D/E SIM by GC/MS
T-SVOA-WI9587 Tetraethyl lead (TEL) in Water and Solids by 8270D/E by GC/MS
T-SVOA-WI9617 Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS
T-SVOA-WI9623 Semivolatile Organic Compounds by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC/MS
T-SVOA-WI9995 Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS

End of document

Version history

Version	Approval	Revision information
11	04.OCT.2016	
12	31.MAY.2017	
13	20.MAR.2019	

eurofins	Always check on-line for validity. **Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035 and Method 5035A**	Level: **Work Instruction**
Document number: **T-VOA-WI11170**		
Old Reference: **1-P-QM-WI-9015193**		
Version: **20**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **09-APR-2021**	Document users: **6_EUUSLA_ Sample Support_VOA prep**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

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Revision Log

Revision: 18		**Effective Date:**	This version
Section	**Justification**		**Changes**
Definitions	Clarification		Updated to reflect new LIMS
Reagents and Standards	Updated to reflect new procedure		Removed all references to sodium bisulfate
Procedure A,B	Updated to reflect new procedure Clarification		Removed all references to sodium bisulfate Updated to reflect new LIMS

Revision: 18		**Effective Date:**	Jul 31, 2018
Section	**Justification**		**Changes**

Revision: 18		**Effective Date:** Jul 31, 2018
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Reference	Reflects revision in use	Changed 5035 reference to Dec 1996; Added Revision number to 5035A reference.
Procedure	Reflects the current procedure Changed to reflect industry standard	Referenced the option to use pre-purchased vials Changed 4° ± 2°C to 0° to 6°C

Reference

1. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 5035, Revision 0, December 1996.
2. *Test Methods for Evaluating Solid Wastes*, SW-846, Method 5035A, Revision 1, July 2002.
3. *Method AK101 for the Determination of Gasoline Range Organics*, April 8, 2002.
4. *Chemical Hygiene Plan*, current version.

Cross Reference

Not applicable

Purpose

The purpose of this SOP is to describe the proper technique to perform the preparation of soil samples for low and high concentration volatile analysis when submitted in a coring device.

Scope

This SOP covers the preparation of vials used when preparing soil samples for low and high concentration volatile analysis. It also covers preparing soil samples that have been collected in a coring device for analysis, such as the Encore™ sampler.

Basic Principles

The sample is collected in a coring device (Encore™) and extruded into a pre-weighed volatile-free container and preserved within 48 hours of collection. The weight of the container, preservative, and soil is captured and the net weight of the sample is calculated and captured in the Volatile Preparation program in LIMS.

Definitions

Analyst Desktop - Reports that reside on the LIMS database. Using the Analyst Desktop application and moisture results pulled from LIMS, the report is populated and the calculations are performed to achieve a Final Extraction Volume to be used when necessary by the GC and GC/MS groups.

Interferences

Sample preparation must be performed in a volatile free environment to avoid contamination. Therefore, this process must be performed in one of the designated volatile free laboratories. It is possible for samples to become contaminated by diffusion of volatiles through the sample vial septum; a trip blank carried through sampling, storage and handling acts as a check for such contamination.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Methanol is flammable. Containers of this solvent must be kept away from any sources of open flames or sparks. Due to the potentially toxic nature of samples received from clients for analysis, safety precautions must be observed when handling samples. Safety glasses, lab coats, and gloves are required. Weighing of hazardous samples must always take place in a hood; see lab notes for further direction.

The solvents utilized in this procedure are disposed of in a solvent waste container which is transferred to a lab-wide disposal facility. Expired standards in methanol are disposed of as hazardous waste. Bulk sample containers and methanolic sample preparations are returned to the sample storage area for future disposal. Other wastes generated by Lancaster Labs are disposed of via incineration at EPA licensed facilities.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP which is maintained in the employee's training record.

The initial training consists of observing the procedure being carried out by an experienced analyst/technician. Next, the trainee performs the procedure while the experienced person watches, answers questions, and gives feedback. Following the initial training, experienced individuals are available as a resource until no longer required. Analysts are considered proficient when able to perform the procedure independently.

Sample Collection, Preservation, and Handling

Samples in either Encore™ sampling devices or jars used for the effervescence check must be refrigerated at 0° to 6°C, not frozen. (Jars used for collection must be glass with a PTFE-lined lid.) Samples must be preserved or frozen in reagent water at ≤-10°C within 48 hours of collection. See individual technical area SOPs for method specific hold times.

Apparatus and Equipment

It is acceptable to use alternate weights and volumes as long as the final concentrations remain the same.

1. 40-mL vials with stir bars, Teflon™-lined low-bleed septa, and screw caps. SciSpec Catalog #376740-MB or equivalent.

2. Encore™ sampler, or equivalent.

3. Pipette capable of dispensing up to 25 mL.

4. Analytical balance capable of weighing 0.01 g

5. Extruder tool for EnCore™ sampler.

6. Analyst Desktop Application - integrates a PC with a balance to collect data directly from the balance. It organizes the data, performs calculations (when required), and stores final results in the Laboratory Information Management System. This procedure must be used whenever possible to facilitate data transfers and other tracking; however, it is allowable to record data traditionally in a logbook if necessary.

Reagents and Standards

The methanol used must have been previously tested and approved for use by the labs.

NOTE: A rinse using reagent water followed by methanol must be performed on the pipette dispensers before adding a new lot of solution or standards.

1. Methanol – Purge and trap grade, store at room temperature and re-analyze yearly. The methanol used must have been previously tested and approved for use by the labs.

2. 8260A/B Surrogate Mix, Restek Catalog #30340 (2500 µg/mL) or equivalent. Store at ≤ -10° C for up to 1 year. This standard is used as is or diluted in methanol to a final concentration of 2.5 µg/mL. Diluted standard must be stored at ≤ -10°C for up to 6 months. This standard is used for the GC/MS analyses.

3. Custom a,a,a-trifluorotoluene (TFT), Restek Catalog #54357 (15,000 µg/mL) or equivalent. This standard is used as is or diluted in methanol to a final concentration of 750 µg/L. Store at ≤ -10°C for up to 30 days. This standard is used for the GC analyses.

4. Reagent water – water in which target analytes are not detected at or above the reporting limit for parameters of interest. In general, the deionized water supplied at the taps in the laboratory meets criteria. If the reagent water does not meet the requirements, see your supervisor for further instructions.

Calibration

Not applicable to this procedure

Procedure

A. Preparing vials

NOTE: Pre-purchased vials can be used for selected preps. Vials containing 5 mL of DI Water, and vials containing 5 mL of methanol are available for Encore preparations. The vials contain the initial tare weight, vial lot number, and the preservative lot number. When using the pre-purchased vials the vial information must be added to the volatile prep application before performing any preparations.

1. Reagent water vials used in preparation for low concentration GC/MS prep method 5035LP Calc/8260.

   a. Add 5 mL of reagent water to a clean 40-mL vial with a magnetic stir bar.

   b. Seal the vial with a screw cap and septum seal. (Septum seal must be able to withstand an acidic solution—low bleed septum recommended).

2. Methanol vials used in preparation for high concentration GC/MS analysis prep method 5035A M Calc/8260.

   a. Add required amount of methanol with 8260 surrogate (pre-made solution) to a clean 40-mL vial.

   b. Seal the vial with a screw cap and septum seal.

   c. Label the vial with a tracking number and capture the information using the volatile prep application.

   d. Store at ≤ -10°C

3. Methanol vials used in preparation for high concentration GC prep method 5035A M Calc/8015.

   a. Add required amount of methanol with TFT surrogate (pre-made solution) to a clean 40-mL vial.

   b. Seal the vial with a screw cap and septum seal.

   c. Label the vial with a tracking number and capture the information using the volatile prep application.

   d. Store at 0° to 6°C, not frozen.

B. Preparing the sample

1. Samples are stored at 0° to 6°C, not frozen, prior to preparation.

2. Samples are removed from the refrigerator/cooler for preparation in small numbers to ensure that they remain cold.

3. Samples for low concentration analysis require three replicate collections.

   a. Two replicates are prepared into reagent water.

   b. One replicate is prepared into methanol as a back up in case we need to change to high level.

4. Samples for high concentration analysis only require one collection prepared into methanol.

5. The methanol vial must be prepared first to ensure at least one vial is available for each required solution.

6. Reagent vials

   a. Weigh a prepared vial to the nearest 0.01 g. Capture the weight.

   b. Extrude the sample from the sampling device into the vial and immediately recap the vial.

   c. Weigh the vial which now contains the soil to the nearest 0.01 g and capture the weight.

   d. The weight of the soil is determined by a calculation performed by the Analyst Desktop program based on subtracting the weight of the prepped vial from the weight of the vial with soil. Note in the comment section if the Encore™ sampling device is not properly sealed or if the device is not full causing a low weight. If the sample is prepped outside of the 48 hour hold time, create an NCM.

   e. Record any unusual observations about the sample.

7. Methanol vials

   a. Weigh a prepared vial to the nearest 0.01 g. Capture this weight.

   b. Extrude the sample from the sampling device into the vial and immediately recap the vial.

   c. Weigh the vial, which now contains the soil to the nearest 0.01 g, and capture this weight.

   d. The weight of the soil is determined by a calculation performed by the Analyst Desktop program based on subtracting the weight of the prepped vial from the weight of the vial with soil. Note in the comment section if the Encore™ sampling device is not properly sealed or if the device is not full causing a low weight. If the sample is prepped outside of the 48 hour hold time, create and NCM.

   e. Record any unusual observations about the sample.

C. Deliver sample to the labs

Once the samples are prepared into either sodium bisulfate or methanol, or frozen in reagent water, they must be transported to the laboratory that performs the analysis. Each department has a designated drop-off spot. Analysis is then performed per the methods of that department.

Calculations

Calculation of sample weight : $Wn = Ws - Wf$

Where:

Wf = weight of container + solution (first weight)

Ws = weight of container + solution + soil (second weight)

Wn = net weight of soil sample

To Determine Final Extract Volume

When there is no moisture value to consider, the Final Extract Volume = the preservation volume (mL) + MeOH added (mL).

When the moisture volume is to be considered, the Final Extract Volume = the preservative volume (mL) + MeOH added (mL) + the moisture volume (mL).

The moisture volume (mL) = weight (g) x (% moisture/100)

Statistical Information/Method Performance
Not applicable to this procedure.

Quality Assurance/Quality Control
The number of sampling devices requested from client services must include enough extra to serve as matrix QC for the volatile analyses requested. Generally, the low-level analysis requires a total of seven Encore™ sampling devices. Four are prepared in sodium bisulfate: two for the unspiked sample, one for the matrix spike sample (MS), and one for the matrix spike duplicate sample (MSD). Three are prepared in methanol: one for the unspiked sample, one for the MS, and one for the MSD. Other numbers of sampling devices for matrix QC purposes are sent at the client's request.

All other QC samples such as the Laboratory Control Samples (LCS), Laboratory Control Sample Duplicates (LCSD), and method blanks are prepared and outlined in the individual technical areas SOPs.

The only surrogate addition performed under this procedure is for the high level containers as noted in Procedure A.3.a and A.4.a, are prepared and outlined in the individual technical areas SOPs.

Volatile Blanks (VB) are created for every 20 samples per reagent used. The preparation of HL lab blank consists of dispensing 10 mL of MeOH/TFT into a 40-mL screw-capped vial. These blanks are then stored in a designated spot in the refrigerator and are analyzed by an analyst.

End of document

Version history

Version	Approval	Revision information
18	17.MAY.2016	
19	31.JUL.2018	
20	09.APR.2021	

eurofins	Always check on-line for validity. **Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD**	Level: **Work Instruction**
Document number: **T-PEST-WI10004**		
Old Reference: **1-P-QM-WI-9015110**		
Version: **10**		Organisation level: **5-Sub-BU**
Approved by: **POK9** Effective Date **30-MAR-2021**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_PCB Chemist**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

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Revision Log

Revision: 10	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed references to old LIMS analysis numbers
Throughout Document	Reflects current practice	Removed references to obsolete work instructions T-PEST-WI10016 and T-PEST-WI10022
Reagents and Standards B.18	New LIMS	Updated reagent database information
Calibration 5.f.(3)	Enhancement	SOP mentioned that quadratic fit may not be used for SC samples, but use of quadratic fit was not discussed. Added discussion about quadratic fit requirements.
Appendix I	New LIMS	Updated reagent database information

Revision	9	**Effective Date:**	29-MAR-2018
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Reference	Reflects current references		Added 8000D

Revision	9	**Effective Date:**	29-MAR-2018
Cross Reference	Updated references to D4		Changed from ETQ reference to D4 throughout document
Interferences	Enhancement		Added information on DDD,DDT, and DDE interference
Sample Collection, Preservation, and Handling	Reflects method hold time		Changed hold time to none recommended
Reagents and Standards 5.	Clarification		Removed sentence on 2 different sources for ICAL and matrix spike
Reagents and standards	Correction		Updated surrogate stock used for IBLK.
Calibration	Reflects current sequence		Added AR166, AR486, and AR546 Changed CCVs from level 3 to level 4.
Calibration 2.a.(4)	Clarification		Added 1248
Calibration 5.	Clarification		Added wording on using each individual peak choosen in the pattern for calculating ave CF.
Statistical Information/Method Performance	Reflects current process		Changed wording to similar verbiage as other department SOPs. added LLOQ requirement
Appendix I	Reflects current sequence		Added AR166, R486 and AR546

Reference

1. *Test Methods for Evaluating Solid Waste*, SW-846, Method 8082A, February 2007.
2. Determinative Chromotographic Separations, SW-846, Method 8000D, July 2014
3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10922	Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550C
T-OE-PEST-WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-PEST-WI10011	QC Data Acceptability and Corrective Action
T-PEST-WI9954	Interpretation of Chromatographic Data
T-PEST-WI10007	Preventative and Corrective GC Maintenance
T-PEST-WI9980	Monitoring QC Data Acceptance Limits
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses

Scope

This method is used for identifying and quantitating the following PCBs in solid samples and wipes using SW846 8082A:

Compound	Soil LOQ (µg/kg)	Wipes LOQ (µg)	Tissue LOQ (µg/kg)
Aroclor 1016	17	0.5	34
Aroclor 1221	17	0.5	34
Aroclor 1232	17	0.5	34
Aroclor 1242	17	0.5	34
Aroclor 1248	17	0.5	34
Aroclor 1254	17	0.5	34
Aroclor 1260	17	0.5	34
Aroclor 1262	17	0.5	34
Aroclor 1268	17	0.5	34

Aroclors 5422, 5432, and 5460 can be analyzed upon request of the client. See Appendix I for GC operating conditions and calibration information.

Compound	Soil LOQ (µg/kg)
Aroclor 5422	33
Aroclor 5432	33
Aroclor 5460	33

Limits of Quantitiation (LOQs) are based on statistical evaluation of laboratory data and are subject to change. The current Method Detection Limits (MDLs) and LOQs are maintained in the LIMS.

Basic Principles

A solid sample or entire wipe is extracted using sonic probe with 1:1 methylene chloride:acetone, or microwave extraction with hexane. The extract is dried, concentrated, and exchanged to hexane. A florisil and sulfuric acid cleanup is utilized to reduce any matrix interferences. The PCBs are then identified and quantitated using gas chromatography (GC) with electron capture detector (ECD). Copper cleanup may also be employed to reduce elemental sulfur or other matrix interferences which introduce large, unresolvable peaks into the chromatogram. Refer to *T-OE-PEST-WI10281* for details on each cleanup procedure.

Solid matrices other than soil can also be analyzed as long as the sample can be handled through the extraction technique. Typically solids are reduced to small pieces for extracting (concrete, wood, other plant material etc). Tissue samples are ground and homogenized prior to extracting. Tissue samples may be whole fish, filets, or other miscellaneous species (usually aquatic but not necessarily). Wipe samples are analyzed by taking the entire wipe sample and any solvent in the sample container.

Reference Modifications

Gas Chromatography conditions are different than those listed in Method 8082A, however, all QC criteria are met.

Interferences

Avoid contact with any plastic material during the extraction and analysis procedures to minimize interferences from phthalate esters.

Scrupulously clean all glassware to minimize interferences caused by laboratory contaminants.

An electron capture detector (ECD) is very sensitive to compounds that contain halogens and will also respond to many other compounds and materials including oxygenated organics, unsaturated organics, and elemental sulfur.

Extracts may require further cleanup by sulfuric acid, florisil, or copper if interferents such as oxygenated organics, unsaturated organics, and elemental sulfur are present. Refer to *T-OE-PEST-WI10281*
for details on each cleanup procedure.

Common single component pesicides such as DDT, DDD, and DDE may cause interference with the aroclor pattern. To ensure that the analyst is aware of this, a standard containing DDE/DDD/DDT will be run with each initial calibration.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for generalinformation regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Gloves, lab coats, and safety glasses must be worn when preparing standards. Safety glasses must be worn around the GC where solvents and sample extracts are handled.

GC vials are disposed of in the designated lab container and subsequently lab packed for final disposal. All solvent waste is placed in designated containers in the laboratory then taken to the lab-wide facility by personnel trained in hazardous waste disposal.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up sequences, perform the calculations, interpret chromatograms, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples, one blind sample, or one ICAL with ICVs and/or CCVs.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass containers with Teflon™-lined caps and kept cool at 0° to 6°C, not frozen.

PCBs have no maximum recommended holding time for the extraction. Some agencies or projects may require a specific hold time for the extraction. If the hold time is specified in the project, this hold time must be followed. Sample analysis must be performed within 40 days of extraction. Extracts are stored in the freezer at ≤-10°C

Apparatus and Equipment

1. HP 7890 gas chromatograph equipped with an electron capture detector or equivalent
2. Columns:
   a. Phenomonex MultiRes I – 30 m × 0.32 mm × 0.5 µm or equivalent
   b. Phenomonex MultiRes II – 30 m × 0.32 mm × .25 µm or equivalent
   c. Alternatively, Restek columns can be used.
3. Integrating system such as Chrom Perfect® by Justice Laboratory Software, or equivalent. Chrom Perfect® is a data system capable of storing and reintegrating chromatographic data and determining peak areas using a forced baseline, area summation, baseline projection, and performing baseline compensation as required.
4. Various sizes of Class A volumetric flasks, pipettes, and syringes

Reagents and Standards

A. Reagents

1. Hexane for autosampler rinse vials, stored at room temperature.
2. UPC (Ultra pure carrier) helium for carrier gas
3. UPC nitrogen for detector make-up gas
4. UPC hydrogen for carrier, either bottled or from a generator

B. Standards

1. All standards are prepared using Class A volumetric pipettes, syringes, and flasks.
2. An analytical balance is used to measure all weights.
3. Unopened ampules are stored according to the manufacturer's instructions and are stable until the expiration date provided by the manufacturer.
4. All prepared standard solutions are stored at ≤-10°C in labeled containers or vessels.
5. Aroclor 1016 & 1260 stock – Restek #32039 at 1,000,000 ppb in isooctane or equivalent. Prepare a ten-fold dilution for an intermediate.
6. Aroclor 1016 ICV Stock – Accustandard Cat# C-2165-H-10X at 1,000,000 ppb in Hexane.

7. Aroclor 1260 ICV Stock - Accustandard Cat# C-2605-H-10X at 1,000,000 ppb in Hexane.

8. Aroclor 1221 stock – Restek #32007 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.

9. Aroclor 1232 stock – Restek #32008 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.

10. Aroclor 1242 stock – Restek #32009 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.

11. Aroclor 1248 stock – Restek #362010 at 1,000,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

12. Aroclor 1254 stock – Restek #32011 at 1,000,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

13. Surrogate stock (SS) – Supelco #861284 containing DCB/TCX at 200,000 ppb in acetone or equivalent. Prepare an intermediate by diluting 1.0 mL to 25 mL of hexane for AR1016/1260, AR1254, AR1248.

14. 1016/1260 Matrix spike (MS) stock – Restek #32039 at 1,000,000 ppb in hexane or equivalent.

15. Aroclor 1262 stock – Restek #32409 at 1,000,000 ppb in hexane or equivalent. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

16. Aroclor 1268 stock – Restek #32410 at 1,000,000 ppb in hexane or equivalent. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

17. Instrument Blank (IBLK) – Surrogate Stock (SS) – Restek #32000 containing Decachlorobiphenyl (DCB) and Tetrachlorometaxylene (TCX) at 2000,000 ppb in acetone or equivalent.

18. Prepare working standards using the reagents module of the LIMS as a guide.

    a. In the reagents module, first enter the reagents in this section as 'source' reagents.

    b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in TALS.

    c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.

    d. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.

    e. The scheme for preparing the matrix and surrogate spiking solutions used in the extraction process are listed below.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
PCB Spike	Aroclor 1016/1260 MS Stock	1.25	250	Acetone	PCB Spike
SS	Pest Surr Stock	1.5	1000	Methanol	SW-846 Water surrogate – identical to that prepared for Pest/PCB analyses

19. An initial calibration verification standard must also be prepared at a concentration at the mid-point of the calibration for 1016, 1260,1248 and 1254 using a stock solution purchased from a different source other than that used for the calibration standards.

20. Additional standards and preparations are listed in Appendix I for Aroclor 5442, 5432, and 5460 (PCT analysis).

Extraction

See organic extraction work instruction T-OE-Pest-WI10922 for sonication extraction and T-OE-Pest-WI10927 for microwave extraction.

Gas Chromatographic Conditions

The conditions listed are usually the optimum operating conditions but can vary to improve the sensitivity, linearity, and overall chromatography or shorten run times on each GC system. A Merlin microseal may be used in place of a traditional septum.

Detector	ECD
Detector Temperature	330°C
Oven Temperature	110°C 40°C/min to 250°C 20°C/min to 280°C 30°C/min. to 330°C Hold until DCB elutes ~ 2 min.
Carrier	Hydrogen at 12 psi, 5ml/min constant flow (Can be substituted with Helium)
Makeup gas	N2 at 30 mL/min. for Varian GCs N2 at 55 mL/min. for HP GCs
Injection size	1 µL, direct injection
Injection Temperature	225°C

Calibration

1. Fill the autosampler rinse vials with clean solvent or replace vials which appear dirty.
2. Prepare a sequence using the following suggested order of injections:

    1. Conditioner
    2. IBLK
    3. EVAL
    4. AR161
    5. AR162
    6. AR163
    7. AR164
    8. AR165
    9. AR166
    10. AR481
    11. AR482
    12. AR483
    13. AR484
    14. AR485
    15. AR486
    16. AR541
    17. AR542
    18. AR543
    19. AR544
    20. AR545
    21. AR546
    22. AR214
    23. AR324
    24. AR424
    25. AR624
    26. AR684
    27. AR16xx
    28. MD16 (MDL)
    29. IC16x (ICV)
    30. IC48x (ICV)
    31. IC54x (ICV)
    32. Blank
    33. LCS
    34. 1234567
    35. 1234567ms
    36. 1234567msd
    37-47. Continue running samples
    48. AR164(CCV)
    49. IBLK

    a. For routine PCBs:

(1) The AR21, AR32, and AR42 are level 4 in the cal and are entered at AR214, AR324, and AR424 in the cal.

(2) AR62 and AR68 are both level 4 and are listed as AR624 and AR684 in the sequences.

(3) A single point of Aroclor 1016 is analyzed with the calibration to aid in better pattern recognition in the samples. Aroclor 1016 and 1242 have similar patterns with the exception of the smaller trailing peaks at the end of the Aroclor 1242 pattern. This is identified in the sequence as AR16xx.

(4) A DDT/Endrin breakdown standard is run with each ICAL in order to provide the retention times for p,p-DDE, p,p-DDD, and p,p-DDT which may interfere with the pattern for aroclor 1248, 1254, and 1260.

b. See Appendix I for a sequence example when the analysis of PCTs (Aroclors 5442, 5432, and 5460) is requested.

3. Inject conditioner to prime the system.

   a. The conditioner injection is usually a standard or sample which has already been injected.

   b. It is used to prime the system and is best utilized when the GC has not been running and there is a gap in time prior to starting a set of injections.

   c. Hexane blanks may also be run to allow the GC to go through some temperature programs and/or to check the cleanliness of the system.

4. An instrument blank (IBLK) is always run prior to a new calibration to confirm that the instrument is free of background noise or contamination. IBLK may also be run with the continuing check standards - this is optional but frequently requested for projects.

5. Initial Calibration (ICAL)

   a. Calibrate for the aroclors using the six levels of 1016, 1260, 1248, and 1254 (calibration range of 50 µg/L through 1000 µg/L) and using the single point for 1221, 1232, 1242, and 1262 and 1268 when needed (200 µg/L standard used).

   b. As an option, 1248 and 1254 may use a single point calibration.

   c. An external standard calibration based on the average calibration factor (AVG CF)for each individual peak chosen in the pattern is used for quantitation where the %RSD is ≤20%.

   d. The surrogate standards are calibrated using the AR16 levels and the calibration is also performed using AVG CF unless the %RSD is >20%.

   e. When the % RSD criteria is not met (i.e. >20%), a linear calibration curve is used.

      (1) The curve must meet a correlation coefficient of 0.99 to be a valid fit.

      (2) Extrapolate or force to zero is not allowed. Set the zero to ignore.

      (3) North Carolina and 8000D requires calculation of % error for any linear fits. The criteria for % error of standard levels at or below the LOQ is +/- 50%. The criteria for % error of all other standard levels is +/-30%.

      %error = ((true – calc)/true) x 100

   f. If the %RSD criteria or 0.99 curve coefficient cannot be met:

      (1) Inspect the data points to see if one or more calibration levels may have concentrated due to solvent evaporation or degraded over time.

      (2) Reinject or remake the standard if this is the cause.

      (3) Use a quadratic fit provided six points are used in the calibration and the curve meets a correlation coefficient of 0.99. The % error must be calculated and meet the criteria defined in e.4. **NOTE:** A quadratic fit may not be used for South Carolina samples.

      (4) Perform instrument maintenance as needed.

      (5) See *T-PEST-WI10007* for troubleshooting linearity problems.

   g. Set up the aroclor calibration data in a custom program under Datalog. The retention times of the peaks to use for identifying and quantifying the aroclors are entered into the calibration file along with the corresponding peak heights and concentrations (in µg/L).

   h. Ensure the surrogate peaks in the standards are labeled properly.

i. Set the scaling of chromatograms so that the size of the peaks of interest for each aroclor are approximately 2 to 3 mm in height at the concentration of the method detection limit (MDL).

(1) Ensure all peaks in the MDL standard are integrated.

(2) By running the 1016/1260 MDL standard, the majority of peaks for all aroclors should be represented.

6. Initial Calibration Verification (ICV)

a. Verify the calibration curves using the ICV mixtures injected directly after the full ICAL.

b. The % difference of the concentrations of each individual peak used to calculate the Aroclor must be within 20% difference of the nominal concentration.

7. Continuing Calibration Verification (CCV)

a. Calibration verification is performed after each set of twenty injections (samples, QC, blanks, etc.) or 12 hours, whichever comes first.

b. Use AR16 to evaluate the calibration of the aroclors (or other aroclors as requested for particular clients or projects).

c. The concentration quantitated for each individual peak used to calculate the Aroclor in the continuing calibration verification standards must be within 20% difference (%D) of the nominal concentration for each peak/surrogate.

d. Samples must be bracketed by compliant standards.

(1) Exception: If standard following a sample is outside the ±20% but exhibits increasing response, the samples before it do not have to be reinjected if the target analytes are not detected. A comment must be added to the analytical report.

(2) If two consecutive/sequential CCVs fail, corrective action must be taken, which can include performing injection port maintenance, baking the instrument or other types of maintenance. Two consecutive/sequential CCVs must meet the criteria or an initial calibration must be performed before sample analysis can continue.

e. If confirmation of target analytes is needed, then the second column should meet the 20% continuing calibration criteria, as well as all initial calibration criteria. If either of these are not met, a comment must be added to the analytical report.

8. The instrument blank (IBLK) is injected after each set of continuing calibration verification when requested.

a. It must be evaluated as a water matrix against the water MDL/LOQs.

b. The IBLK must not have any target compounds above the reporting limits.

(1) If a target analyte is detected in the IBLK, any associated samples with a detection for that same target must be evaluated.

(2) Unless the concentration in the sample is more than 10x the IBLK value, the sample must be injected after another compliant IBLK.

(3) Instrument maintenance, i.e., baking the system or injection port maintenance is usually necessary to clean up the instrument.

9. Retention time (RT) windows

a. Established as 3× the standard deviation determined over 72 hours, or at no less than ±0.02 min, applied to the midpoint initial calibration standard.

b. If the RTs for a continuing calibration verification standard fall outside the RT window, update the midpoint RT using that standard.

(1) Save this under the appropriate name to indicate an update has occurred.

(2) RTs cannot be updated more than once per day. All subsequent standards run within a 24-hour period must be within this window.

(3) If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Prepare a sequence of injections as suggested in the Calibration Section, along with the appropriate check standards.

2. Retention times of peaks in the samples are compared to the standard RT windows.

a. Peaks present on both columns that are also in the correct ratios to represent an aroclor are quantitated, and the high value is reported unless chromatographic anomalies are observed. See *T-PEST-WI9954*.

b. Use a minimum of three to six peaks for quantitation, with the exception of certain mixes where it may be more accurate to use less peaks to avoid excessive overlap of patterns.

3. Continue running groups of samples/injections followed by check standards every 12 hours or 20 injections, whichever comes first.

   a. For projects where a known aroclor is present and at the request of clients, other aroclors can be run for the continuing check standard. For instance, a set of continuing standards may be AR484, AR164, IBLK.

   b. Aroclor 1262 and 1268 can be analyzed when requested. A full six point curve can also be run, depending on the project requirements.

4. If significant interference is present, schedule florisil and/or sulfuric acid cleanup. If elemental sulfur is present, TBA or copper the extract or have it put through GPC cleanup. If these techniques do not reduce the matrix problems, dilute the extract with hexane and adjust LOQs accordingly.

5. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

Calculations

1. The peak heights generated by the integration system are used to calculate the calibration factors (CF) for peaks of interest for each aroclor.

   Usually, the six major peaks that are unique to each aroclor are chosen for quantitation, with the exception of 1221 where only three peaks are available.

2. Sample concentrations are calculated per peak using average calibration factor (AVG CF) from the initial calibration.

$$\frac{\text{Sample Height}}{\text{AVG CF (CF)}} \times \frac{FV}{IW} \times DF = \mu g/kg \text{ as received per peak}$$

Where:

FV = Final volume (mL)

IW = Initial weight (g)

DF = Dilution factor, as needed

The final result that is reported is determined as the average of the result for each peak chosen for quantitation:

$$(\text{Result 1} + \text{Result 2} + \ldots + \text{Result } n) \;/\; n = \text{Average Result}$$

3. The surrogate results are determined using either AVGRF or linear curve:

   a. Using AVGCF from the initial calibration:

$$\frac{\text{Sample Height}}{\text{AVCRF (CF)}} \times \frac{FV}{IW} \times DF = \mu g/kg \text{ as received}$$

   b. Using linear curve from the initial calibration:

$$[(\text{Sample Height} - Y\text{-intercept})/\text{Slope}] \times \frac{FV}{IW} \times DF = \mu g/kg \text{ as received}$$

Where:

FV = Final volume

IW = Initial weight

DF = Dilution factor, as needed

4. See *T-PEST-WI9847* for all other equations related to the analysis.

Statistical Information/Method Performance

LCS,MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Acceptance limits are generated according to *T-PEST-WI9980*. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

When 8000D is referenced, a lower limit of quantification (LLOQ) verification is required annually on at least one instrument. All instruments must have one at least every three years.

Quality Assurance/Quality Control

QC Acceptance limits are established as statistical limits. See *T-PEST-WI9980* for further information on monitoring and establishing limits.

A sodium sulfate blank and a sodium sulfate spike (LCS) are analyzed with every group of samples up to a maximum of 20. An MS/MSD is performed per batch. For wipes and when an MS/MSD cannot be performed, an LCSD will be extracted.

Aroclor 1016 and 1260 are routinely spiked; however, other aroclors can be spiked as requested by clients.

DCB and TCX are added as surrogates to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the GC run.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed.

See *T-PEST-WI10011* for details on QC acceptance criteria and corrective action.

Appendix I

PCT Analysis (Aroclor 5422, 5432, and 5460)

A. Standards:

1. PCT Stocks- Aroclor 5432, 5442, and 5460 are purchased as individually ampulated solutions from Accustandard at 35,000 ug/L.

2. Surrogate Stock- Ultra ISM-320 containing TCX/DCB at 200,000ppb in acetone. Prepare an intermediate by diluting 0.25mL to 25mL of hexane.

3. MS stock of Aroclor 5442 - Absolute cat# 71791, 1000ug/L in Methanol.

4. Prepare working standards using the reagents module of the LIMS as a guide.

   a. In the reagents module, first enter the reagents in this section as 'source' reagents.

   b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in TALS.

   c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.

d. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.

e. The scheme for preparing the matrix and surrogate spiking solutions used in the extraction process are listed below.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
MS	Aroclor 5422 Stock	0.75	100	Acetone	Aroclor 5442 PCT Spike
SS	Pest Surr mix	1.5	1000	methanol	SW 846 surrogate

B. GC Chromatographic Analysis:

The conditions listed serve as a guideline only and are typically the optimum operating conditions. The analyst may make any changes to the chromatographic conditions to improve the speed of analysis, linearity, sensitivity, and/or improve separation if initial and continuing calibration criteria and quality assurance criteria listed within this analysis document are met.

Detector	ECD
Detector temp	330°C
Oven Temp	110°C to 250° at 40°C/min, to 280°C at 20°C/min, to 330°C at 30°C/min, hold 9 min.
Carrier	Hydrogen at 3.6 mL/min
Makeup gas	N2 at 60mL/min or equivalent
Injection size	1-uL, direct injection
Injection temp	225°C

C. Example of a Sequence:

1. Conditioner
2. IBLK
3. EVAL
4. AR161
5. AR162
6. AR163
7. AR164
8. AR165
9. AR166
10. AR481
11. AR482
12. AR483
13. AR484
14. AR485
15 AR486
16. AR541
17. AR542
18. AR543
19. AR544
20. AR545
21. AR546
22. PCT1
23. PCT2
24. PCT3
25. PCT4
26. PCT5
27. A4421
28. A4422
29. A4423
30. A4424
31. A4425
32. AR213
33. AR323
34. AR423
35. AR623
36. AR683
37. AR16xx
38. MDPCTX
39. MD16
40. IC16
41. IC48

42. IC54
43. Blank
44. LCS
45. 1234567
46. 1234567MS
47. 1234567MSD
48-62. Continue running samples
63. AR163
64. PCT3
65. A4423
66. IBLK

T-OE-PEST-WI10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-PEST-WI10922 Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550C
T-OE-PEST-WI10927 Microwave Extraction Method 3546 for PCBs in a Solid Matrix
T-PEST-WI10007 Preventative and Corrective GC Maintenance
T-PEST-WI10011 QC Data Acceptability and Corrective Action
T-PEST-WI9847 Common Equations Used During Chromatographic Analyses
T-PEST-WI9954 Interpretation of Chromatographic Data
T-PEST-WI9980 Monitoring QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information
8	26.AUG.2016	
9	29.MAR.2018	
10	16.MAR.2021	

Appendix C
Soil and Groundwater Sampling Forms

MONTROSE ENVIRONMENTAL

Lithologic Log

Site: _____ Date: _____

Location/Boring/Station No.: _____

Technicians: _____

Drilling Firm: _____ Driller(s): _____

Drill Rig: _____ Collection Method: _____ Boring Location/Coordinates: _____

Ground Elevation: _____ Estimated ☐ Surveyed ☐ Depth to Ground Water: _____ft.

Depth from – to (ft)	PID (ppm)	Hg Vapor Analyzer ($\mu g/m^3$)	Lithologic Description

Time	Sample ID	Sample Depth from – to (ft)	Grab or Composite	Analysis

Notes: _____

MONTROSE ENVIRONMENTAL

Field Instrument Calibration Record

Site: _____

Calibration Performed by: _____ Company: _____

Instrument Make/Model/SN: _____

Calibration Gas: _____ Lot No. _____ Expiration Date: _____

Date	Time	Regeneration (Y/N)	Zero Instrument (Y/N)

Notes:

NA = Not Applicable

MONTROSE ENVIRONMENTAL

Field Instrument Calibration Record

Site: _____

Calibration Performed by: _____ Company: _____

Instrument Make/Model/SN: _____

Calibration Gas: Isobutylene _____ Lot No. _____ Expiration Date: _____

Date	Time	Zero (Fresh Air) Cal (Pass/Fail)	Span Setting	Instrument Response

Notes:

NA = Not Applicable

Appendix D
Quality Assurance Manuals

Quality Assurance Manual

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Facility Distribution No. _____ **Distributed To:**_____

1.0 Title Page

Quality Assurance Manual
Approval Signatures

Signatures on File

Business Unit Manager – Patrick Garcia-Strickland | Date

Quality Assurance Manager – Terri Torres | Date

2.0 TABLE OF CONTENTS

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3.0 INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

Eurofins Frontier Global Science's Quality Assurance (QA) Manual is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving the laboratory's QA Program. Governing SOPs are in place within the organization to ensure the proper execution of this QA Manual (refer to Appendix 1). This manual and referenced documents are required reading for all personnel.

The laboratory is a team of people who work together to serve the health and environmental needs of society through science and technology. We expertise in mercury, trace metals and metals speciation in environmental and industrial matrices and client relations and maintain a national perspective in terms of quality.

As such, this QA Manual has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009 and 2016; ISO/IEC Guide 17025: 2005 and 2017 and the Department of Defense (DoD)/Department of Energy (DOE) Quality Systems Manual (QSM). Policies and procedures listed in Appendix 1 are compliant with the National Divisional Support Center (NDSC) Quality Management Plan (QMP) for Eurofins Environmental Testing America and the various accreditation and certification programs which are held by the laboratory to support environmental work (Appendix 2). The QMP provides a summary of Eurofins Environmental Testing America quality and data integrity system. It contains requirements and general guidelines under which all Eurofins Environmental Testing America facilities shall conduct their operations.

Refer to Appendix 3 for a list of additional references for which this QA Manual is compliant; and Appendix 4 for the compliance crosswalk of this manual to the TNI & ISO/IEC Guide 17025 requirements.

3.2 Terms and Definitions

A QA Program is a system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the local management level through company goals, from guidance at the executive management level, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. Our program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization to better serve our clients.

Refer to Appendix 5 for a list of Terms and Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples. Sample matrices vary among effluent water, groundwater, hazardous waste, sludge and soils. The Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly

evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Laboratory Information Management System (LIMS). Our areas of expertise include:

Standard Services
• Low-level Mercury • Trace Metals • Metals Speciation • Non-Potable Water Testing • Soil and Surface Water Testing • Air Analysis • Sediment and Tissue Testing

NOTE: All current certificates and scopes of accreditation are available on the laboratory's website at http://www.eurofinsus.com/frontier.

The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory President, Laboratory Vice-President, Director of Operations, Laboratory Director and/or Business Unit Manager and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory President, Laboratory Vice-President, Director of Operations, Laboratory Director and/or Business Unit Manager and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Eurofins National Divisional Support Center (NDSC), which houses the Quality Assurance leadership team for Eurofins Environment Testing America. NDSC QA will assure that the template remains in compliance with Section 3.1. This manual itself is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the QMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. EFQA-Q-QD-SOP2804 and EFQA-Q-QD-SOP2802).

4.0 MANAGEMENT REQUIREMENTS

4.1 Overview

The laboratory is a local operating unit of Eurofins Environment Testing America. The laboratory's operational and support staff have the day-to-day independent operational authority under the direction of the Laboratory President, Laboratory Vice-President, Director of Operations, Laboratory Director and/or Business Unit Manager and is supported by the NDSC QA team. The laboratory management staff includes directors, managers and group leaders. The organizational chart of the management staff are presented in Figure 4-1. Individual departmental staff lists are maintained in the laboratory's internal intranet.

4.2 Roles and Responsibilities

In order for the QA Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The responsibility for quality resides with every employee of the laboratory. All employees have access to the QA Manual, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks impartially and in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to Eurofins Environment Testing America Chief Operating Officer (COO). With the aid of the NDSC Quality Team Members, Business Unit Managers, Laboratory Directors, the VP-QA/EHS has the responsibility for the establishment, general overview and maintenance of the Quality Assurance and EH&S Programs within Eurofins Environment Testing America. Additional responsibilities include:

- Review of QA/QC and EHS aspects of NDSC Official Document, national projects and expansions or changes in services.
- Work with various organizations outside of the laboratory to further the development of quality standards and represent the laboratory at various trade meetings.
- Prepare monthly reports for quality and EH&S metrics across the environmental testing laboratories and a summary of any quality and EH&S related initiatives and issues.
- With the assistance of the Executive Management, and the EHS Managers, maintenance and implementation of the Eurofins Environment Testing America Environmental, Health and Safety Program.

4.2.2 Quality Directors

There are four (4) Quality Directors within NDSC that report directly to the VP-QA/EHS. These Quality Directors have oversight of the general overview and maintenance of the QA Program within the Eurofins Environment Testing America laboratories. Supported tasks include:

- Monitors laboratory internal audit findings;
- Identifies common laboratory weaknesses and monitors corrective action closures.

- Develops NDSC quality guidance documents and management tools for ensuring and improving compliance;
- Monitors and communicates DoD/DoE requirements;
- Monitors and communicates regulatory and certification requirements;
- Training and OnBoarding
- Laboratory assessments, mentoring, and interventions
- Track/drive root cause investigations and corrective action plans
- Builds knowledge base for preventive actions

4.2.3 Quality Information Manager

The Quality Information works directly with the NDSC Quality Directors and EHS Managers; and reports directly to the VP-QA/EHS. The Quality Information Manager is responsible for the management of:

- NDSC Official Documents
- TALS/LIMS Certification Module Data
- Company's Intranet website
- Company's Regulatory Limits Database
- Subcontract laboratory and approved vendor information
- Internal and External client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions
- Communicate regulatory information and lists

4.2.4 Environmental Health and Safety (EH&S) Managers

There are 3 EH&S Managers within NDSC that report directly to the VP-QA/EHS. These EH&S Managers have oversight of the general overview and maintenance of the EH&S Program within the Eurofins Environment Testing America laboratories. Supported tasks include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for Eurofins Environment Testing America locations.
- Coordination/preparation of the Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.
- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.5 Ethics and Compliance Officers (ECOs)

The NDSC VP-QA/EHS and Corporate Counsel are designated Ethics and Compliance Officer (ECO). Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire executive management personnel and lab management staff.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President, COO, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratory's regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.6 Laboratory Director/Business Unit Manager (BUMA)

The Laboratory Director/BUMA is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their business unit President. The Laboratory Director/BUMA is also responsible for any service centers connected with their laboratory that perform analytical tests, such as short holding time analyses for pH. The Laboratory Director/BUMA provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Provides one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.
- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented. Works with Eurofins Environment Testing Human Resources for hiring of new personnel.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures company human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory. Assesses laboratory capacity and workload.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QA Manual or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.

- Pursues and maintains appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensures client specific reporting and quality control requirements are met.
- Contributes to the continuous improvement of the laboratory operations.
- Maintains an awareness of technical developments and regulatory requirements.
- Captains the management team, consisting of the QA Manager, the Technical Manager(s), and the Operations Manager as direct reports.

4.2.7 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system at the laboratory where they work. The QA Manager is also responsible for any service centers connected with their laboratory that perform analytical tests, such as short holding time analyses for pH.

The QA Manager reports directly to the Laboratory Director/BUMA and their NDSC Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. The NDSC QA Team may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officer to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Have functions independent from laboratory operations for which he/she has quality assurance oversight.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Have a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arrange for or conducting internal audits on quality systems and the technical operation
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QA Manual or laboratory SOPs shall be investigated following procedures outlined in Section 14 and if deemed necessary may be temporarily suspended during the investigation.
- Maintaining and updating the QA Manual.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.

- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Performing technical data audits and method audits to ensure consistency and compliance with regulatory requirements.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or NDSC QA Team.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Participate in the vendor and supplier approval process, including subcontractors.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Communication to the relevant regulatory authorities when there are management or facility changes that impact the laboratory.
- Ensuring communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025
- Compliance with the DoD/DOE QSM.

4.2.8 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for compliance with the ISO 17025:2017 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.

- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc.
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.
- Compliance with ISO 17025.
- Compliance with the DoD/DOE QSM.

4.2.10 Project Manager (PM)

Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager who serves as their primary contact at the laboratory. It is the PM'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 – including all verbal communcations.

- Scheduling sample submissions, sample container orders and sample pick-up via the laboratory courier service.
- Confirming certification status

- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.
- Answering common technical questions, facilitating problem resolution and coordinating technical details with the laboratory staff.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample status reports or results prior to receipt of the final report.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.

4.2.12 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

4.2.13 Safety Officer

The Safety Officer reports to the Laboratory Director/BUMA and ensures that systems are maintained for the safe operation of the laboratory. The Safety Officer is responsible to:

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.

- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is "reasonable" and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by Eurofins medical consultants.

4.2.14 Sample Receiving Staff

The Sample Receiving Technicians report to the Sample Receiving Supervisor; the Supervisor reports to the Operations Manager. The responsibilities are outlined below:

- Ensures implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Reports non-conformances associated with condition-upon-receipt of samples.
- Logs incoming samples into the LIMS.
- Ensures that all samples are stored in the proper environment.
- Ensure the verification of data entry from login.
- Responsible for meeting quality requirements including documenting preservation.
- Responsible for ensuring the timely and correct shipment of sample containers, including proper preservatives and instructions, to clients

4.3 Business Continuity and Contingency 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. Deputies are identified 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. The QA Manager communicates to the relevant regulatory authorities 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.

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Patrick Garcia-Strickland Laboratory Director/BUMA	Terri Torres QA Manager
Terri Torres Quality Manager	Patrick Garcia-Strickland Laboratory Director/BUMA
Monica Garcia-Strickland Metals Technical Manager	Patrick Garcia-Strickland Laboratory Director/BUMA
Lilly-Anna LaCount EHS Coordinator	Patrick Garcia-Strickland Laboratory Director/BUMA

Figure 4-1. Laboratory Organization Charts

>>> Amend the most current Lab Org Chart with only MGMT Personnel/Titles. <<<

5.0 PERSONNEL

5.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

5.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for laboratory employees are outlined in job descriptions maintained by Eurofins Environment Testing America Human Resources.

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Managers – **General**	Bachelor's Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

5.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	60 days of hire	All
Data Integrity	60 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status and records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Laboratory Training SOP (EFQA-Q-QD-SOP2814).

5.4 Data Integrity and Ethics Training Program

The laboratory's Ethics and Data Integrity Program is discussed in Section 6.2. Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by the NDSC.

6.0 ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

6.1 Overview

The laboratory is a 20,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, sample analysis, and administrative functions.

6.2 Environment

Laboratory accommodation, test areas, energy sources, and lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

When the laboratory performs laboratory activities at sites or facilities outside its permanent control, it shall ensure that the requirements related to facilities and environmental conditions of this document are met.

Specific requirements for facility and environmental conditions, as well as periodic monitoring of conditions, are given in the Environmental Health & Safety Manual plus each laboratory's Facility Addendum.

6.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

6.4 Responding to Emergencies

Employees must be aware of procedures to respond to all emergencies that might occur in the workplace. Employees must be familiar with the location and proper operation of all emergency equipment, evacuation routes and designated assembly areas for all areas where they work. Refer to the Chemical Hygiene Plan Document No. EFHS-S-HS-12066, Sec. 1.11 and the laboratory's Health and Safety Evaluation and Auditing, SOP No. EFHS-S-HS-SOP5670 for complete details. These documents provide direction for situations where normal operations of the laboratory are not possible (e.g., electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, etc.)

In the event that the building or information technology (IT) systems would be severely challenged, a designated disaster recovery team, which includes Facility Management, Maintenance, Safety, Laboratory/Executive 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.

6.5 Building Security

The laboratory is considered a secure facility. All outside doors (except the sample control entrance) are locked during normal business hours to prevent unauthorized entry. (An attendant monitors this entrance at all times.) Building keys are distributed to employees as necessary.

All visitors to the laboratory must sign in and out in a visitor's logbook that is located in the lobby. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. Both visitors and vendors must review and sign specific EH&S forms; and are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

7.0 QUALITY SYSTEM

7.1 Quality Policy Statement

The Quality Policy statement gives employees clear requirements for the production of analytical data. 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 concerns 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

7.2 Ethics and Data Integrity

Eurofins Environment Testing America is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The laboratory operates our Ethics and Data Integrity program under the guidance of Eurofin's Key Guidance Document (KGD). The elements of the our program include:

- An Ethics Policy (NDSC Document No. CW-L-P-004 and laboratory Document No. EFQA-M-MC-5669) and Employee Ethics Statements.
- Ethics and Compliance Officer/s (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (NDSC Document No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (NDSC Document No. CW-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (SOP No. EFQA-Q-QD-SOP2989).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Provide procedures and guidance to ensure the impartiality and confidentiality of all data and customer information.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

7.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance (QA) Manual – Each laboratory has a lab-specific QA manual.
- NDSC Official Documents – Each laboratory may use the Guidance (instructional use) documents at their discretion. Template documents are process documents that the

laboratory's need to implement locally by using the document as is or as an outline to define their internal practices that meet the minimum requirements of the template. Required documents need to be implemented as is and listed in the laboratory's document control list.

- Key Guidance Documents (KGDs) - Documents compiled at the Group Service Centre (GSC) level by Functional Leaders (document owners) aimed at providing specific Eurofins groups of employees with guidelines necessary for the good conduct of their respective work.
- Laboratory SOPs and Policies – General and Technical
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).

7.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Quality Management Plan (QMP)
- NDSC Guidance Documents
- KGDs
- Laboratory Quality Assurance Manual (QA Manual)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

NOTE: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the QMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QA Manual shall take precedence over the QMP in those cases.

7.4 QA/QC Objectives for the Measurement of Data

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, DOE and any other regulatory agencies (i.e., states) in which the laboratory maintains accreditation.

Quality Control (QC) is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. The client is

responsible for developing the QAPP; however, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS). Each laboratory SOP defines the required QC indicators.

7.4.1 Precision

The objective is to meet the performance for precision demonstrated for the methods on similar samples and to meet DQOs of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

7.4.2 Accuracy

The objective is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet DQOs of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

7.4.3 Representativeness

The objective is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. Refer to laboratory SOPs for subsampling and homogenization techniques appropriate to the analytical method.

7.4.4 Comparability

The objective is to provide analytical data for which the accuracy, precision, representativeness, and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

Comparability is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision, and reporting limits with those of other laboratories.

7.4.5 Completeness

The completeness objective for data is 95% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered

valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope, or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

7.4.6 Selectivity

Selectivity is defined as the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), and specific electrodes (separation and identification).

7.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (above the Method Detection Limit) or quantified (above the Reporting Limit).

7.5 Criteria for Quality Indicators

The laboratory maintains tables, housed in LIMS, that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated, and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in the Control Charting SOP No. EFQA-Q-QD-SOP-2819.

7.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts use the current limits entered into LIMS. The QA department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 26. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in

LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

7.6.1 QC Charts

The QA Manager evaluates these to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file. Further details of the laboratory's control charting program are described in the Laboratory Control Charting SOP (EFQA-Q-QD-SOP2819)

7.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 18). These metrics are used to drive continuous improvement in the laboratory's Quality System.

8.0 DOCUMENT CONTROL

8.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance (QA) Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- NDSC Documents[1]
- KGDs[1]

[1]Includes locally implemented documents that are document controlled within the laboratory's document control system. The NDSC documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving NDSC Official Documents is found in Document No. CW-Q-S-001, NDSC Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. EFQA-Q-QD-SOP2804.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports.

Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data, and final reports.

8.2 Document Approval and Issue

The pertinent elements of the document control system includes a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number, and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a responsible manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every year and revised as appropriate. Changes to documents occur when a procedural change warrants.

8.3 Procedures for Document Control Policy

Changes to the QA Manual are tracked by revision number. Whenever practical, altered or new text shall be italicized in the document. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. Electronic copies are stored on the Public server in the QA folder (or define location) for the applicable revision.

For changes to SOPs, refer to Document No. EFQA-Q-QD-SOP2804, (Creation and Control of Standard Operating Procedures). The SOP identified above also defines the process of changes to SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA department; hard copies are kept in QA files.

8.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. EFQA-Q-QD-SOP2804.

9.0 SERVICE TO THE CLIENT

9.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily fit into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals, and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another Eurofins facility on the same LIMS or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 10 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or Eurofins Frontier Global Sciences are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

9.2 Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relationship Manager or Proposal Team, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in NDSC Document No. CA-L-P-002, Contract Compliance Policy or define local SOP No. EFPM-P-PR-SOP2815 "Contract Review".

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Laboratory Project Manager
- Laboratory Directors/BUMA and/or Technical Managers
- Account Executives
- Quality Managers
- Laboratory Environmental Health and Safety Managers/Directors

The Laboratory Director/BUMA reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

9.3 Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the Vice-President, Laboratory Director/BUMA and Managers. 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 and complex 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 between laboratory management, PMs 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-house.

9.4 Documentation

The Contracts Department and the Laboratory Director/BUMA maintain copies of all signed contracts.

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Appropriate records are maintained for every contract or work request in the contract directory on the server.
The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director/BUMA.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client and officially documented with a follow-up email to the client.

9.4.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, a PM is assigned to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new project information to maximize production and client satisfaction, while maintaining quality.

Any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document (e.g., letter, e-mail, variance, contract addendum), which has been signed by both parties.

Such changes are also communicated to the laboratory via e-mail. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technical Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

9.5 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 17 and 25).

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assisting client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

When the client requests a statement of conformity to a specification or standard based on the analysis performed by the laboratory (e.g., pass/fail, in-tolerance/out-of-tolerance), the decision rule shall be clearly defined. Unless inherent in the requested specification or standard, the decision rule selected shall be communicated to the client. Associated reporting requirements are addressed in Section 25.2.18.

9.6 Client Communication

PMs are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

9.7 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

9.8 Client Feedback and Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. Eurofins Sales and Marketing teams periodically develop lab and client specific surveys to assess client satisfaction.

When a complaint is received, we 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 Quality Assuance Manager is responsible for entering client concerns into iCAT. In some cases, an iCAT / ICAR (Investigation and Corrective Action Report) 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/iCAT if a trend is evident.

10.0 SUBCONTRACTING OF TESTS

10.1 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 PM must notify the client in writing when any of their requested analyses will be subcontracted to another lab. Client approval must be obtained in writing before samples are shipped.

Subcontract laboratories are selected based on their qualifications and accreditations. The laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). If projects require a specific agency certification (i.e. individual state agencies, NELAP, DoD, DOE, ISO 17025), only an appropriately accredited laboratory is used. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility.

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.

10.2 Qualifying and Monitoring Subcontractors

Whenever a PM [or Account Executive (AE), etc.] becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by Eurofins Frontier Global Sciences – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the public drive; \\us34fivp002\Quality Assurance\Subcontract Lab Approval.

All Eurofins Environmental Testing America laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations and can adhere to the project/program requirements.

10.2.1 When the potential subcontract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director/BUMA. The Laboratory Director/BUMA requests that the QA Manager begin the process of approving the subcontract laboratory.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability and forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the public drive.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the public drive site are known to meet minimal standards. Eurofins Frontier Global Sciences does not certify laboratories. The subcontractors on our approved list can only be recommended to the extent that we would use them.

10.3 Oversight and Reporting

The status and performance of qualified subcontractors will be monitored by the Quality Assuance Manager, and includes an annual review process (SOP No. EFQA-S-P-SOP2809 "Ordering Laboratory Supplies"). Any problems identified will be brought to the attention of the Laboratory Director/BUMA, Procurement personnel, etc.

- Complaints shall be investigated. Documentation of the complaint, investigation, and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the approved subcontractor listing. Client Service personnel will notify the Quality Assurance Manager if any laboratory requires removal from the approved subcontractor list.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

10.3.1 All subcontracted samples must be accompanied by a Eurofins Frontier Global Sciences Chain of Custody (COC). A copy of the original COC sent by the client must be available in LIMS for all samples workshared. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratory's EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

10.4 Contingency Planning

The full qualification of a subcontractor may be waived to meet emergency needs. This decision and justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract agreement with Eurofins Frontier Global Sciences at this time.

10.5 Use of NELAP and A2LA Logo

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

11.0 PURCHASING SERVICES AND SUPPLIES

11.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Contracts will be signed in accordance with the NDSC Document No. CW-F-P-002, Company-Wide Authorization Matrix Policy. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in the NDSC Document No. CW-F-P-004, Guidance on Procurement and Contracts Policy. RFP's allow the laboratory to determine if a vendor is capable of meeting requirements such as supplying all of the laboratory facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

11.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

11.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment, consumables, and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with NDSC Document No. CA-Q-S-001, Solvent & Acid Lot Testing & Approval. Approval information for the solvents and acids tested under Document No.

CA-Q-S-001 is stored on the Eurofin's SharePoint site, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

11.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst completes the Material Request Sheet when requesting reagents, standards, or supplies.

The analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The purchasing manager places the order.

11.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials were received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared "public" folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

11.3.3 Specifications

Methods used in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP expiration date unless verified as outlined below.

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded. In this case, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained on-file and available for review in the reagent module of the LIMS.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of samples, standards or reagents must have a specific conductivity of less than 1-µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified clean by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in files. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the

new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

11.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Chemical Hygiene Plan Document No. EFHS-S-HS-12066 and method SOPs or manufacturer instructions.

11.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director/BUMA. If they agree with the request, the procedures outlined in NDSC Document No. CA-T-P-001. Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 20). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

11.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 22. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager.

Analytical balances are serviced and calibrated annually in accordance with SOP No. EFQA-R-MT-SOP2710. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. Calibration certificates are filed for reference. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc., are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

11.6 Suppliers

The laboratory selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts).

This process is defined in the NDSC Document No. CW-F-P-004, Procurement & Contracts Policy and laboratory SOP EFQA-S-P-SOP2809, Ordering Laboratory Supplies. The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on the laboratory's business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Purchasing Group by completing a Vendor Performance Report.

The Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

Suppliers are subject to re-evaluation, as deemed appropriate, through the use of Vendor Performance Reports used to summarize and review to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the purchasing system.

11.6.1 New Vendor Procedure

Laboratory employees who wish to request the addition of a new vendor must complete a Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with laboratory employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Services Director are consulted with vendor and product selection that have an impact on quality.

12.0 COMPLAINTS

12.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures client knowledge that enables our operations to continually improve processes and client satisfaction. An

effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 14 (Corrective Actions) and is documented following SOP EFQA-Q-QD-SOP2835. A copy of this procedure will be made available to any interested party on request.

12.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to (SOP# EFQA-Q-QD-SOP2835).

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and documenting complaints
- Acknowledging receipt of complaint, whenever possible
- Complaint investigation and service recovery
- Process improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

12.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 14. In addition, Executive Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 14.

12.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the Laboratory Director/BUMA and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Systems Review (Section 18).

13.0 CONTROL OF NON-CONFORMING WORK

13.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 14).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the Technical Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 14. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 21. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Technical Manager and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

13.2 Responsibilities and Authorities

Under certain circumstances, the Laboratory Director/BUMA, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also

be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director/BUMA, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

13.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

The NDSC Document entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

The NDSC Document entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in NDSC Document No. CW-Q-S-005.

13.4 Prevention of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

13.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target analyte which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 13.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director/BUMA shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 14 if one has not already been started. A copy of any meeting notes and agreed upon steps should be e-mailed by the laboratory to their Business Unit President; VP-QA & EHS. This e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc.). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (e.g., Laboratory Director, Technical Manager, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete.

14.0 CORRECTIVE ACTION

14.1 Overview

A major component of the laboratory's (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. The laboratory employs two systems to manage non-conformances. Issues suspected of being systematic in nature and for which root cause analysis and a formal Corrective Action Report (CAR) are documented in the Incident Corrective Action Tracking (ICAT) database. Routine batch non-conformances, events that are understood to be isolated in nature, are documented in the LIMS non-conformance memo (NCM) system.

14.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

14.2.1 Non-Conformance Memo (NCM)

NCMs are used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips (Forms of documentation other than NCMs in LIMS are also acceptable)

14.2.2 Corrective Actions Documented In the iCAT Database

- Internal and external audit findings
- Failed or unacceptable PT results
- Identified poor process or method performance trends
- Systematic reporting / calculation errors
- Data recall investigations
- Questionable trends that are found in the review of NCMs.
- Client complaints
- Excessive revised reports

The ICAT database is used to document background information, track the results of corrective action investigations and root cause analysis, and to provide reports of corrective action plans.

14.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

14.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An entry into the ICAT system must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director/BUMA, or QA Manager (or QA designee) is consulted.

14.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The ICAT record is used for this documentation.

14.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. NDSC Document No. CA-Q-S-009, Root Cause Analysis, provides guidance on this procedure.

Systematically analyze and document the root causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed and continue to plague the laboratory or operation.

14.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- The QA Manager reviews monthly NCM and ICAT records for trends. Highlights are included in the QA monthly report (refer to Section 18). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the NDSC Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

14.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 17.1.4, Special Audits.)

14.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 13). The documentation of these procedures is through the use of an NCM or record in the ICAT system.

Table 14-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 14-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QA Manual Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample

results may be impaired, the PM is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

14.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original uncorrected file must be maintained intact and a second corrected- file is created. This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated. When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Table 14-1. Example – General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in ***(state where limits are maintained)***.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in ***(state where limits are maintained).***	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s), Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, NDSC QA, Executive Management)	- NDSC Document No. CW-Q-S-005, Data Recall **or** local SOP No.	- Corrective action is determined by type of error. Follow the procedures in NDSC Document No. CW-L-S-002 **or** your lab's CA SOP.
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technical Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

Note:
1. Except as noted below for certain compounds, the method blank should be below the detection limit (1/2 detection level for DoD/DOE).

15.0 PREVENTIVE ACTION / IMPROVEMENT

15.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its QA Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit

findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The metrics report is reviewed monthly by the laboratory management, NDSC QA Team and Local and Executive Mangement. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lessons Learned, Technical Services audit report, Technical Best Practices, or as Executive or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

15.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

15.1.2 Any preventive actions/process improvement undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

15.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes. This process is discussed in further detail in EFQA-Q-QD-SOP2833, Developing Effective Preventive Actions Through Risk Management.

16.0 CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that

complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2.

16.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. More detailed information on retention of specific records is provided in NDSC Document Nos. CW-L-P-001, Records Retention Policy and CW-L-WI-001, Records Retention/Storage Schedule. Quality records are maintained by the QA department in a database and files, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by Technical Managers.

Table 16-1. Record Index

	Record Types [1]:	**Retention Time:**
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method and Software Validation / Verification Data	Indefinitely
QA Records	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types [1]:	Retention Time:
Project Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to NDSC Doc. No. CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to NDSC Doc. No. CW-L-WI-001
	IT Records	Refer to NDSC Doc. No. CW-L-WI-001
	NDSC Governance Records	Refer to NDSC Doc. No. CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 16-2.

16.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss ***at the laboratory or the Iron Mountain data storage facility.*** All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Retention of records are maintained on-site at the laboratory for at least 1 year after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as NDSC Documents, QA, or Administrative Records,

the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 16-2 have lengthier retention requirements and are subject to the requirements in Section 16.1.3.

16.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 16-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 16-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
DOE Hanford	5 years, Written approval must be received from DOE Hanford prior to disposal of analytical data
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
OSHA	30 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

16.2.1 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.15.1 for more information.

16.2.2 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (Records stored off site should be accessible within 2 days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored with the invoice and the work order sheet generated by LIMS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.
- All information relating to the laboratory facilities' equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification

are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into LIMS for each method as required.
- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.
- Also refer to Section 19.15.1 'Computer and Electronic Data Related Requirements'.

16.3 Technical and Analytical Records

16.3.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

16.3.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

16.3.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code;
- Date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.

- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in LIMS and on specific analytical report formats.

16.3.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a periodic, documented supervisory or peer review.

16.4 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

16.4.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

16.5 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 16-1.

16.6 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in LIMS – no logbooks are used to record that data. Records are considered archived when noted as such in the records management system (a.k.a., document control.)

16.6.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of NDSC. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

16.6.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

17.0 AUDITS

17.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to Executive Management.

Audits are conducted and documented as described in the NDSC Document No. on performing Internal Auditing, SOP No. CW-Q-S-003 and Quality Assurance Internal Auditing Procedures, SOP No. EFQA-Q-QD-SOP2989. The types and frequency of routine internal audits are described in Table 17-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 17-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or NDSC QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to NDSC CW-Q-S-003 or local SOP No. EFQA-Q-QD-SOP2989)	QA Technical Audits Frequency: 50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to NDSC CW-Q-S-003 or local SOP No. EFQA-Q-QD-SOP2989)	SOP Compliance Review Frequency: • Every 2 years • **100% of SOPs annually (DoD/DOE Methods)**
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI-field of testing or as dictated by regulatory requirements

17.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, Eurofins Data Integrity and Ethics Policies (see Sec. 7.2), TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

17.1.2 QA Technical Audits

QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

17.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. ***Annually for methods and administrative SOPs related to DoD/DOE programs.*** It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

17.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

17.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Nonpotable Water and Soil

It is Eurofins policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written investigations for unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

17.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is Eurofins policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response. Audit responses are due in the time allotted by the client or agency performing the audit.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

17.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 and 2016 TNI

standards.

17.3 Audit Findings

Audit findings are documented using the corrective action process and database (see Section 14). The laboratory's corrective action responses may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24 hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

18.0 MANAGEMENT REVIEWS

18.1 Quality Assurance Report

The QA Department is responsible for preparing a comprehensive monthly metrics report to Management to keep them apprised of current quality issues. This report fosters communication, review, and refinement of the QA system to evaluate the suitability of policies and procedures to meet both regulatory and laboratory quality objectives.

The NDSC QA team compiles information from all of the Environment Testing laboratories monthly metrics reports for the Executive Management team. This report includes notable information and concerns regarding the laboratories QA program and a listing of new regulations that may potentially impact the laboratories.

18.2 Annual Management Review

The Laboratory Management team (Laboratory Director/BUMA, Technical Managers, QA Manager) conducts a review annually of its quality systems to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. NDSC personnel is be included in this meeting at the discretion of the Laboratory Director/BUMA. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This management systems review (NDSC Document No. CW-Q-S-004 and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.
- For labs analyzing radioactive samples, also include the following:
  - Radiation health and safety
  - Radioactive hazardous waste management
  - Radioactive materials management
- Evaluation of overall risk, including risks to impartiality, confidentiality, reporting statements of conformity, and nonconforming work.

A report is generated by the QA Manager and management. The report is distributed to the Laboratory Manager/BUMA, President of the Business Unit and Technical Managers. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

18.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The NDSC Document No. CW-L-S-002, Internal Investigations shall be followed. All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

The Eurofins Environment Testing America Presidents, Business Unit Managers, Laboratory Directors, NDSC Team are informed of any current data integrity or data recall investigations via the monthly metrics report.

19.0 TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to NDSC Document No. CW-Q-S-002, Writing a Standard Operating Procedure', and the laboratory's SOP EFQA-Q-QD-SOP2804, Creation and Control of Standard Operating Procedures
- SOPs are reviewed at a minimum of every 2 years (annually for DoD/DOE SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the PM. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data. Refer to Appendix 6 for a list of the currently accepted U.S. EPA analytical method references used by the laboratory.

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.1.1 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 PM 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 IDOC 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.

19.4.1.2 Procedural Deviations

Analysts are required to follow a documented method for all tests performed; and any deviations from analytical methods must be 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 situation
- Reason or justification for the deviation
- Impact the deviation had on the testing
- Signature/date of analyst performing the test
- Signature/date of QA and Laboratory management approving the deviation
- Signature/date of client approval, if necessary

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

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix

sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability, DOC (SOP# EFQA-Q-QD-SOP2814, Personnel Training Procedures) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst has not performed the test within the last 12 months).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratory's archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (e.g., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve*.

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

When changes are made to any validated methods, the influence of such changes shall be documented and, if appropriate, a new validation shall be performed.

19.6.1.1 **Determination of Method Selectivity** – Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 **Determination of Method Sensitivity** – Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Detection limit studies are conducted as described in Section 19.7. Where other protocols for estimations and/or demonstrations of sensitivity are required by regulation or client agreement, these shall be followed.

19.6.1.3 **Relationship of Limit of Detection (LOD) to the Limit of Quantitation (LOQ)** – An important characteristic of expression of sensitivity is the distinction between the LOD and the LOQ. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The LOQ is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias, equivalent to the laboratory's routine reporting limit (RL). For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the LOQ. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the LOQ, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 **Determination of Interferences** – A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 **Determination of Range** – Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 **Determination of Accuracy and Precision** – Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 **Documentation of Method** – The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 **Continued Demonstration of Method Performance** – Continued demonstration of method performance is addressed in the SOP. Continued demonstration of method performance

is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limit (MDL) / Limits of Detection (LOD)

The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, August, 2017. The MDL is equivalent to the TNI LOD or DL, and is also equivalent to the DoD/DOE Quality Systems Manual (QSM) DL. The working or final MDL is the higher of the MDL value determined from spikes (MDLs) and the MDL value determined from blanks (MDLb). An initial MDL study shall be performed during the method validation process and when the method is altered in a way that can reasonably be expected to change its sensitivity. On-going data are collected during each quarter in which samples are being analyzed. At least once every 13 months the MDLs and MDLb are re-calculated and re-evaluated using data collected during the preceding period. Details of the laboratory's procedure for conducting MDL studies are given in NDSC Document No. CA-Q-S-006.

19.8 Verification of Detection Limits

If it is found during the re-evaluation of detection limit results that more than 5% of the spiked samples do not return positive numeric results that meet all method qualitative identification criteria, then then spiking level shall be increased and the initial MDL study pre-performed at the new spiking concentration. For DoD/DOE labs, additional guidance provided in NDSC Document No. CA-Q-S-006 - Attachment 2.

19.9 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDL or in some cases required by the analytical method or program requirements. IDLs are most commonly used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

19.10 Limit of Quantitation

The LOQ shall be at a concentration equivalent to the lowest calibration standard concentration, with the exception of methods using a single-point calibration, and shall be greater than the MDL. The LOQ is verified by preparing and analyzing spikes at concentrations 1-2X the selected LOQ, employing the complete analytical process. For DoD/DOE labs, additional requirements provided in NDSC Document No. CA-Q-S-006.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit or by a DL check samples at or below the LOQ. The LOQ is verified annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

19.11 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specified in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept on-file and available for review. Complete details are available in the laboratory SOPs.

19.12 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.13 Estimation of Uncertainty of Measurement

19.13.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty" defined as the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.13.2 Uncertainty is not error. Error is a single value (i.e., the difference between the true result and the measured result). On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.13.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.13.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for

the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.

19.13.5 In the case where a well-recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.14 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.**

Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.
- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor or Laboratory Director if unsure.

19.15 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.15.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below.

The laboratory is currently using the Element LIMS system, which has been highly customized to meet the needs of the laboratory.

19.15.1.1 Maintain the Database Integrity – Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, documentation of system failures and corrective actions taken, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.15.1.2 Ensure Information Availability – Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.15.1.3 Maintain Confidentiality – Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.15.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged using NDSC Document No. CA-Q-S-002, Acceptable Manual Integration Practices, as the guideline for our internal SOP No. EFTM-P-I-SOP2828, entitled Manual Integration.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.15.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.15.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.

19.15.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.15.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a formatter for significant figure criterion for each analyte.

19.15.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS, electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.15.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 14.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.15.4 Review / Verification Procedures

Review procedures are outlined in the SOP Data Review and Validation, EFQA-P-DR-SOP2801 to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The general review concepts are discussed below, more specific information can be found in the SOP.

19.15.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.15.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for

continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.15.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.15.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.15.4.5 The results are then entered or directly transferred into the computer database and a (pdf) is printed for the client.

19.15.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that the COC is followed, cover letters / narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.15.4.7 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.15.4.8 A brief overview of sample flow and information through the laboratory, as well as data review and validation, is presented in Figure 19-1.

19.15.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using NDSC Document No. CA-Q-S-002, Acceptable Manual Integration Practices, as the guideline for our internal SOP No. EFTM-P-I-SOP2828, entitled Manual Integration.

19.15.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.15.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.

19.15.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.15.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on ~~an~~ expanded scale “before” and “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented NDSC approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example – Work Flow

Action	Personnel Involved
Bottle orders generated upon request - Bottles packed and shipped to the client under CoC	- Client Service Personnel / PM - Bottle Preparation Personnel
Samples received at laboratory - Unpacked and reconciled against client paperwork or CoC - Samples acceptance documented against completed (CoC)[1]	Sample Login Personnel

Action	Personnel Involved
Samples are entered into LIMS - Work Order # assigned - Methods/Analytes linked from project - Sample labels generated - LIMS backlogs updated immediately	Sample Login Personnel
Sample Storage - Short TATs and hold-time samples are delivered directly to the laboratory for analysis - Samples stored in assigned locations (refrigerated walk-in coolers, freezers; etc.)	Sample Login Personnel
Sample Receipt Acknowledgement sent to client (when requested)	Project Management Assistants / Project Management
Sample Acquisition/Testing - Analysts collect samples from assigned storage. - Legal CoC samples are signed in-and-out of storage - Remaining sample returned to storage.	Analysts / Login Personnel
Preparation and analysis is performed according to selected analytical method and applicable Project notes - Raw data recorded/reviewed[2] - Data imported to LIMS	Analysts
LIMS performs calculations: - Data reviewed by primary/secondary analyst - Data approved as final	Data Process (LIMS / Analyst)
Generation/review/release of reports (automated through LIMS) - Electronic copy saved in LIMS	Project Management Assistants / Project Management
Electronic Data Deliverables (EDDs) generated (as applicable)	Project Management Assistants / Project Management
Hard copy and electronic batch raw data is archived according to data archiving procedures.	Analysts / IT

[1]Refer to Sec. 23.3.
[2]Analyses requiring the analyst's interpretation may involve manual data reduction before entry into LIMS.

20.0 EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of available laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Scheduled routine maintenance is defined in each method SOP. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures are also outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.
- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling), gives suspect results, or otherwise has shown to be defective or outside of specified limits it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered.

If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. (EFQA-R-MT-SOP2710, Balance Verification, Calibration & Maintenance)

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to $\pm$ 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters used in the laboratory are capable or measuring conductivity with an error not exceeding 1% or one umhos/cm, whichever is greater. The meters are also calibrated before each use with a known standard.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH, Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer.

- If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly. IR Thermometers should be calibrated over the full range of use, including ambient, iced (4°C) and frozen (0°C to -5°C), per the Drinking Water Manual.

The mercury/digital NIST thermometers are recalibrated every five years/one year (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree, and have ranges applicable to method and certification requirements. The NIST traceable thermometers are used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the Use, Calibration, and Maintenance of Laboratory Thermometers SOP EFQA-R-MT-SOP2831.

20.3.4 Refrigerators/Freezer Units, Water baths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. (Sample storage for DoD/DOE samples is monitored 7 days a week).

Ovens, water baths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0°C and $\leq$ 6 °C.

Specific temperature settings/ranges for other refrigerators, ovens, water baths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis (daily for DoD/DOE projects).

For those dispensers that are not used for measurements, a label shall be applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, and type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 14).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules. ICP and ICPMS

methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 and 2016 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification (ICV) is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications (CCV) may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 and 2016 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing calibration verification standards may not be are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the calibrations must be verified by an ICV analyzed immediately following initial calibration and before sample analysis. The ICV may be used as the first bracketing CCV, if criteria for both are met.

A continuing instrument calibration verification (CCV) is generally analyzed at the beginning of each 12-hour analytical shift during which samples are analyzed. The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12-hours of the beginning of the shift. For methods that have quantitation by external calibration models, a CCV is analyzed at the end of each analytical sequence. Some methods have more frequent CCV requirements. See specific SOPs. Most

inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (e.g., GCMS) then bracketing standards are not required, only daily verifications are needed, except as specified by program or method requirements.

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed and documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable reported based upon discussion and approval of the client under the following special conditions:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported case narrative comment explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

21.0 MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia–Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated

- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the true value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory's Chemical Hygiene Plan.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to NDSC Document No. CA-Q-S-001, Solvent and Acid Lot Testing and Approval]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are scanned and appended to the standard record in the LIMS. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to SOP EFTM-T-TM-SOP2839, "Stock and Prepared Standards".

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID from LIMS
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained by the EH&S Officer.

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

22.0 SAMPLING

22.1 Overview

The laboratory does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in days (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in hours (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots and subsampling are located SOP # EFQA-P-SP-SOP5147.

23.0 HANDLING OF SAMPLES

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.

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 management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible. This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available

- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to the laboratory personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a laboratory courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by the laboratory when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are detailed in the laboratory's SOP No. EFSR-P-SH-SOP2793, Shipping and Receiving of Client Samples and summarized in the following sections.

23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Receipt Checklist and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

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.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-1) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- Client must notify the lab of any potentially hazardous samples;
- Client must notify the lab of any samples from potentially radioactive sites, the samples must by surveyed for radioactive prior to shipment to the lab and the results of this radioassay must accompany the sample.
- sample holding times must be adhered to (Sampling Guide);
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into LIMS according SOP No. EFSR-P-SH-SOP2793

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Samples for 200.8 analysis are stored on ambient storage shelves. Samples are never to be stored with reagents, standards or materials that may create contamination.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated storage location and place them on carts, analyze the sample, and return the

remaining sample or empty container to the storage location from which it originally came. All samples are kept in the storage locations until approved for disposal by the PM.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of Eurofins Frontier Global Sciences.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste or foreign soil samples only. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory. Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a Eurofins Frontier Global Sciences courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The laboratory's Chemical Hygiene Plan contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: EFHS-S-HS-SOP2991). All procedures in the laboratory's Chemical Hygiene Plan are followed during disposal. Samples are normally maintained in the laboratory no longer than 90 days from receipt unless otherwise

requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any Eurofins Frontier Global Sciences facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

1) Chain of Custody

   The Chain of Custody should include:

   - Requested analytes and methods
   - Unique sample identifier
   - Date and time of sample collection
   - Samplers' initials
   - Location
   - Field preservation (when samples are preserved prior to receipt at EFGS)
   - Any special instructions concerning the samples

   If the Chain of Custody is incomplete, the EFGS project manager may reject the samples.

2) Sample Container Labeling

   - The sample containers must be labeled with a unique sample (if EFGS supplied the bottles, this may be the EFGS bottle ID).
   - The label must be water-resistant and any information on It must be in indelible ink or printing.

3) Sample Volume

   - The client must submit adequate volume for the analysis requested.
   - The EFGS form "Bottle Types, Preservation, and Handling Instructions" lists volumes required.

- If insufficient sample volume is received, sample dilution may be required. Sample dilution will elevate the reporting limit(s) for the sample results.

4) Health & Safety

- It is the responsibility of the client to alert the EFGS project manager if the samples are potentially hazardous. All samples know or suspected to be very high in trace metals (or any other hazardous constituents) must be so identified by the client.
- Samples fro potentially radioactive sites must be surveyed for radioactivity before shipment to EFGS. The results of this radioassay must accompany the samples, and EFGS must be notified as to when these samples are expected to arrive.

Failure to follow these safety precautions may results in additional charges, return of the samples, or possible liability for damages or injuries that results

5) Most analytical methods require chilling samples to 4° C (other than water samples for EPA 200.8 metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.)Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate

Sample Holding Times

- Eurofins Frontier Global Sciences will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time for us to ensure analysis.

6) The project manager will be notified if any sample is received in damaged condition. Eurofins Frontier Global Sciences will request that a sample be resubmitted for analysis.

7) Recommendations for packing samples for shipment.

- Pack samples in Ice rather than "Blue" ice packs.
- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.
- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.
- Fill extra cooler space with bubble wrap.

24.0 ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, acid digestion and drying. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1. Example – Negative Controls

Control Type	Details
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process, a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, Toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the

use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).
- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.
- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.
- The maximum acceptable recovery limit will be 180%.
- The maximum acceptable RPD limit will be 35% for waters and 50% for soils. The minimum RPD limit is 10%.
- If either the high or low end of the control limit changes by ≤ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. See SOP EFQA-Q-QD-SOP2819, Control Charting, for more information.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, and if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 17).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 11 and 21.
- A discussion on selectivity of the test is included in Section 7.
- Constant and consistent test conditions are discussed in Section 6.
- The laboratories sample acceptance policy is included in Section 23.

25.0 REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 9.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g., Analytical Report)

25.2.2 The cover page shall include the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g., Eurofins Frontier Global Sciences Work Order ID #) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc.).

25.2.11 Reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory, except when information is provided by the client. When data is provided by the client there shall be a clear identification of it, and a disclaimer shall be put in the report when the client supplied data can affect the validity of the test.

25.2.18 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.19 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.20 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.21 The laboratory includes a cover letter.

25.2.22 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.23 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.24 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.25 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or how your lab identifies it). A complete report must be sent once all of the work has been completed.

25.2.26 Any non-Eurofins Frontier Global Sciences subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.27 A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

Note: Refer to the NDSC Document No. CA-I-P-002, Electronic Reporting and Signature Policy, for details on internally applying electronic signatures of approval.

25.2.28 Where the laboratory is responsible for the sampling stage, in addition to the requirements listed above, reports containing the results of sampling shall include the following, where necessary for the interpretation of test results:

- the date of sampling;
- unambiguous identification of the material sampled;
- the location of sampling plan and procedures, and deviations, addition to or exclusions from the sample procedures;
- a reference to the sampling plan and procedure, and deviations, additions to or exclusions from the sample procedures;
- details of any environmental conditions during sampling that affect the interpretation of test results;

- information required to evaluate measurement uncertainty for subsequent testing

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level 1 is a report with all of the elements outlined in Section 25.2 above, excluding 25.2.15 (QC data).
- Level II is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in EDD (see below). Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.4 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of Eurofins Frontier Global Sciences services in addition to the test report as described in Section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. Eurofins Frontier Global Sciences offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Staged Electronic Data Deliverable (SEDD) Environmental Quality Information System (EQuIS), Electronic Deliverable Format (EDF), Excel and custom files.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.5 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as estimated.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

When, as requested by the client and agreed to by Eurofins Frontier Global Sciences, the report includes a statement of conformity to specification or standard (see Special Services, Section 7.4), the report shall clearly identify:

- to which results the statement applies,
- which specifications, standard or parts thereof are met or not, and
- the decision rule that was applied (unless the decision rule is inherent in the requested specification or standard, taking into account the level of risk (such as false accept and false reject and statistical assumptions) associated with the decision rule.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.6 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the NDSC Document No. CW-L-S-004, Subcontracting.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of Eurofins are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.7 Client Confidentiality

The laboratory will ensure the highest standards of quality and integrity of the data and services provided to our clients

The laboratory is responsible for maintaining in confidence all client information obtained or created. In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

The laboratory will not intentionally divulge to any person (other than the client or any other person designated by the client in writing) any information regarding the services provided by the laboratory or any information disclosed to the laboratory by the client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Information about the client obtained from sources other than the client (e.g., complainant, regulators) shall be confidential between client and the laboratory. The source of this information shall be confidential to the laboratory and shall not be shared with the client, unless agreed by the source.

Note: This shall not apply to the extent that the information is required to be disclosed by the laboratory under the compulsion of legal process. The laboratory will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.7.1 Report deliverable formats are discussed with each new client. If a client requests that reports be e-mailed, the reports are to meet all requirements of this document.

25.8 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.9 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "Revised". There will be a footnote applied to each page that states the report is revised with a brief explanation of reason for the revision.

25.10 Policies on Client Requests for Amendments

25.10.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.

- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.10.2 Multiple Reports

The laboratory does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. List of Governing Documents applicable to the QA Manual

(NDSC and Laboratory SOPs and Policies)

NDSC Doc. No.	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CA-Q-M-002	Quality Management Plan
CA-Q-S-001	Acid and Solvent-Lot Testing and Approval Program
CA-Q-S-002	Manual Integrations
CA-Q-S-006	Detection and Quantitation Limits
CA-Q-S-009	Root Cause Analysis
CW-E-M-001	Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-I-M-001	IT Change Control Procedure Manual
CW-L-P-001	Records Retention Policy
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CW-Q-S-001	Document Control and Archiving
Local Laboratory Document No.	**Title**
EFHS-S-HS-12066	Chemical Hygiene Plan
EFHS-S-HS-SOP2991	Waste Disposal Procedures for Client Sample Waste
EFHS-S-HS-SOP5670	Health and Safety Evaluation and Auditing

EFPM-P-PR-SOP2815	Contract Review
EFQA-M-MC-5669	Laboratory Ethics and Data Integrity Policy
EFQA-P-DR-SOP2801	Data Review and Validation and Monthly Logbook Reviews
EFQA-P-SP-SOP5147	Subsampling of Solids and Multiphasic Liquids
EFQA-Q-QD-SOP2802	Document Management System
EFQA-Q-QD-SOP2804	Creation and Control of Standard Operating Procedures
EFQA-Q-QD-SOP2814	Personnel Training Procedures
EFQA-Q-QD-SOP2819	Control Charting
EFQA-Q-QD-SOP2833	Developing Effective Preventive Actions Through Risk Management
EFQA-Q-QD-SOP2835	Incident Reports, Out-of-Specification Reports and Client Complaints
EFQA-Q-QD-SOP2989	Quality Assurance Internal Auditing Procedures
EFQA-R-MT-SOP2710	Balance Verification, Calibration & Maintenance
EFQA-R-MT-SOP2831	Use, Calibration, and Maintenance of Laboratory Thermometers
EFQA-S-P-SOP2809	Ordering Laboratory Supplies/Services and Testing Acid and Bottle Lots
EFSR-P-SH-SOP2793	Shipping and Receiving of Client Samples
EFTM-P-I-SOP2828	Manual Integration
EFTM-T-TM-SOP2839	Stock and Prepared Standards

Appendix 2. List of Laboratory Certifications, Accreditations, Validations

The laboratory maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/ certification/licensing with the following organizations:

Primary NELAP accreditation with the State of Louisiana Department of Environmental Quality.

Secondary NELAP accreditations with the Florida Department of Health, New York Department of Health and New Jersey Department of Environmental Protection.

State accreditations by the Washington Department of Ecology the State of Arkansas Department of Environmental Quality, State of Alaska Department of Environmental Quality, State of California Water Boards, State of Maine Department of Health and Human Services, State of Wisconsin Department of Natural Resources.

ISO/IEC 17025:2017, DoD and DOE accredited

A certification summary with expiration dates and PDF files of current ISO/IEC 17025:2017, NELAP, federal and state accreditations and registrations with their scopes are located at: \\us34fivp002\General and Admin\Quality Assurance\Certifications-Apps-Approval\Current Certs

Appendix 3. References used to prepare the QA Manual

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-79-019, Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.
- U.S. Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3, dated 2019
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- APHA, Standard Methods for the Examination of Water and Wastewater, 18th Edition, 19th, 20th, 21st, 22nd and on-line Editions.
- U.S. Department of Energy Order 414.1B, Quality Assurance, Approved April 29, 2004.
- U.S. Department of Energy Order 414.1C, Quality Assurance, June 17, 2005.
- U.S. Department of Energy Order 414.1D, Quality Assurance, April, 25, 2011.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

Appendix 4. QA Manual Crosswalk with TNI and ISO/IEC 17025 Standards

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
-	QUALITY ASSURANCE MANUAL	V1M2 Sec. 4.2.8.3		
1.0	Title Page			
2.0	Table of Contents	V1M2 Secs. 4.2.8.3-4.2.8.4		8.1.2, 8.2.1
3.0	Introduction, Scope and Applicability	V1M2 Sec. 4.2.8.4		
3.1	Introduction and Compliance References	V1M2 Secs. 1.1; 1.2; 2.0; 3.2; 4.1.2; 4.2.4	4.1.2; 4.2.4	5.3; 5.4; 8.2.4; 8.3.1
3.2	Terms and Definitions	V1M2 Secs. 3.0; 4.2.4	4.2.4	
3.3	Scope /Field of Testing	V1M2 Secs. 1.2; 4.2.4	4.1.2; 4.2.4	5.3; 5.4; 8.2.1; 8.2.4
3.4	Management of The Manual	V1M2 Secs. 4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	5.3
4.0	Management and Responsibilities	V1M2 Sec. 4		8.2.4; 8.2.5
4.1	Overview	V1M2 Secs. 4.1.1, 4.1.3; 4.1.5	4.1.1; 4.1.3; 4.1.5; 4.2.6	5.1; 5.2; 5.5; 5.6 ; 6.2.1; 6.2.4
4.2	Roles and Responsibilities	V1M2 Secs. 4.1.4; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.3; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.1 to 4.1.3; 4.1.5; 5.5; 5.6; 6.2.1; 6.2.4; 6.2.6 8.2.2;
4.3	Business Continuity and Contingency Plan *(Prev. Deputies)*	V1M2 Secs. 4.1.5; 4.1.7.2; 4.2.7	4.1.5; 4.2.7	
5.0	PERSONNEL	V1M2 Secs. 5.2; 5.2.1	5.2.1	6.1; 6.2.3
5.1	Overview	V1M2 Secs. 5.2.2; 5.2.3; 5.2.5	5.2.2; 5.2.3; 5.2.5	6.2.2
5.2	Education and Experience Requirements for Technical Staff	V1M2 Secs. 5.2.1; 5.2.3; 5.2.4	5.2.1; 5.2.3; 5.2.4	6.2.2 to 6.2.4
5.3	Training	V1M2 Sec. 5.2.5	5.2.5	4.2.1; 6.2.2; 6.2.4; 6.2.5
5.4	Data Integrity and Ethics Training Program	V1M2 Sec. 4.2.8.1; 5.2.7		4.1.1
6.0	ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS	V1M2 Sec. 5.3		6.1; 6.3.1
6.1	Overview	V1M2 Secs. 5.3.1; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.3; 5.3.4; 5.3.5	6.3.1
6.2	Environment	V1M2 Secs. 5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	6.3.1 to 6.3.5
6.3	Work Area	V1M2 Secs. 5.3.3; 5.3.4; 5.3.5	5.3.3; 5.3.4; 5.3.5	6.3.1
6.4	Responding to Emergencies			
6.5	Building Security	V1M2 Sec. 5.3.4	5.3.4	6.3.4
7.0	QUALITY SYSTEM			6.1; 8.2.4
7.1	Quality Policy	V1M2 Secs. 4.1.5; 4.2.2; 4.2.3; 4.2.8.3	4.1.5; 4.2.2; 4.2.3	8.2.3; 8.6.1
7.2	Ethics and Data Integrity	V1M2 Secs. 4.1.5; 4.16; 4.2.2; 4.2.8.1; 5.2.7	4.1.5; 4.2.2	4.1.1 to 4.1.3; 4.2.1; 6.2.1; 8.2.2; 8.2.3

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
7.3	Quality System Documentation	V1M2 Secs. 4.1.5; 4.2.2; 4.2.5	4.2.2; 4.2.5	8.2.4
7.4	QA/QC Objectives for the Measurement of Data	V1M2 Sec. 4.2.2	4.1.5; 4.2.2	6.2.4
7.5	Criteria for Quality Indicators			
7.6	Statistical Quality Control			
7.7	Quality System Metrics			
8.0	Document Control	V1M2 Secs. 4.2.7; 4.3.1; 4.3.2.2 ; 4.3.3.3; 4.3.3.4	4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4	8.2.4; 8.3.1
8.1	Overview			8.2.5; 8.3.1; 8.3.2
8.2	Document Approval and Issue	V1M2 Secs. 4.3.2; 4.3.2.1-4.3.2.3; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.3.1	8.2.5; 8.3.2
8.3	Procedures for Document Control Policy	V1M2 Secs. 4.3.2.1–4.3.2.2; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.3.1	8.2.5; 8.3.2
8.4	Obsolete Documents	V1M2 Secs. 4.3.2.1–4.3.2.2	4.3.2.1; 4.3.2.2	8.2.5; 8.3.2
9.0	SERVICE TO THE CLIENT	V1M2 Secs. 4.4.1 - 4.4.4	4.4.1; 4.4.2; 4.4.3; 4.4.4	7.1.1; 7.1.1.4; 7.1.1.5; 7.1.1.8; 7.1.2.1
9.1	Overview	V1M2 Secs. 4.4.5; 4.5.5; 5.7.1	4.4.5; 5.7.1	
9.2	Review Sequence and Key Personnel	V1M2 Sec. 4.4.5	4.4.5	7.1.1.6
9.3	Balancing Laboratory Work Load and Capacity			
9.4	Documentation	V1M2 Sec. 5.7.1	5.7.1	
9.5	Special Services	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.3; 7.1.1.7
9.6	Client Communication	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7
9.7	Reporting	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7
9.8	Client Feedback and Surveys	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7; 8.6.2
10.0	SUBCONTRACTING OF TESTS	V1M2 Secs. 4.4.3; 4.5.4	4.4.3; 4.5.4	
10.1	Overview	V1M2 Secs. 4.5.1 - 4.5.3; 4.5.5; 5.3.1	4.5.1; 4.5.2; 4.5.3; 5.3.1	6.6.1; 7.1.2.1; 7.1.2.2
10.2	Qualifying and Monitoring Subcontractors	V1M2 Secs. 4.5.1; 4.5.2; 4.5.3; 4.5.5	4.5.1; 4.5.2; 4.5.3	6.6.1; 7.1.2.1; 7.1.2.2
10.3	Oversight and Reporting	V1M2 Sec. 4.5.5		
10.4	Contingency Planning			
10.5	Use of NELAP and A2LA Logo			
11.0	PURCHASING SERVICES AND SUPPLIES	V1M2 Sec. 4.6.1	4.6.1	
11.1	Overview	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	6.6.1; 6.6.2
11.2	Glassware	V1M2 Sec. 5.5.13.1		
11.3	Reagents, Standards & Supplies	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4 2016 V1M4 1.7.2.5	4.6.2; 4.6.3; 4.6.4	6.6.1 to 6.6.3
11.4	Purchase of Equipment / Instruments / Software			
11.5	Services			
11.6	Suppliers			

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
12.0	COMPLAINTS	V1M2 Sec. 4.8	4.8	8.6.1; 8.6.2
12.1	Overview			7.9.1 to 7.9.3 8.6.1; 8.6.2;
12.2	External Complaints			7.9.2 to 7.9.7 8.6.1; 8.6.2;
12.3	Internal Complaints			8.6.1; 8.6.2
12.4	Management Review			8.6.1; 8.6.2
13.0	CONTROL OF NON-CONFORMING WORK	V1M2 Secs. 4.9.1; 5.10.5	4.9.1; 5.10.5	7.10.1
13.1	Overview	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	7.10.1
13.2	Responsibilities and Authorities	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5; 5.2.7	4.9.1; 4.11.3; 4.11.5	7.10.1
13.3	Evaluation of Significance and Action Taken	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	4.1.5; 7.10.1; 7.10.2; 8.5.3
13.4	Prevention of Non-Conforming Work	V1M2 Secs. 4.9.4; 4.11.2	4.9.2; 4.11.2	7.10.2; 7.10.3; 8.5.3
13.5	Method Suspension / Restriction (Stop Work Procedures)	V1M2 Secs. 4.9.1; 4.9.2; 4.11.5	4.9.1; 4.9.2; 4.11.5	7.10.1; 7.10.2
14.0	CORRECTIVE ACTION	V1M2 Sec. 4.11		4.1.4; 4.1.5
14.1	Overview	V1M2 Secs. 4.9.2; 4.11.1; 4.11.2	4.9.2; 4.11.1; 4.11.2; 8.7.1; 8.7.3	7.10.2 8.7.1; 8.7.3;
14.2	General	V1M2 Sec. 4.11.2; 4.11.3	4.11.2; 4.11.3	7.7.2; 8.5.3; 8.7.1;
14.3	Closed Loop Correction Action Process	V1M2 Sec. 4.11.2; 4.11.3; 4.11.4; 4.11.6; 4.11.7; 4.12.2	4.11.2; 4.11.3; 4.11.4; 4.12.2	8.5.3; 8.6.1; 8.7.2
14.4	Technical Corrective Actions	V1M2 Sec. 4.11.6		8.7.1
14.5	Basic Corrections	V1M2 Secs. 4.11.1; 4.13.2.3	4.11.1; 4.13.2.3	7.5.2; 8.7.1
15.0	PREVENTIVE ACTION / IMPROVEMENT	V1M2 Secs. 4.10; 4.12.1; 4.12.2	4.10; 4.12.1; 4.12.2	4.1.4
15.1	Overview	V1M2 Secs. 4.15.1; 4.15.2	4.15.1; 4.15.2	8.6.2
15.2	Management of Change			
16.0	CONTROL OF RECORDS	V1M2 Secs. 4.2.7; 4.13.1.1; 4.13.3	4.2.7; 4.13.1.1	8.4.2
16.1	Overview	V1M2 Secs. 4.13.1.1 - 4.13.1.4; 4.13.2.1-4.13.2.3; 4.13.3	4.13.1.1 - 4.13.1.4; 4.13.2.1-4.13.2.3	8.4.1; 8.4.2
16.2	Programs with Longer Retention Requirements			
16.3	Technical and Analytical Records	V1M2 Sec. 4.13.2.2 - 4.13.2.3	4.13.2.2; 4.13.2.3	7.5.1; 8.4.2
16.4	Laboratory Support Activities			7.5.2; 8.4.2
16.5	Administrative Records			8.4.2
16.6	Records Management, Storage and Disposal	V1M2 Sec. 4.13.3		4.2.1; 8.4.2
17.0	AUDITS			

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
17.1	Internal Audits	V1M2 Sec. 4.2.8.1; 4.14; 4.14.1; 4.14.2 ; 4.14.3; 4.14.5; 5.9.1; 5.9.2	4.14.1; 4.14.2; 4.14.3; 5.9.1; 5.9.2	8.6.1; 8.8.1; 8.8.2
17.2	External Audits	V1M2 Secs.4.14.2; 4.14.3	4.14.2; 4.14.3; 4.14.4	4.2.1; 8.6.1
17.3	Audit Findings	V1M2 Secs. 4.14.2; 4.14.3; 4.14.5		8.6.1
18.0	MANAGEMENT REVIEWS	V1M2 Sec. 4.1.6; 4.15; 4.15.1; 4.15.2	4.1.6; 4.15.1; 4.15.2	4.1.4; 8.5.1; 8.6.1; 8.9.1; 8.9.2
18.1	Quality Assurance Report			8.5.1
18.2	Annual Management Review	V1M2 Sec. 4.2.2; 4.15.3	4.2.2	4.1.1, 4.1.4; 4.2.1; 7.1.1.3; 8.2.2; 8.5.1 to 8.5.3; 8.6.1; 8.9.3
18.3	Potential Integrity Related Managerial Reviews			4.1.5; 8.5.1; 8.6.1
19.0	TEST METHODS AND METHOD VALIDATION	V1M2 Sec. 5.4.1	5.4.1	7.2.1.1; 8.2.5
19.1	Overview	V1M2 Sec. 5.4.1	5.4.1; 5.4.5.1	6.2.3; 7.2.1.1 to 7.2.1.3
19.2	Standard Operating Procedures (SOPs)	V1M2 Secs. 4.2.8.5; 4.3.3.1; 5.4.2	4.3.3.1; 5.4.2	7.2.1.4
19.3	Laboratory Methods Manual	V1M2 Sec. 4.2.8.5 (2019 5.4.4.2)		6.2.3
19.4	Selection of Methods	V1M2 Secs. 4.13.3; 5.4.1; 5.4.2; 5.4.3. (2019 5.4.4) V1M4 Secs. 1.4; 1.5.1; 1.6.1; 1.6.2; 1.6.2.1; 1.6.2.2	5.4.1; 5.4.2; 5.4.3; 5.4.4; 5.4.5.1; 5.4.5.2; 5.4.5.3	7.1.1.2; 7.2; 7.2.1.2; 7.2.1.3; 7.1.2.4 to 7.2.1.7; 7.2.2.1 to 7.2.1.7; 7.2.2.1
19.5	Laboratory Developed Methods and and Non-Standard Methods	V1M2 Sec. 5.4.2. (2019 5.4.4.1, 5.4.4.2) V1M4 Sec. 1.5.1	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	7.1.1.2; 7.2.1.4 to 7.2.1.7 7.2.2.1; 7.2.2.3; 8.2.5
19.6	Validation of Methods	V1M2 Sec. 5.4.2. (2019 5.4.5.4) V1M4 Secs. 1.5.1; 1.5.2; 1.5.2.1; 1.5.2.2; 1.5.3	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	7.1.1.2; 7.1.2.4; 7.2.1.6; 7.2.2.1 to 7.2.2.4
19.7	Method Detection Limits (MDLs) / Limit of Detection (LOD)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.5.2; 1.5.2.1; 1.5.2.2	5.4.5.3	7.2.2.3
19.8	Verification of Detection Limits	V1M2 Sec. 5.9.3		
19.9	Instrument Detection Limits (IDLs)	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.2.1		
19.10	Limit of Quantitation	V1M2 Sec. 5.9.3		
19.11	Retention Windows	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.4; (2009 1.7.3.6) (2016 1.7.2.6)		

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
19.12	Evaluation of Selectivity	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.4; (2009 1.7.3.6) (2016 1.7.2.6)		
19.13	Estimation of Uncertainty of Measurement	V1M2 Sec. 5.1.1; 5.1.2; 5.4.6	5.1.1; 5.1.2; 5.4.6.1; 5.4.6.2; 5.4.6.3	7.6.1; 7.6.2; 7.6.3
19.14	Sample Reanalysis Guidelines	V1M2 Sec 5.9.1	5.9.1	
19.15	Control of Data	V1M2 Secs. 5.4.7.1; 5.4.7.2; 5.9.1	5.4.7.1; 5.4.7.2; 5.9.1	7.11.1 to 7.11.6
20.0	EQUIPMENT AND CALIBRATIONS	V1M2 Secs. 5.5.4; 5.5.5; 5.5.6	5.5.4; 5.5.5; 5.5.6; 5.6.1	6.1; 6.4.3; 6.4.6; 6.4.9
20.1	Overview	V1M2 Secs. 5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10	5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10; 5.6.1	6.4.1; 6.4.4 to 6.4.6; 6.4.9; 6.4.11
20.2	Preventive Maintenance	V1M2 Secs. 5.5.1; 5.5.3; 5.5.7; 5.5.9	5.5.1; 5.5.3; 5.5.7; 5.5.9; 5.6.1	6.4.1 to 6.4.3; 6.4.6; 6.4.10
20.3	Support Equipment	V1M2 Secs. 5.5.10; 5.5.11; 5.5.13.1	5.5.10; 5.5.11; 5.6.2.1.2; 5.6.2.2.1; 5.6.2.2.2	6.4.11; 6.4.12; 6.5.1; 6.5.2; 6.5.3
20.4	Instrument Calibrations	V1M2 Secs. 5.5.8; 5.5.10; 5.6.3.1. V1M4 Sec. 1.7.1.1; (2009 1.7.2) (2016 1.7.1.2)	5.5.8; 5.5.9; 5.5.10; 5.6.1; 5.6.2; 5.6.3.1	6.4.2; 6.4.3; 6.4.6 to 6.4.8; 6.4.11; 6.4.13; 6.4.14; 6.5.1; 6.5.2
20.5	Tentatively Identified Compounds (TICs) – GC/MS Analysis			
20.6	GC/MS Tuning			
21.0	MEASUREMENT OF TRACEABILITY			
21.1	Overview	V1M2 Sec. 5.6.3.1	5.6.2.1.2; 5.6.2.2.2; 5.6.3.1	6.4.14; 6.5.1; 6.5.2; 6.5.3
21.2	NIST-Traceable Weights and Thermometers	V1M2 Secs. 5.5.13.1; 5.6.3.1; 5.6.3.2	5.6.3.1; 5.6.3.2	6.4.14
21.3	Reference Standards / Materials	V1M2 Secs. 5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.6.4.1; 5.6.4.2; 5.9.1; 5.9.3	5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.9.1	6.4.14
21.4	Documentation and Labeling of Standards, Reagents, and Reference Materials	V1M2 Secs. 5.6.4.2; 5.9.3		
22.0	SAMPLING			
22.1	Overview	V1M2 Secs. 5.7.1; 5.7.3	5.7.1; 5.7.3	7.3.1; 7.3.2; 7.3.3
22.2	Sampling Containers			
22.3	Definition of Holding Time			
22.4	Sampling Containers, Preservation Requirements, Holding Times			
22.5	Sample Aliquots / Subsampling	V1M2 Sec. 5.7.1	5.7.1	7.3.1; 7.3.2
23.0	HANDLING OF SAMPLES	V1M2 Sec. 5.8.1	5.8.1	7.4.1
23.1	Chain of Custody (CoC)	V1M2 Secs. 5.7.2; 5.7.4; 5.8.4; 5.8.7.5; 5.8.8; 5.9.1	5.7.2; 5.8.4; 5.9.1	7.1.1.6; 7.4.1

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
23.2	Sample Receipt	V1M2 Secs. 5.8.1; 5.8.2; 5.8.3; 5.8.5; 5.8.7.3; 5.8.7.4; 5.8.7.5	5.8.2; 5.8.3	7.4.3
23.3	Sample Acceptance Policy	V1M2 Secs. 5.8.6; 5.8.7.2		
23.4	Sample Storage	V1M2 Secs. 5.7.4; 5.8.4	5.8.4	7.4.1; 7.4.4
23.5	Hazardous Samples and Foreign Soilds			
23.6	Sample Shipping	V1M2 Sec. 5.8.2	5.8.2	7.4.2
23.7	Sample Disposal			
24.0	ASSURING THE QUALITY OF TEST RESULTS			
24.1	Overview	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	7.7.2 to 7.7.3
24.2	Controls	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	7.7.1; 7.7.3
24.3	Negative Controls	V1M2 Secs. 5.9.2; 5.9.3 V1M4 Secs. (2019 1.7.3; 1.7.3.1; 1.7.4.1) (2016 1.7.2, 1.7.2.1, 1.7.3.1)	5.9.2	7.7.1; 7.7.3
24.4	Positive Controls	V1M2 Secs 5.9.2; 5.9.3. V1M4 Secs.(2009 1.7.3; 1.7.3.2; 1.7.3.2.1; 1.7.3.2.2; 1.7.3.2.3) (2016 1.7.2, 1.7.2.2, 1.7.3.2)	5.9.2	7.7.1; 7.7.3
24.5	Sample Matrix Controls	V1M2 Secs. 5.9.2; 5.9.3. V1M4 Secs. (2009 1.7.3 ; 1.7.3.3; 1.7.3.3.1; 1.7.3.3.2; 1.7.3.3.3) (2016 1.7.2, 1.7.2.3, 1.7.3.3)	5.9.2	7.7.1; 7.7.3
24.6	Acceptance Criteria (Control Limits)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.7.4.2; 1.7.4.3		7.7.1; 7.7.3
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25.0	REPORTING RESULTS			
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25.3	Reporting Level or Report Type	V1M2 Secs. 5.10.1; 5.10.7; 5.10.8	5.10.1; 5.10.7; 5.10.8	
25.4	Electronic Data Deliverables (EDDs)			

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
25.5	Supplemental Information for Test	V1M2 Secs. 5.10.1; 5.10.3.1; 5.10.5	5.10.1; 5.10.3.1; 5.10.5	7.1.1.3; 7.8.6.1; 7.8.6.2; 7.8.7.1 to 7.8.7.3
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Appendix 5. Terms/Glossary and Acronyms (EL-V1M2 Sec. 3.1)

Terms/Glossary: ***[Add definitions as needed.]***

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguard identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis. No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Integrity: The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements. (TNI)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, August, 2017.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

> *Aqueous:* Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: See Limit of Detection (LOD)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report

CCV – Continuing Calibration Verification

CF – Calibration Factor

CFR – Code of Federal Regulations

COC – Chain of Custody

DOC – Demonstration of Capability

DQO – Data Quality Objectives

DUP - Duplicate

EHS – Environment, Health and Safety

EPA – Environmental Protection Agency

GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 6. Analytical Method References

Reference methods include:

- Eastern Environmental Radiation Facility Radiochemistry Procedures Manual, EPA, PB84-215581, June 1984.
- HASL-300 28th Edition, Environmental Measurements Laboratory (EML), 1997.
- Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition, EPA/600/4-90/027F, August 1993.
- Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002.
- Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; August 28, 2017.
- Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.
- Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.
- Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.
- NIOSH Manual of Analytical Methods, 4th ed., August 1994.
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015.
- Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.
- National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.
- Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261

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Document number: **QA-QM11872**	**Environmental Quality Policy Manual**	**Quality Manual**
Old Reference: **1-P-QM-GDL-9015377; DOD - EQPM**		
Version: **18**		Organisation level: **5-Sub-BU**
Approved by: **UDM6, XL3S** Effective Date **17-SEP-2020**	Document users: **4_EUUSLA_ELLE_All_Support, 4_EUUSLA_ELLE_All_Technical**	Responsible: **5_EUUSLA_Env Quality Assurance_All**

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Environmental Quality Policy Manual

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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.
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

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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

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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.

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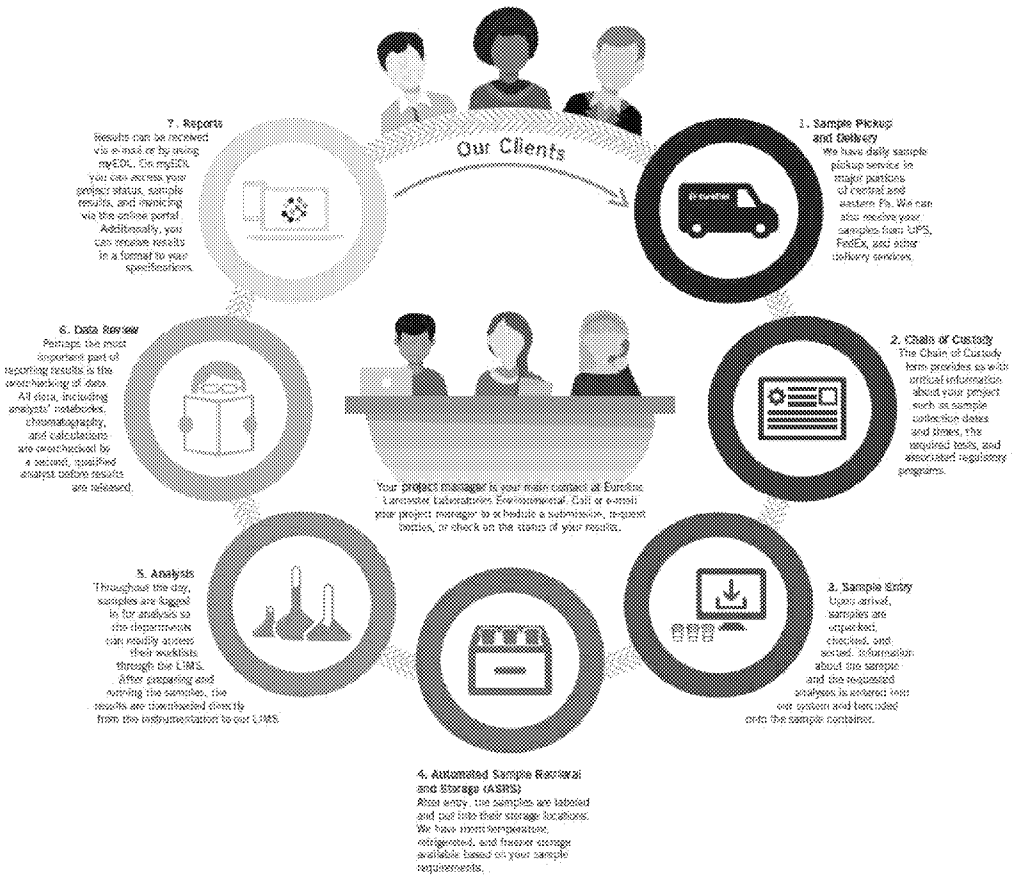
1.4 Sample Flow-Through Diagram



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

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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

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- 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

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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.

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- 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

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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.

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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

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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.

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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.

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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

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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)

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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

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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.

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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

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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.

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- 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.

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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

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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.

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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.

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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,

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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

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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

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- 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.

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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

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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

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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.) · Electronic record of sample #, container type, and location	Sample Registration
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	Client Service Representative or

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released to client Electronic copy saved in the LIMS	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

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- 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

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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

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- 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

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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.

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- 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

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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

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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.

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- 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

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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.

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

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

End of document

Version history

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

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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

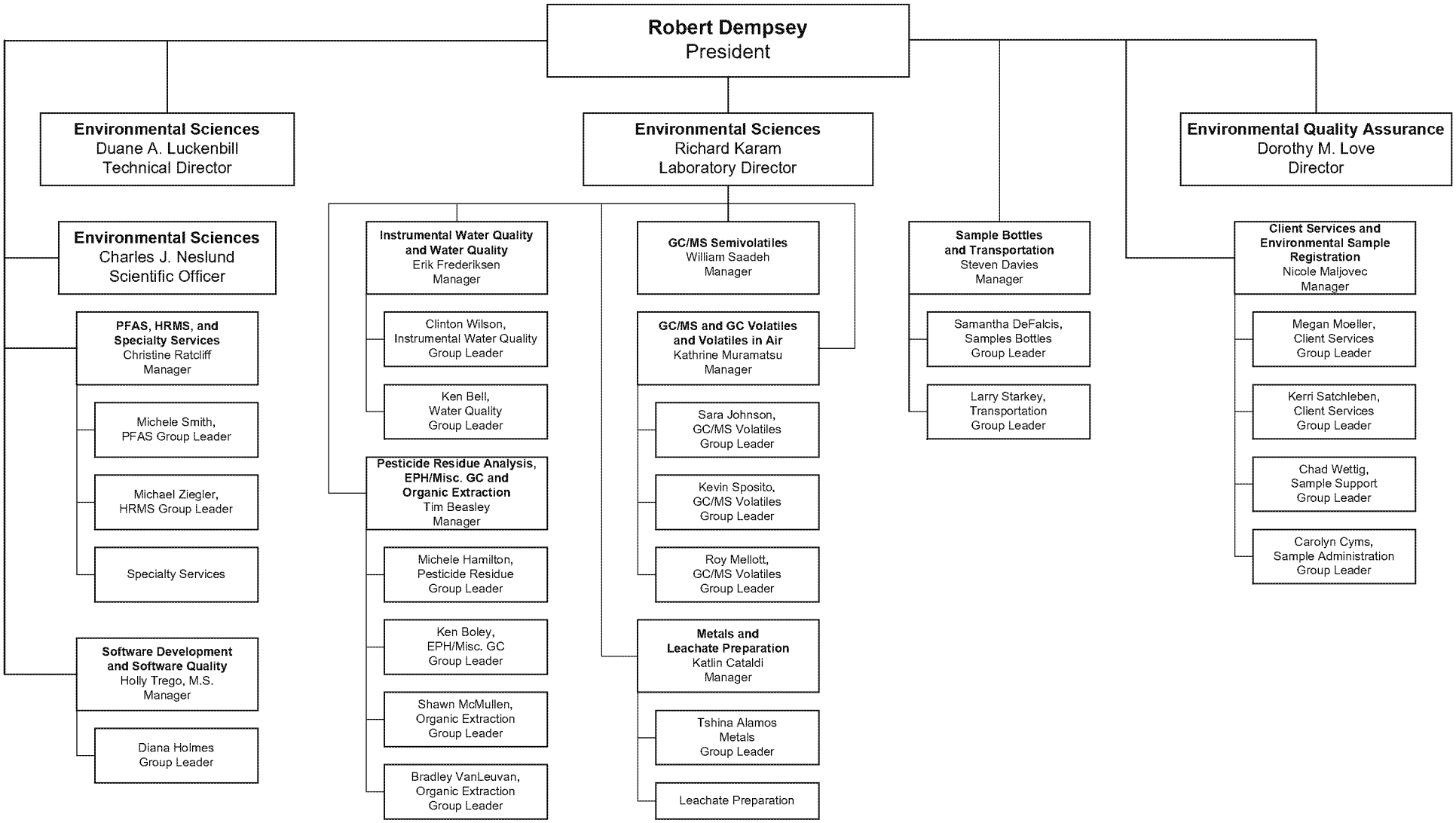
Agency	Parameter	Applicable Matrices	Lab ID No.
Commonwealth of Massachusetts, Department of Environmental Protection	Inorganics, Organics and PFAS	Nonpotable Water and Potable Water	M-PA009
State of Michigan, Department of Environmental Quality	Dioxin, Inorganics, Organics and PFAS	Potable Water	9930
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.

The above information may not be used or duplicated by others without written consent.

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.

The above information may not be used or duplicated by others without written consent.

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.

The above information may not be used or duplicated by others without written consent.

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.

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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.

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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

Appendix E - SOPs and Analytical Methods

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

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

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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

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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

Appendix E - SOPs and Analytical Methods

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.

Appendix E
Laboratory Accreditations

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF LABORATORIES

LABORATORY ACCREDITATION PROGRAM

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

NELAP RECOGNIZED TNI ACCREDITATION BODY

Certifies That

36-00037

Eurofins Lancaster Laboratories Environmental LLC

2425 New Holland Pike, Lancaster, PA, 17601-5994

Having duly met the requirement of
The act of June 29, 2002 (P.L. 596, No. 90)
dealing with Environmental Laboratories Accreditation
(27 Pa. C.S. 4104-4113) and the
National Environmental Laboratory Accreditation Program Standard
is hereby approved as an

Accredited Laboratory

to conduct analysis within the fields of accreditations more fully described in the attached Scope of Accreditation

NELAP accreditation granted by the PA DEP to an environmental laboratory is conditioned upon continued compliance with the current edition of the NELAC Standard or TNI Standard and the following Subchapters and Sections of 25 Pa. Code Chapter 252: Subchapter A (relating to general provisions); Subchapter B (relating to application, fees and supporting documents); Subchapter E (relating to proficiency test study requirements); Subchapter F (relating to assessment requirements); Subchapter G (relating to miscellaneous provisions); Section 252.307; and Section 252.401.

Expiration Date: **01/31/2022**

Certificate Number: **020**

Annmarie Beach

Annmarie Beach, Chief
Laboratory Accreditation Program
Bureau of Laboratories

Continued accreditation status depends on successful ongoing participation in the program
Certificate not transferable Surrender upon revocation
To be conspicuously displayed at the Laboratory
Not valid unless accompanied by a valid Scope of Accreditation
Shall not be used to imply endorsement by the Commonwealth of Pennsylvania
Customers are urged to verify the laboratory's current accreditation status
PA DEP is a NELAP recognized accreditation body

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 110.2		Color	NELAP	PA	04/04/2005
EPA 1613	B	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	NELAP	PA	10/05/2010
EPA 1664	A	Oil and grease	NELAP	PA	05/24/2011
EPA 1664	B	Oil and grease	NELAP	PA	01/27/2014
EPA 180.1		Turbidity	NELAP	PA	04/04/2005
EPA 200.7	4.4	Barium	NELAP	PA	01/22/2001
EPA 200.7	4.4	Calcium	NELAP	PA	11/28/2001
EPA 200.7	4.4	Chromium	NELAP	PA	01/22/2001
EPA 200.7	4.4	Cobalt	NELAP	PA	10/16/2008
EPA 200.7	4.4	Copper	NELAP	PA	01/22/2001
EPA 200.7	4.4	Iron	NELAP	PA	04/04/2005
EPA 200.7	4.4	Lithium	NELAP	PA	11/13/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	12/04/2007
EPA 200.7	4.4	Manganese	NELAP	PA	04/04/2005
EPA 200.7	4.4	Nickel	NELAP	PA	01/22/2001
EPA 200.7	4.4	Potassium	NELAP	PA	05/24/2011
EPA 200.7	4.4	Silver	NELAP	PA	01/26/2001
EPA 200.7	4.4	Sodium	NELAP	PA	01/22/2001
EPA 200.7	4.4	Strontium	NELAP	PA	05/24/2011
EPA 200.7	4.4	Sulfur	NELAP	PA	11/09/2012
EPA 200.7	4.4	Tin	NELAP	PA	11/03/2008
EPA 200.7	4.4	Vanadium	NELAP	PA	10/16/2008
EPA 200.7	4.4	Zinc	NELAP	PA	04/04/2005
EPA 200.8	5.4	Aluminum	NELAP	PA	01/25/2019
EPA 200.8	5.4	Antimony	NELAP	PA	02/10/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	02/10/2005
EPA 200.8	5.4	Barium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Beryllium	NELAP	PA	02/10/2005
EPA 200.8	5.4	Cadmium	NELAP	PA	02/10/2005
EPA 200.8	5.4	Calcium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Chromium	NELAP	PA	02/10/2005
EPA 200.8	5.4	Copper	NELAP	PA	03/09/2007
EPA 200.8	5.4	Iron	NELAP	PA	11/02/2012
EPA 200.8	5.4	Lead	NELAP	PA	02/10/2005
EPA 200.8	5.4	Magnesium	NELAP	PA	11/02/2012
EPA 200.8	5.4	Manganese	NELAP	PA	11/16/2011
EPA 200.8	5.4	Nickel	NELAP	PA	02/10/2005
EPA 200.8	5.4	Potassium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Selenium	NELAP	PA	02/10/2005
EPA 200.8	5.4	Sodium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Strontium	NELAP	PA	11/16/2011

Annmarie Beach

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

ED_006371_00001599-00647

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 200.8	5.4	Thallium	NELAP	PA	02/10/2005
EPA 200.8	5.4	Zinc	NELAP	PA	11/16/2011
EPA 245.1	3.0	Mercury	NELAP	PA	08/29/2001
EPA 300.0	2.1	Chloride	NELAP	PA	05/17/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	03/30/2021
EPA 300.0	2.1	Nitrate as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Sulfate	NELAP	PA	07/07/2003
EPA 335.4		Cyanide	NELAP	PA	07/11/2006
EPA 353.2		Nitrate as N	NELAP	PA	02/28/2002
EPA 353.2		Nitrite as N	NELAP	PA	02/28/2002
EPA 353.2		Total nitrate-nitrite	NELAP	PA	05/24/2011
EPA 524.2	4.1	1,1,1,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,1-Trichloroethane	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,1,2,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,2-Trichloroethane	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,1-Dichloro-2-propanone (1,1-Dichloropropanone)	NELAP	PA	05/17/2005
EPA 524.2	4.1	1,1-Dichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,1-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,3-Trichlorobenzene	NELAP	PA	04/04/2005
EPA 524.2	4.1	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,4-Trichlorobenzene	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,2,4-Trimethylbenzene	NELAP	PA	04/04/2005
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,2-Dichloropropane	NELAP	PA	03/06/2018
EPA 524.2	4.1	1,3,5-Trimethylbenzene	NELAP	PA	05/17/2005
EPA 524.2	4.1	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,3-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	03/06/2018
EPA 524.2	4.1	1-Chlorobutane	NELAP	PA	05/24/2007
EPA 524.2	4.1	2,2-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	05/24/2007
EPA 524.2	4.1	2-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Hexanone	NELAP	PA	05/24/2007
EPA 524.2	4.1	2-Nitropropane	NELAP	PA	05/24/2007
EPA 524.2	4.1	4-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	05/24/2007
EPA 524.2	4.1	Acetone	NELAP	PA	05/24/2007
EPA 524.2	4.1	Acrylonitrile	NELAP	PA	05/24/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 524.2	4.1	Allyl chloride (3-Chloropropene)	NELAP	PA	07/03/2007
EPA 524.2	4.1	Benzene	NELAP	PA	03/06/2018
EPA 524.2	4.1	Bromobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromochloromethane	NELAP	PA	04/04/2005
EPA 524.2	4.1	Bromodichloromethane	NELAP	PA	11/03/2016
EPA 524.2	4.1	Bromoform	NELAP	PA	11/03/2016
EPA 524.2	4.1	Carbon disulfide	NELAP	PA	05/24/2007
EPA 524.2	4.1	Carbon tetrachloride	NELAP	PA	03/06/2018
EPA 524.2	4.1	Chloroacetonitrile	NELAP	PA	05/24/2007
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	03/06/2018
EPA 524.2	4.1	Chloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroform	NELAP	PA	11/03/2016
EPA 524.2	4.1	Dibromochloromethane	NELAP	PA	11/03/2016
EPA 524.2	4.1	Dibromomethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dichlorodifluoromethane (Freon 12)	NELAP	PA	04/04/2005
EPA 524.2	4.1	Diethyl ether (Ethyl ether)	NELAP	PA	05/24/2007
EPA 524.2	4.1	Diisopropyl ether (DIPE)	NELAP	PA	01/07/2010
EPA 524.2	4.1	Ethyl methacrylate	NELAP	PA	05/24/2007
EPA 524.2	4.1	Ethyl tert-butyl ether (ETBE)	NELAP	PA	01/24/2007
EPA 524.2	4.1	Ethylbenzene	NELAP	PA	03/06/2018
EPA 524.2	4.1	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	04/04/2005
EPA 524.2	4.1	Isopropylbenzene (Cumene)	NELAP	PA	04/04/2005
EPA 524.2	4.1	Methacrylonitrile	NELAP	PA	05/24/2007
EPA 524.2	4.1	Methyl bromide (Bromomethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl chloride (Chloromethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl iodide (Iodomethane)	NELAP	PA	05/24/2007
EPA 524.2	4.1	Methyl tert-butyl ether (MTBE)	NELAP	PA	04/04/2005
EPA 524.2	4.1	Methylacrylate	NELAP	PA	05/24/2007
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	03/06/2018
EPA 524.2	4.1	Methylmethacrylate	NELAP	PA	05/24/2007
EPA 524.2	4.1	Naphthalene	NELAP	PA	05/17/2005
EPA 524.2	4.1	Nitrobenzene	NELAP	PA	05/17/2005
EPA 524.2	4.1	Pentachloroethane	NELAP	PA	05/24/2007
EPA 524.2	4.1	Propionitrile (Ethyl cyanide)	NELAP	PA	05/24/2007
EPA 524.2	4.1	Styrene	NELAP	PA	03/06/2018
EPA 524.2	4.1	Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	03/06/2018
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	05/24/2007
EPA 524.2	4.1	Toluene	NELAP	PA	03/06/2018
EPA 524.2	4.1	Total trihalomethanes (TTHMs)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	03/06/2018
EPA 524.2	4.1	Trichlorofluoromethane (Freon 11)	NELAP	PA	04/04/2005
EPA 524.2	4.1	Vinyl chloride (Chloroethene)	NELAP	PA	03/06/2018

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ED_006371_00001599-00649

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 524.2	4.1	Xylenes, total	NELAP	PA	03/06/2018
EPA 524.2	4.1	cis-1,2-Dichloroethene	NELAP	PA	03/06/2018
EPA 524.2	4.1	cis-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	m+p-Xylene	NELAP	PA	03/06/2018
EPA 524.2	4.1	n-Butylbenzene	NELAP	PA	04/04/2005
EPA 524.2	4.1	n-Propylbenzene	NELAP	PA	05/17/2005
EPA 524.2	4.1	o-Xylene	NELAP	PA	03/06/2018
EPA 524.2	4.1	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	05/17/2005
EPA 524.2	4.1	sec-Butylbenzene	NELAP	PA	04/04/2005
EPA 524.2	4.1	tert-Amyl methyl ether (TAME)	NELAP	PA	01/24/2007
EPA 524.2	4.1	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	05/24/2007
EPA 524.2	4.1	tert-Butylbenzene	NELAP	PA	04/04/2005
EPA 524.2	4.1	trans-1,2-Dichloroethene	NELAP	PA	03/06/2018
EPA 524.2	4.1	trans-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	trans-1,4-Dichloro-2-butene	NELAP	PA	05/24/2007
EPA 525.2	2.0	2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	05/17/2005
EPA 525.2	2.0	Acenaphthene	NELAP	PA	05/25/2007
EPA 525.2	2.0	Acenaphthylene	NELAP	PA	04/28/2010
EPA 525.2	2.0	Benzo[a]anthracene	NELAP	PA	05/25/2007
EPA 525.2	2.0	Benzo[a]pyrene	NELAP	PA	01/24/2001
EPA 525.2	2.0	Benzo[b]fluoranthene	NELAP	PA	06/04/2007
EPA 525.2	2.0	Benzo[ghi]perylene	NELAP	PA	07/03/2007
EPA 525.2	2.0	Benzo[k]fluoranthene	NELAP	PA	06/04/2007
EPA 525.2	2.0	Benzyl butyl phthalate (Butyl benzyl phthalate)	NELAP	PA	05/25/2007
EPA 525.2	2.0	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	05/25/2007
EPA 525.2	2.0	Di-n-butyl phthalate	NELAP	PA	05/25/2007
EPA 525.2	2.0	Dibenzo[a,h]anthracene	NELAP	PA	05/25/2007
EPA 525.2	2.0	Diethyl phthalate	NELAP	PA	05/25/2007
EPA 525.2	2.0	Dimethyl phthalate	NELAP	PA	05/25/2007
EPA 525.2	2.0	Fluoranthene	NELAP	PA	03/07/2012
EPA 525.2	2.0	Fluorene	NELAP	PA	02/07/2012
EPA 525.2	2.0	Indeno(1,2,3-cd)pyrene	NELAP	PA	02/07/2012
EPA 525.2	2.0	Phenanthrene	NELAP	PA	05/25/2007
EPA 525.2	2.0	Pyrene	NELAP	PA	05/25/2007
EPA 525.2	2.0	bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	01/24/2001
EPA 531.1	3.1	3-Hydroxycarbofuran	NELAP	PA	11/07/2006
EPA 531.1	3.1	Aldicarb (Temik)	NELAP	PA	04/14/2015
EPA 531.1	3.1	Aldicarb sulfone	NELAP	PA	01/24/2001
EPA 531.1	3.1	Aldicarb sulfoxide	NELAP	PA	01/24/2001
EPA 531.1	3.1	Carbaryl (Sevin)	NELAP	PA	10/09/2002
EPA 531.1	3.1	Carbofuran (Furaden)	NELAP	PA	01/24/2001
EPA 531.1	3.1	Methomyl (Lannate)	NELAP	PA	01/24/2001

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Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 531.1	3.1	Oxamyl (Vydate)	NELAP	PA	01/24/2001
EPA 533		11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NELAP	PA	11/03/2020
EPA 533		1H, 1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2-FTS)	NELAP	PA	11/03/2020
EPA 533		1H, 1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2-FTS)	NELAP	PA	11/03/2020
EPA 533		1H, 1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2-FTS)	NELAP	PA	11/03/2020
EPA 533		4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	NELAP	PA	11/03/2020
EPA 533		9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NELAP	PA	11/03/2020
EPA 533		Hexafluoropropylene oxide dimer acid (HFPO-DA)	NELAP	PA	11/03/2020
EPA 533		Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	NELAP	PA	11/03/2020
EPA 533		Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	NELAP	PA	11/03/2020
EPA 533		Perfluoro-3-methoxypropanoic acid (PFMPA)	NELAP	PA	11/03/2020
EPA 533		Perfluoro-4-methoxybutanoic acid (PFMBA)	NELAP	PA	11/03/2020
EPA 533		Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	11/03/2020
EPA 533		Perfluorobutanoic acid (PFBA)	NELAP	PA	11/03/2020
EPA 533		Perfluorodecanoic acid (PFDA)	NELAP	PA	11/03/2020
EPA 533		Perfluorododecanoic acid (PFDoA)	NELAP	PA	11/03/2020
EPA 533		Perfluoroheptanesulfonic acid (PFHpS)	NELAP	PA	11/03/2020
EPA 533		Perfluoroheptanoic acid (PFHpA)	NELAP	PA	11/03/2020
EPA 533		Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	11/03/2020
EPA 533		Perfluorohexanoic acid (PFHxA)	NELAP	PA	11/03/2020
EPA 533		Perfluorononanoic acid (PFNA)	NELAP	PA	11/03/2020
EPA 533		Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	11/03/2020
EPA 533		Perfluorooctanoic acid (PFOA)	NELAP	PA	11/03/2020
EPA 533		Perfluoropentane sulfonic acid (PFPeS)	NELAP	PA	11/03/2020
EPA 533		Perfluoropentanoic acid (PFPeA)	NELAP	PA	11/03/2020
EPA 533		Perfluoroundecanoic acid (PFUnA)	NELAP	PA	11/03/2020
EPA 537	1.1	Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorodecanoic acid (PFDA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorododecanoic acid (PFDoA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluoroheptanoic acid (PFHpA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorohexanoic acid (PFHxA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorononanoic acid (PFNA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorooctanoic acid (PFOA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorotetradecanoic acid (PFTA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluorotridecanoic acid (PFTrDA)	NELAP	PA	05/14/2018
EPA 537	1.1	Perfluoroundecanoic acid (PFUnA)	NELAP	PA	05/14/2018

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ED_006371_00001599-00651

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 537	1.1	n-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NELAP	PA	07/16/2018
EPA 537	1.1	n-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NELAP	PA	05/14/2018
EPA 537.1		11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NELAP	PA	08/01/2019
EPA 537.1		4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	NELAP	PA	08/01/2019
EPA 537.1		9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NELAP	PA	08/01/2019
EPA 537.1		Hexafluoropropylene oxide dimer acid (HFPO-DA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorodecanoic acid (PFDA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorododecanoic acid (PFDoA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluoroheptanoic acid (PFHpA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorohexanoic acid (PFHxA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorononanoic acid (PFNA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorooctanoic acid (PFOA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorotetradecanoic acid (PFTA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluorotridecanoic acid (PFTrDA)	NELAP	PA	08/01/2019
EPA 537.1		Perfluoroundecanoic acid (PFUnA)	NELAP	PA	08/01/2019
EPA 537.1		n-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NELAP	PA	08/01/2019
EPA 537.1		n-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NELAP	PA	08/01/2019
EPA 8015	C, D	Nonhalogenated organics by GC/FID	NELAP	PA	05/24/2011
EPA 8015	B, C, D	Ethane	NELAP	PA	05/24/2011
EPA 8015	B, C, D	Methane	NELAP	PA	05/24/2011
EPA 8015	B, C, D	Propane	NELAP	PA	11/09/2012
RSK-175		Acetylene (Ethyne)	NELAP	PA	11/19/2015
RSK-175		Carbon dioxide	NELAP	PA	11/19/2015
RSK-175		Ethane	NELAP	PA	11/19/2015
RSK-175		Ethene	NELAP	PA	11/19/2015
RSK-175		Isobutane (2-Methylpropane)	NELAP	PA	11/19/2015
RSK-175		Methane	NELAP	PA	11/19/2015
RSK-175		n-Butane	NELAP	PA	11/19/2015
SM 2120 B		Color	NELAP	PA	05/25/2005
SM 2130 B		Turbidity	NELAP	PA	05/17/2005
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	01/24/2001
SM 2340 C		Total hardness as CaCO3	NELAP	PA	05/24/2011
SM 2510 B		Conductivity	NELAP	PA	05/17/2005
SM 2540 B		Residue, total	NELAP	PA	09/04/2018
SM 2540 C		Total dissolved solids (TDS)	NELAP	PA	06/02/2004

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Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
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(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	05/24/2011
SM 2550 B		Temperature, deg. C	NELAP	PA	04/04/2005
SM 4500-Cl F		Total residual chlorine	NELAP	PA	05/24/2011
SM 4500-F- C		Fluoride	NELAP	PA	10/15/2003
SM 4500-H+ B		pH	NELAP	PA	05/16/2007
SM 4500-P E		Orthophosphate as P	NELAP	PA	06/12/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	05/24/2007
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	04/18/2013
SM 5540 C		Surfactants as MBAS	NELAP	PA	05/24/2007

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
ASTM D7511-09		Total cyanide	NELAP	PA	02/15/2013
ASTM D7511-12		Total cyanide	NELAP	PA	01/25/2019
EPA 1010	A	Ignitability	NELAP	PA	08/30/2019
EPA 1010		Ignitability	NELAP	PA	12/12/2005
EPA 130.2		Hardness	NELAP	PA	01/19/2005
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005
EPA 160.1		Residue, filterable (TDS)	NELAP	PA	01/19/2005
EPA 160.4		Residue, volatile	NELAP	PA	01/19/2005
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	06/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010
EPA 1613	B	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 1613	B	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010

Annmarie Beach

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1613	B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	06/30/2010
EPA 1613	B	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	06/30/2010
EPA 1613	B	Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	08/06/2010
EPA 1613	B	Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	08/06/2010
EPA 1613	B	Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	08/06/2010
EPA 1613	B	Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	08/06/2010
EPA 1613	B	Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	08/06/2010
EPA 1613	B	Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	08/06/2010
EPA 1613	B	Total tetrachlorodibenzo-p-dioxin (TCDD)	NELAP	PA	08/06/2010
EPA 1613	B	Total tetrachlorodibenzofuran (TCDF)	NELAP	PA	08/06/2010
EPA 1664	A	Non-polar material	NELAP	PA	03/27/2018
EPA 1664	A	Oil and grease	NELAP	PA	01/19/2005
EPA 1664	B	Non-polar material	NELAP	PA	01/31/2020
EPA 1664	B	Oil and grease	NELAP	PA	01/27/2014
EPA 1666	A	4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 1666	A	Diisopropyl ether (DIPE)	NELAP	PA	01/19/2005
EPA 1666	A	Ethyl acetate	NELAP	PA	01/19/2005
EPA 1666	A	Isobutyraldehyde	NELAP	PA	01/19/2005
EPA 1666	A	Isopropyl acetate	NELAP	PA	01/19/2005
EPA 1666	A	Isopropyl alcohol (2-Propanol)	NELAP	PA	12/02/2009
EPA 1666	A	Methyl formate	NELAP	PA	01/19/2005
EPA 1666	A	Tetrahydrofuran (THF)	NELAP	PA	01/19/2005
EPA 1666	A	Xylenes, total	NELAP	PA	01/19/2005
EPA 1666	A	n-Amyl acetate (n-Pentyl acetate)	NELAP	PA	04/04/2005
EPA 1666	A	n-Amyl alcohol (1-Pentanol)	NELAP	PA	04/04/2005
EPA 1666	A	n-Butyl acetate	NELAP	PA	04/04/2005
EPA 1666	A	n-Heptane	NELAP	PA	01/19/2005
EPA 1666	A	n-Hexane	NELAP	PA	01/19/2005
EPA 1666	A	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	04/04/2005
EPA 1668	A, C	PCBs as congeners by HRGC/HRMS	NELAP	PA	03/04/2015
EPA 1668	A, C	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	02/01/2013
EPA 1668	A, C	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012

Annmarie Beach

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	02/01/2013
EPA 1668	A, C	2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	02/01/2013
EPA 1668	A, C	2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012

Annmarie Beach

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012

Annmarie Beach

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	02/01/2013
EPA 1668	A, C	2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	02/01/2013
EPA 1668	A, C	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668	A, C	2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4',5-Trichlorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,5-Trichlorobiphenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668	A, C	3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668	A, C	4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668	A, C	4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668	A, C	Decachlorobiphenyl	NELAP	PA	02/01/2013
EPA 1671	A	Acetonitrile	NELAP	PA	01/19/2005
EPA 1671	A	Diethylamine	NELAP	PA	01/19/2005
EPA 1671	A	Dimethyl sulfoxide	NELAP	PA	01/19/2005
EPA 1671	A	Ethanol	NELAP	PA	01/19/2005
EPA 1671	A	Methanol	NELAP	PA	01/19/2005
EPA 1671	A	Methyl cellosolve (2-Methoxyethanol)	NELAP	PA	01/19/2005
EPA 1671	A	Triethylamine	NELAP	PA	01/19/2005
EPA 1671	A	n-Propanol (1-Propanol)	NELAP	PA	01/19/2005
EPA 170.1		Temperature, deg. C	NELAP	PA	04/04/2005
EPA 180.1		Turbidity	NELAP	PA	01/19/2005
EPA 200.7	4.4	Aluminum	NELAP	PA	05/01/2020
EPA 200.7	4.4	Antimony	NELAP	PA	01/19/2005

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Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 200.7	4.4	Arsenic	NELAP	PA	01/19/2005
EPA 200.7	4.4	Barium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Beryllium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Boron	NELAP	PA	01/19/2005
EPA 200.7	4.4	Cadmium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Calcium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Chromium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Cobalt	NELAP	PA	01/19/2005
EPA 200.7	4.4	Copper	NELAP	PA	01/19/2005
EPA 200.7	4.4	Iron	NELAP	PA	01/19/2005
EPA 200.7	4.4	Lead	NELAP	PA	01/19/2005
EPA 200.7	4.4	Lithium	NELAP	PA	02/07/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Manganese	NELAP	PA	01/19/2005
EPA 200.7	4.4	Molybdenum	NELAP	PA	01/19/2005
EPA 200.7	4.4	Nickel	NELAP	PA	01/19/2005
EPA 200.7	4.4	Potassium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Selenium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Silver	NELAP	PA	04/04/2005
EPA 200.7	4.4	Sodium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Strontium	NELAP	PA	05/24/2011
EPA 200.7	4.4	Tellurium	NELAP	PA	02/04/2016
EPA 200.7	4.4	Thallium	NELAP	PA	05/01/2020
EPA 200.7	4.4	Thorium	NELAP	PA	11/19/2015
EPA 200.7	4.4	Tin	NELAP	PA	01/19/2005
EPA 200.7	4.4	Titanium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Tungsten	NELAP	PA	11/19/2015
EPA 200.7	4.4	Vanadium	NELAP	PA	01/19/2005
EPA 200.7	4.4	Zinc	NELAP	PA	01/19/2005
EPA 200.7	4.4	Zirconium	NELAP	PA	07/29/2015
EPA 200.8	5.4	Aluminum	NELAP	PA	01/07/2010
EPA 200.8	5.4	Antimony	NELAP	PA	04/04/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	04/04/2005
EPA 200.8	5.4	Barium	NELAP	PA	04/04/2005
EPA 200.8	5.4	Beryllium	NELAP	PA	04/04/2005
EPA 200.8	5.4	Cadmium	NELAP	PA	04/04/2005
EPA 200.8	5.4	Calcium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Chromium	NELAP	PA	04/04/2005
EPA 200.8	5.4	Cobalt	NELAP	PA	11/23/2010
EPA 200.8	5.4	Copper	NELAP	PA	04/04/2005
EPA 200.8	5.4	Iron	NELAP	PA	11/23/2010
EPA 200.8	5.4	Lead	NELAP	PA	04/04/2005

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 200.8	5.4	Magnesium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Manganese	NELAP	PA	11/23/2010
EPA 200.8	5.4	Molybdenum	NELAP	PA	01/07/2010
EPA 200.8	5.4	Nickel	NELAP	PA	04/04/2005
EPA 200.8	5.4	Potassium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Selenium	NELAP	PA	12/12/2005
EPA 200.8	5.4	Silver	NELAP	PA	05/01/2020
EPA 200.8	5.4	Sodium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Strontium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Thallium	NELAP	PA	05/31/2006
EPA 200.8	5.4	Tin	NELAP	PA	01/07/2010
EPA 200.8	5.4	Titanium	NELAP	PA	09/19/2019
EPA 200.8	5.4	Uranium (mass)	NELAP	PA	11/19/2015
EPA 200.8	5.4	Vanadium	NELAP	PA	01/07/2010
EPA 200.8	5.4	Zinc	NELAP	PA	01/18/2011
EPA 218.6		Chromium VI	NELAP	PA	04/04/2005
EPA 245.1	3.0	Mercury	NELAP	PA	01/19/2005
EPA 300.0	2.1	Bromide	NELAP	PA	04/04/2005
EPA 300.0	2.1	Chloride	NELAP	PA	01/19/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	05/25/2005
EPA 300.0	2.1	Nitrate as N	NELAP	PA	01/19/2005
EPA 300.0	2.1	Nitrite as N	NELAP	PA	01/19/2005
EPA 300.0	2.1	Sulfate	NELAP	PA	01/19/2005
EPA 3005	A	Preconcentration under acid	NELAP	PA	12/12/2005
EPA 3010	A	Hot plate acid digestion (HNO3 + HCl)	NELAP	PA	12/12/2005
EPA 3020	A	Hot plate acid digestion (HNO3 only)	NELAP	PA	12/12/2005
EPA 305.2		Acidity as CaCO3	NELAP	PA	03/27/2018
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	01/24/2007
EPA 310.1		Alkalinity as CaCO3	NELAP	PA	11/19/2015
EPA 335.4		Total cyanide	NELAP	PA	01/19/2005
EPA 350.1	2.0	Ammonia as N	NELAP	PA	10/09/2013
EPA 350.3		Ammonia as N	NELAP	PA	01/19/2016
EPA 351.2		Kjeldahl nitrogen, total (TKN)	NELAP	PA	06/25/2020
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 3511		Organic compounds in water by microextraction	NELAP	PA	03/07/2012
EPA 3520	C	Continuous liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 353.2		Nitrate as N	NELAP	PA	01/19/2005
EPA 353.2		Nitrite as N	NELAP	PA	01/19/2005
EPA 353.2		Total nitrate-nitrite	NELAP	PA	04/04/2005
EPA 3620	B	Florisil cleanup	NELAP	PA	12/12/2005
EPA 3620	C	Florisil cleanup	NELAP	PA	09/04/2018
EPA 3630	C	Silica gel cleanup	NELAP	PA	12/12/2005

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	12/12/2005
EPA 365.1		Phosphorus, total	NELAP	PA	07/21/2020
EPA 365.3		Orthophosphate as P	NELAP	PA	06/25/2020
EPA 3660	B	Sulfur cleanup	NELAP	PA	12/12/2005
EPA 370.1		Silica, dissolved	NELAP	PA	11/19/2015
EPA 375.4		Sulfate	NELAP	PA	04/04/2005
EPA 410.4	2.0	Chemical oxygen demand (COD)	NELAP	PA	04/01/2005
EPA 415.1		Total organic carbon (TOC)	NELAP	PA	01/19/2005
EPA 420.4		Total phenolics	NELAP	PA	04/17/2007
EPA 425.1		Surfactants as MBAS	NELAP	PA	01/19/2005
EPA 5030	B	Aqueous-phase purge-and-trap	NELAP	PA	12/12/2005
EPA 5030	C	Aqueous-phase purge-and-trap	NELAP	PA	01/27/2014
EPA 524.2	4.1	1,2,4-Trimethylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	01/18/2011
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	01/18/2011
EPA 524.2	4.1	1,3,5-Trimethylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	05/24/2011
EPA 524.2	4.1	Acetone	NELAP	PA	01/18/2011
EPA 524.2	4.1	Acrolein (Propenal)	NELAP	PA	11/19/2015
EPA 524.2	4.1	Benzene	NELAP	PA	01/18/2011
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	01/18/2011
EPA 524.2	4.1	Chloroform	NELAP	PA	01/18/2011
EPA 524.2	4.1	Dichlorodifluoromethane (Freon 12)	NELAP	PA	11/19/2015
EPA 524.2	4.1	Diisopropyl ether (DIPE)	NELAP	PA	11/19/2015
EPA 524.2	4.1	Ethyl tert-butyl ether (ETBE)	NELAP	PA	11/19/2015
EPA 524.2	4.1	Ethylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	Isopropylbenzene (Cumene)	NELAP	PA	05/14/2018
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	05/24/2011
EPA 524.2	4.1	Naphthalene	NELAP	PA	05/14/2018
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	05/24/2011
EPA 524.2	4.1	Toluene	NELAP	PA	01/18/2011
EPA 524.2	4.1	m+p-Xylene	NELAP	PA	07/25/2011
EPA 524.2	4.1	n-Butylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	n-Hexane	NELAP	PA	11/19/2015
EPA 524.2	4.1	n-Propylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	o-Xylene	NELAP	PA	05/24/2011
EPA 524.2	4.1	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	05/14/2018
EPA 524.2	4.1	sec-Butylbenzene	NELAP	PA	05/14/2018
EPA 524.2	4.1	tert-Amyl methyl ether (TAME)	NELAP	PA	11/19/2015
EPA 531.1	3.1	3-Hydroxycarbofuran	NELAP	PA	11/19/2015
EPA 531.1	3.1	Aldicarb (Temik)	NELAP	PA	11/19/2015
EPA 531.1	3.1	Aldicarb sulfone	NELAP	PA	11/19/2015

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ED_006371_00001599-00662

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 531.1	3.1	Aldicarb sulfoxide	NELAP	PA	11/19/2015
EPA 531.1	3.1	Methiocarb (Mesurol)	NELAP	PA	11/19/2015
EPA 531.1	3.1	Methomyl (Lannate)	NELAP	PA	11/19/2015
EPA 531.1	3.1	Propoxur (Baygon)	NELAP	PA	11/19/2015
EPA 537 Isotope Dilution	1.1	10:2 Fluorotelomersulfonate (10:2 FTS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NELAP	PA	11/03/2020
EPA 537 Isotope Dilution	1.1	1H, 1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2-FTS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	1H, 1H, 2H, 2H-Perfluorododecane sulfonic acid (10:2-FTS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	1H, 1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2-FTS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	1H, 1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2-FTS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	NELAP	PA	11/03/2020
EPA 537 Isotope Dilution	1.1	6:2 Fluorotelomersulfonate (6:2FTS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	8:2 Flurotelomersulfonate (8:2FTS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NELAP	PA	11/03/2020
EPA 537 Isotope Dilution	1.1	Fluorotelomer sulfonate (4:2FTS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Hexafluoropropylene oxide dimer acid (HFPO-DA)	NELAP	PA	11/03/2020
EPA 537 Isotope Dilution	1.1	N-Ethylperfluorooctanesulfonamide (EtFOSA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	N-Methylperfluorooctanesulfonamide (MeFOSA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	N-ethylperfluoro-1-octanesulfonamido ethanol (N-EtFOSE)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	N-methylperfluoro-1-octanesulfonamido ethanol (N-MeFOSE)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorobutanoic acid (PFBA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorodecane sulfonate (PFDS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorodecane sulfonic acid (PFDS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	Perfluorodecanoic acid (PFDA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorododecane sulfonate	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorododecane sulfonic acid (PFDoS)	NELAP	PA	11/04/2019

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Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 537 Isotope Dilution	1.1	Perfluorododecanoic acid (PFDoA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluoroheptanesulfonic acid (PFHpS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluoroheptanoic acid (PFHpA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorohexadecanoic acid (PFHxDA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorohexanoic acid (PFHxA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorononane sulfonic acid (PFNS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	Perfluorononanesulfonate (PFNS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorononanoic acid (PFNA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorooctadecanoic acid (PFODA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorooctane sulfonamide (PFOSA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorooctanoic acid (PFOA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluoropentane sulfonic acid (PFPeS)	NELAP	PA	11/04/2019
EPA 537 Isotope Dilution	1.1	Perfluoropentanesulfonate (PFPeS)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluoropentanoic acid (PFPeA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorotetradecanoic acid (PFTA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluorotridecanoic acid (PFTrDA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	Perfluoroundecanoic acid (PFUnA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	n-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NELAP	PA	08/30/2019
EPA 537 Isotope Dilution	1.1	n-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NELAP	PA	08/30/2019
EPA 6010	B, C	Metals by ICP/AES	NELAP	PA	03/26/2012
EPA 6010	D	Metals by ICP/AES	NELAP	PA	07/09/2018
EPA 6010	B, C, D	Aluminum	NELAP	PA	05/01/2020
EPA 6010	B, C, D	Antimony	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Arsenic	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Barium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Beryllium	NELAP	PA	12/12/2005

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 6010	B, C, D	Boron	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Cadmium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Calcium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Chromium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Cobalt	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Copper	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Iron	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Lead	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Lithium	NELAP	PA	01/18/2011
EPA 6010	B, C, D	Magnesium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Manganese	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Molybdenum	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Nickel	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Potassium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Selenium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Silver	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Sodium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Strontium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Sulfur	NELAP	PA	12/19/2011
EPA 6010	B, C, D	Tellurium	NELAP	PA	02/04/2016
EPA 6010	B, C, D	Thallium	NELAP	PA	05/01/2020
EPA 6010	B, C, D	Thorium	NELAP	PA	11/19/2015
EPA 6010	B, C, D	Tin	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Titanium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Tungsten	NELAP	PA	11/19/2015
EPA 6010	B, C, D	Vanadium	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Zinc	NELAP	PA	12/12/2005
EPA 6010	B, C, D	Zirconium	NELAP	PA	07/29/2015
EPA 6020	A	Metals by ICP/MS	NELAP	PA	03/26/2012
EPA 6020	B	Metals by ICP/MS	NELAP	PA	07/09/2018
EPA 6020		Metals by ICP/MS	NELAP	PA	12/12/2005
EPA 6020	A, B	Aluminum	NELAP	PA	01/07/2010
EPA 6020	A, B	Antimony	NELAP	PA	12/12/2005
EPA 6020	A, B	Arsenic	NELAP	PA	12/12/2005
EPA 6020	A, B	Barium	NELAP	PA	12/12/2005
EPA 6020	A, B	Beryllium	NELAP	PA	12/12/2005
EPA 6020	A, B	Cadmium	NELAP	PA	12/12/2005
EPA 6020	A, B	Calcium	NELAP	PA	01/07/2010
EPA 6020	A, B	Chromium	NELAP	PA	12/12/2005
EPA 6020	A, B	Cobalt	NELAP	PA	11/23/2010
EPA 6020	A, B	Copper	NELAP	PA	12/12/2005
EPA 6020	A, B	Iron	NELAP	PA	11/23/2010

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 6020	A, B	Lead	NELAP	PA	12/12/2005
EPA 6020	A, B	Magnesium	NELAP	PA	01/07/2010
EPA 6020	A, B	Manganese	NELAP	PA	11/23/2010
EPA 6020	A, B	Molybdenum	NELAP	PA	01/07/2010
EPA 6020	A, B	Nickel	NELAP	PA	07/23/2008
EPA 6020	A, B	Potassium	NELAP	PA	01/07/2010
EPA 6020	A, B	Selenium	NELAP	PA	12/12/2005
EPA 6020	A, B	Silver	NELAP	PA	05/01/2020
EPA 6020	A, B	Sodium	NELAP	PA	01/07/2010
EPA 6020	A, B	Strontium	NELAP	PA	01/07/2010
EPA 6020	A, B	Thallium	NELAP	PA	12/12/2005
EPA 6020	A, B	Tin	NELAP	PA	01/07/2010
EPA 6020	A, B	Titanium	NELAP	PA	09/19/2019
EPA 6020	A, B	Uranium (mass)	NELAP	PA	11/19/2015
EPA 6020	A, B	Vanadium	NELAP	PA	01/07/2010
EPA 6020	A, B	Zinc	NELAP	PA	01/18/2011
EPA 608.3		2,4'-DDD	NELAP	PA	05/14/2018
EPA 608.3		2,4'-DDE	NELAP	PA	05/14/2018
EPA 608.3		2,4'-DDT	NELAP	PA	05/14/2018
EPA 608.3		4,4'-DDD	NELAP	PA	05/14/2018
EPA 608.3		4,4'-DDE	NELAP	PA	05/14/2018
EPA 608.3		4,4'-DDT	NELAP	PA	05/14/2018
EPA 608.3		Aldrin (HHDN)	NELAP	PA	05/14/2018
EPA 608.3		Aroclor-1016 (PCB-1016)	NELAP	PA	05/14/2018
EPA 608.3		Aroclor-1221 (PCB-1221)	NELAP	PA	07/16/2018
EPA 608.3		Aroclor-1232 (PCB-1232)	NELAP	PA	07/16/2018
EPA 608.3		Aroclor-1242 (PCB-1242)	NELAP	PA	07/16/2018
EPA 608.3		Aroclor-1248 (PCB-1248)	NELAP	PA	07/16/2018
EPA 608.3		Aroclor-1254 (PCB-1254)	NELAP	PA	07/16/2018
EPA 608.3		Aroclor-1260 (PCB-1260)	NELAP	PA	05/14/2018
EPA 608.3		Chlordane (tech.)	NELAP	PA	05/14/2018
EPA 608.3		Dieldrin	NELAP	PA	07/05/2018
EPA 608.3		Endosulfan I	NELAP	PA	05/14/2018
EPA 608.3		Endosulfan II	NELAP	PA	05/14/2018
EPA 608.3		Endosulfan sulfate	NELAP	PA	05/14/2018
EPA 608.3		Endrin	NELAP	PA	05/14/2018
EPA 608.3		Endrin aldehyde	NELAP	PA	05/14/2018
EPA 608.3		Endrin ketone	NELAP	PA	05/14/2018
EPA 608.3		Heptachlor	NELAP	PA	05/14/2018
EPA 608.3		Heptachlor epoxide	NELAP	PA	05/14/2018
EPA 608.3		Methoxychlor	NELAP	PA	05/14/2018
EPA 608.3		Mirex	NELAP	PA	05/14/2018

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 608.3		Telodrin	NELAP	PA	05/14/2018
EPA 608.3		Toxaphene (Chlorinated camphene)	NELAP	PA	05/14/2018
EPA 608.3		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	05/14/2018
EPA 608.3		alpha-Chlordane	NELAP	PA	05/14/2018
EPA 608.3		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	05/14/2018
EPA 608.3		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	05/14/2018
EPA 608.3		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	05/14/2018
EPA 608.3		gamma-Chlordane	NELAP	PA	05/14/2018
EPA 624.1		1,1,1,2-Tetrachloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,1,1-Trichloro-2,2,2-trifluoroethane (Freon 113a)	NELAP	PA	07/16/2018
EPA 624.1		1,1,1-Trichloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,1,2,2-Tetrachloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	05/14/2018
EPA 624.1		1,1,2-Trichloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,1-Dichloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	05/14/2018
EPA 624.1		1,1-Dichloropropene	NELAP	PA	05/14/2018
EPA 624.1		1,2,3-Trichlorobenzene	NELAP	PA	05/14/2018
EPA 624.1		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	05/14/2018
EPA 624.1		1,2,4-Trichlorobenzene	NELAP	PA	05/14/2018
EPA 624.1		1,2,4-Trimethylbenzene	NELAP	PA	05/14/2018
EPA 624.1		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	05/14/2018
EPA 624.1		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	05/14/2018
EPA 624.1		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 624.1		1,2-Dichloroethane	NELAP	PA	05/14/2018
EPA 624.1		1,2-Dichloropropane	NELAP	PA	05/14/2018
EPA 624.1		1,3,5-Trimethylbenzene	NELAP	PA	05/14/2018
EPA 624.1		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 624.1		1,3-Dichloropropane	NELAP	PA	05/14/2018
EPA 624.1		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 624.1		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	05/14/2018
EPA 624.1		2,2-Dichloropropane	NELAP	PA	05/14/2018
EPA 624.1		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	05/14/2018
EPA 624.1		2-Chloroethyl vinyl ether	NELAP	PA	07/16/2018
EPA 624.1		2-Chlorotoluene	NELAP	PA	05/14/2018
EPA 624.1		2-Hexanone	NELAP	PA	05/14/2018
EPA 624.1		4-Chlorotoluene	NELAP	PA	05/14/2018
EPA 624.1		4-Methyl-2-pentanone (MIBK)	NELAP	PA	05/14/2018
EPA 624.1		Acetone	NELAP	PA	05/14/2018
EPA 624.1		Acetonitrile	NELAP	PA	05/14/2018

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DEP Laboratory ID: 36-00037
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TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 624.1		Acrolein (Propenal)	NELAP	PA	05/14/2018
EPA 624.1		Acrylonitrile	NELAP	PA	05/14/2018
EPA 624.1		Benzene	NELAP	PA	05/14/2018
EPA 624.1		Benzyl chloride	NELAP	PA	05/14/2018
EPA 624.1		Bromobenzene	NELAP	PA	05/14/2018
EPA 624.1		Bromochloromethane	NELAP	PA	05/14/2018
EPA 624.1		Bromodichloromethane	NELAP	PA	05/14/2018
EPA 624.1		Bromoform	NELAP	PA	05/14/2018
EPA 624.1		Carbon disulfide	NELAP	PA	05/14/2018
EPA 624.1		Carbon tetrachloride	NELAP	PA	05/14/2018
EPA 624.1		Chlorobenzene	NELAP	PA	05/14/2018
EPA 624.1		Chlorodifluoromethane (Freon 22)	NELAP	PA	05/14/2018
EPA 624.1		Chloroethane	NELAP	PA	05/14/2018
EPA 624.1		Chloroform	NELAP	PA	07/05/2018
EPA 624.1		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	05/14/2018
EPA 624.1		Cyclohexane	NELAP	PA	05/14/2018
EPA 624.1		Dibromochloromethane	NELAP	PA	05/14/2018
EPA 624.1		Dibromomethane	NELAP	PA	05/14/2018
EPA 624.1		Dichlorodifluoromethane (Freon 12)	NELAP	PA	05/14/2018
EPA 624.1		Dichlorofluoromethane (Freon 21)	NELAP	PA	05/14/2018
EPA 624.1		Diisopropyl ether (DIPE)	NELAP	PA	05/14/2018
EPA 624.1		Ethyl acetate	NELAP	PA	05/14/2018
EPA 624.1		Ethyl methacrylate	NELAP	PA	05/14/2018
EPA 624.1		Ethylbenzene	NELAP	PA	05/14/2018
EPA 624.1		Freon-123A	NELAP	PA	05/14/2018
EPA 624.1		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	05/14/2018
EPA 624.1		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	05/14/2018
EPA 624.1		Isopropyl acetate	NELAP	PA	05/14/2018
EPA 624.1		Isopropyl alcohol (2-Propanol)	NELAP	PA	05/14/2018
EPA 624.1		Isopropylbenzene (Cumene)	NELAP	PA	05/14/2018
EPA 624.1		Methacrylonitrile	NELAP	PA	05/14/2018
EPA 624.1		Methyl bromide (Bromomethane)	NELAP	PA	05/14/2018
EPA 624.1		Methyl chloride (Chloromethane)	NELAP	PA	05/14/2018
EPA 624.1		Methyl iodide (Iodomethane)	NELAP	PA	05/14/2018
EPA 624.1		Methyl tert-butyl ether (MTBE)	NELAP	PA	05/14/2018
EPA 624.1		Methylene chloride (Dichloromethane)	NELAP	PA	05/14/2018
EPA 624.1		Methylmethacrylate	NELAP	PA	05/14/2018
EPA 624.1		Naphthalene	NELAP	PA	05/14/2018
EPA 624.1		Propionitrile (Ethyl cyanide)	NELAP	PA	05/14/2018
EPA 624.1		Styrene	NELAP	PA	05/14/2018
EPA 624.1		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	05/14/2018
EPA 624.1		Tetrahydrofuran (THF)	NELAP	PA	05/14/2018

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Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 624.1		Toluene	NELAP	PA	05/14/2018
EPA 624.1		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	05/14/2018
EPA 624.1		Trichlorofluoromethane (Freon 11)	NELAP	PA	05/14/2018
EPA 624.1		Vinyl acetate	NELAP	PA	05/14/2018
EPA 624.1		Vinyl chloride (Chloroethene)	NELAP	PA	05/14/2018
EPA 624.1		Xylenes, total	NELAP	PA	05/14/2018
EPA 624.1		cis-1,2-Dichloroethene	NELAP	PA	05/14/2018
EPA 624.1		cis-1,3-Dichloropropene	NELAP	PA	05/14/2018
EPA 624.1		cis-1,4-Dichloro-2-butene	NELAP	PA	05/14/2018
EPA 624.1		m+p-Xylene	NELAP	PA	05/14/2018
EPA 624.1		n-Butyl acetate	NELAP	PA	05/14/2018
EPA 624.1		n-Butylbenzene	NELAP	PA	05/14/2018
EPA 624.1		n-Heptane	NELAP	PA	05/14/2018
EPA 624.1		n-Hexane	NELAP	PA	05/14/2018
EPA 624.1		n-Propyl acetate	NELAP	PA	05/14/2018
EPA 624.1		n-Propylbenzene	NELAP	PA	05/14/2018
EPA 624.1		o-Xylene	NELAP	PA	05/14/2018
EPA 624.1		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	05/14/2018
EPA 624.1		sec-Butylbenzene	NELAP	PA	05/14/2018
EPA 624.1		tert-Amyl ethyl ether (TAEE)	NELAP	PA	05/14/2018
EPA 624.1		tert-Amyl methyl ether (TAME)	NELAP	PA	07/05/2018
EPA 624.1		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	05/14/2018
EPA 624.1		tert-Butyl ethyl ether	NELAP	PA	07/16/2018
EPA 624.1		tert-Butylbenzene	NELAP	PA	05/14/2018
EPA 624.1		trans-1,2-Dichloroethene	NELAP	PA	05/14/2018
EPA 624.1		trans-1,3-Dichloropropene	NELAP	PA	05/14/2018
EPA 624.1		trans-1,4-Dichloro-2-butene	NELAP	PA	05/14/2018
EPA 625.1		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	05/14/2018
EPA 625.1		1,2,4,5-Tetrachlorobenzene	NELAP	PA	05/14/2018
EPA 625.1		1,2,4-Trichlorobenzene	NELAP	PA	05/14/2018
EPA 625.1		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 625.1		1,2-Diphenylhydrazine	NELAP	PA	05/14/2018
EPA 625.1		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 625.1		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	05/14/2018
EPA 625.1		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	05/14/2018
EPA 625.1		1-Methylnaphthalene	NELAP	PA	05/14/2018
EPA 625.1		1-Methylphenanthrene	NELAP	PA	05/14/2018
EPA 625.1		2,2'-oxybis(1-Chloropropane)	NELAP	PA	05/14/2018
EPA 625.1		2,3,4,6-Tetrachlorophenol	NELAP	PA	05/14/2018
EPA 625.1		2,3-Dichloroaniline	NELAP	PA	05/14/2018
EPA 625.1		2,3-Dinitrotoluene	NELAP	PA	05/14/2018
EPA 625.1		2,4,5-Trichlorophenol	NELAP	PA	05/14/2018

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 625.1		2,4,6-Trichlorophenol	NELAP	PA	05/14/2018
EPA 625.1		2,4-Dichlorophenol	NELAP	PA	05/14/2018
EPA 625.1		2,4-Dimethylphenol	NELAP	PA	05/14/2018
EPA 625.1		2,4-Dinitrophenol	NELAP	PA	05/14/2018
EPA 625.1		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	05/14/2018
EPA 625.1		2,6-Dichlorophenol	NELAP	PA	05/14/2018
EPA 625.1		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	05/14/2018
EPA 625.1		2-Chloronaphthalene	NELAP	PA	05/14/2018
EPA 625.1		2-Chlorophenol	NELAP	PA	05/14/2018
EPA 625.1		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	05/14/2018
EPA 625.1		2-Methylnaphthalene	NELAP	PA	05/14/2018
EPA 625.1		2-Methylphenol (o-Cresol)	NELAP	PA	05/14/2018
EPA 625.1		2-Nitroaniline	NELAP	PA	05/14/2018
EPA 625.1		2-Nitrophenol	NELAP	PA	05/14/2018
EPA 625.1		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	05/14/2018
EPA 625.1		3,3'-Dichlorobenzidine	NELAP	PA	05/14/2018
EPA 625.1		3-Nitroaniline	NELAP	PA	05/14/2018
EPA 625.1		4-Bromophenyl phenyl ether	NELAP	PA	05/14/2018
EPA 625.1		4-Chloro-3-methylphenol	NELAP	PA	05/14/2018
EPA 625.1		4-Chloroaniline	NELAP	PA	05/14/2018
EPA 625.1		4-Chlorophenyl phenyl ether	NELAP	PA	05/14/2018
EPA 625.1		4-Nitroaniline	NELAP	PA	05/14/2018
EPA 625.1		4-Nitrophenol	NELAP	PA	05/14/2018
EPA 625.1		Acenaphthene	NELAP	PA	05/14/2018
EPA 625.1		Acenaphthylene	NELAP	PA	05/14/2018
EPA 625.1		Acetophenone	NELAP	PA	05/14/2018
EPA 625.1		Aniline	NELAP	PA	05/14/2018
EPA 625.1		Anthracene	NELAP	PA	05/14/2018
EPA 625.1		Benzidine	NELAP	PA	05/14/2018
EPA 625.1		Benzo[a]anthracene	NELAP	PA	05/14/2018
EPA 625.1		Benzo[a]pyrene	NELAP	PA	05/14/2018
EPA 625.1		Benzo[b]fluoranthene	NELAP	PA	05/14/2018
EPA 625.1		Benzo[ghi]perylene	NELAP	PA	05/14/2018
EPA 625.1		Benzo[k]fluoranthene	NELAP	PA	05/14/2018
EPA 625.1		Benzoic acid	NELAP	PA	05/14/2018
EPA 625.1		Benzyl alcohol	NELAP	PA	05/14/2018
EPA 625.1		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	05/14/2018
EPA 625.1		Carbazole	NELAP	PA	05/14/2018
EPA 625.1		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	05/14/2018
EPA 625.1		Di-n-butyl phthalate	NELAP	PA	05/14/2018
EPA 625.1		Di-n-octyl phthalate	NELAP	PA	05/14/2018

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 625.1		Dibenzo[a,h]anthracene	NELAP	PA	05/14/2018
EPA 625.1		Dibenzofuran	NELAP	PA	05/14/2018
EPA 625.1		Diethyl phthalate	NELAP	PA	05/14/2018
EPA 625.1		Dimethyl phthalate	NELAP	PA	05/14/2018
EPA 625.1		Diphenyl ether	NELAP	PA	05/14/2018
EPA 625.1		Fluoranthene	NELAP	PA	05/14/2018
EPA 625.1		Fluorene	NELAP	PA	05/14/2018
EPA 625.1		Hexachlorobenzene	NELAP	PA	05/14/2018
EPA 625.1		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	05/14/2018
EPA 625.1		Hexachlorocyclopentadiene	NELAP	PA	05/14/2018
EPA 625.1		Hexachloroethane	NELAP	PA	05/14/2018
EPA 625.1		Indeno(1,2,3-cd)pyrene	NELAP	PA	05/14/2018
EPA 625.1		Isophorone	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosodi-n-butylamine	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosodi-n-propylamine	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosodiethylamine	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosodimethylamine	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosodiphenylamine	NELAP	PA	05/14/2018
EPA 625.1		N-Nitrosopyrrolidine	NELAP	PA	05/14/2018
EPA 625.1		Naphthalene	NELAP	PA	05/14/2018
EPA 625.1		Nitrobenzene	NELAP	PA	05/14/2018
EPA 625.1		Pentachlorobenzene	NELAP	PA	05/14/2018
EPA 625.1		Pentachlorophenol (PCP)	NELAP	PA	05/14/2018
EPA 625.1		Phenanthrene	NELAP	PA	05/14/2018
EPA 625.1		Phenol	NELAP	PA	05/14/2018
EPA 625.1		Pyrene	NELAP	PA	05/14/2018
EPA 625.1		Pyridine	NELAP	PA	05/14/2018
EPA 625.1		alpha-Terpineol	NELAP	PA	05/14/2018
EPA 625.1		bis(2-Chloroethoxy)methane	NELAP	PA	05/14/2018
EPA 625.1		bis(2-Chloroethyl) ether	NELAP	PA	05/14/2018
EPA 625.1		bis(2-Chloroisopropyl)ether	NELAP	PA	07/16/2018
EPA 625.1		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	05/14/2018
EPA 625.1		n-Decane	NELAP	PA	05/14/2018
EPA 625.1		n-Docosane	NELAP	PA	05/14/2018
EPA 625.1		n-Eicosane	NELAP	PA	05/14/2018
EPA 625.1		n-Hexadecane	NELAP	PA	05/14/2018
EPA 625.1		n-Octadecane	NELAP	PA	05/14/2018
EPA 625.1		n-Tetradecane	NELAP	PA	05/14/2018
EPA 625.1		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	05/14/2018
EPA 625.1 SIM		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	09/24/2020
EPA 625.1 SIM		1-Methylnaphthalene	NELAP	PA	09/24/2020
EPA 625.1 SIM		2-Methylnaphthalene	NELAP	PA	09/24/2020

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 625.1 SIM		Acenaphthene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Acenaphthylene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Anthracene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[a]anthracene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[a]pyrene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[b]fluoranthene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[e]pyrene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[ghi]perylene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Benzo[k]fluoranthene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	09/24/2020
EPA 625.1 SIM		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	09/24/2020
EPA 625.1 SIM		Di-n-butyl phthalate	NELAP	PA	09/24/2020
EPA 625.1 SIM		Di-n-octyl phthalate	NELAP	PA	09/24/2020
EPA 625.1 SIM		Dibenzo[a,h]anthracene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Dibenzofuran	NELAP	PA	09/24/2020
EPA 625.1 SIM		Diethyl phthalate	NELAP	PA	09/24/2020
EPA 625.1 SIM		Dimethyl phthalate	NELAP	PA	09/24/2020
EPA 625.1 SIM		Diphenylamine	NELAP	PA	09/24/2020
EPA 625.1 SIM		Fluoranthene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Fluorene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Hexachlorobenzene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Indeno(1,2,3-cd)pyrene	NELAP	PA	09/24/2020
EPA 625.1 SIM		N-Nitrosodimethylamine	NELAP	PA	09/24/2020
EPA 625.1 SIM		N-Nitrosodiphenylamine	NELAP	PA	09/24/2020
EPA 625.1 SIM		Naphthalene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Perylene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Phenanthrene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Pyrene	NELAP	PA	09/24/2020
EPA 625.1 SIM		Quinoline	NELAP	PA	09/24/2020
EPA 625.1 SIM		bis(2-Chloroethyl) ether	NELAP	PA	09/24/2020
EPA 625.1 SIM		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	09/24/2020
EPA 680		Decachlorobiphenyl	NELAP	PA	01/19/2016
EPA 680		Dichlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Heptachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Hexachlorbiphenyls	NELAP	PA	01/19/2016
EPA 680		Monochlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Nonachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Octachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Pentachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Tetrachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Trichlorobiphenyls	NELAP	PA	01/19/2016
EPA 6850		Perchlorate	NELAP	PA	01/19/2011

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Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 7196	A	Chromium VI	NELAP	PA	04/06/2006
EPA 7199		Chromium VI	NELAP	PA	01/04/2006
EPA 7470	A	Mercury	NELAP	PA	11/21/2005
EPA 8011		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	05/02/2006
EPA 8011		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8015	B, C	Nonhalogenated organics by GC/FID	NELAP	PA	03/26/2012
EPA 8015	D	Nonhalogenated organics by GC/FID	NELAP	PA	07/29/2015
EPA 8015	B, C, D	Diesel-range organics (DRO)	NELAP	PA	12/12/2005
EPA 8015	B, C, D	Diethylene glycol	NELAP	PA	01/20/2012
EPA 8015	B, C, D	Ethane	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Ethanol	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Ethene	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Ethylene glycol	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
EPA 8015	B, C, D	Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	02/07/2012
EPA 8015	B, C, D	Isopropyl alcohol (2-Propanol)	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Methane	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Methanol	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Propane	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Propylene glycol	NELAP	PA	01/20/2012
EPA 8015	B, C, D	Total petroleum hydrocarbons (TPH)	NELAP	PA	01/24/2007
EPA 8015	B, C, D	Triethylene glycol	NELAP	PA	01/20/2012
EPA 8015	B, C, D	n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	02/07/2012
EPA 8015	B, C, D	n-Propanol (1-Propanol)	NELAP	PA	02/07/2012
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	03/26/2012
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	01/01/2013
EPA 8081	A, B	2,4'-DDD	NELAP	PA	11/19/2015
EPA 8081	A, B	2,4'-DDE	NELAP	PA	11/19/2015
EPA 8081	A, B	2,4'-DDT	NELAP	PA	11/19/2015
EPA 8081	A, B	4,4'-DDD	NELAP	PA	02/10/2006
EPA 8081	A, B	4,4'-DDE	NELAP	PA	12/12/2005
EPA 8081	A, B	4,4'-DDT	NELAP	PA	12/12/2005
EPA 8081	A, B	Aldrin (HHDN)	NELAP	PA	12/12/2005
EPA 8081	A, B	Chlordane (tech.)	NELAP	PA	12/12/2005
EPA 8081	A, B	Dieldrin	NELAP	PA	12/12/2005
EPA 8081	A, B	Endosulfan I	NELAP	PA	02/10/2006
EPA 8081	A, B	Endosulfan II	NELAP	PA	12/12/2005
EPA 8081	A, B	Endosulfan sulfate	NELAP	PA	12/12/2005
EPA 8081	A, B	Endrin	NELAP	PA	12/12/2005
EPA 8081	A, B	Endrin aldehyde	NELAP	PA	12/12/2005
EPA 8081	A, B	Endrin ketone	NELAP	PA	02/10/2006

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DEP Laboratory ID: 36-00037
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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8081	A, B	Heptachlor	NELAP	PA	12/12/2005
EPA 8081	A, B	Heptachlor epoxide	NELAP	PA	12/12/2005
EPA 8081	A, B	Kepone	NELAP	PA	05/02/2006
EPA 8081	A, B	Methoxychlor	NELAP	PA	12/12/2005
EPA 8081	A, B	Mirex	NELAP	PA	12/12/2005
EPA 8081	A, B	Toxaphene (Chlorinated camphene)	NELAP	PA	12/12/2005
EPA 8081	A, B	alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	02/10/2006
EPA 8081	A, B	alpha-Chlordane	NELAP	PA	02/10/2006
EPA 8081	A, B	beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	02/10/2006
EPA 8081	A, B	delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	02/10/2006
EPA 8081	A, B	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	02/10/2006
EPA 8081	A, B	gamma-Chlordane	NELAP	PA	02/10/2006
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	03/26/2012
EPA 8082		PCBs by GC/ECD	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1016 (PCB-1016)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1221 (PCB-1221)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1232 (PCB-1232)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1242 (PCB-1242)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1248 (PCB-1248)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1254 (PCB-1254)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1260 (PCB-1260)	NELAP	PA	12/11/2006
EPA 8082	A	Aroclor-1262 (PCB-1262)	NELAP	PA	07/23/2008
EPA 8082	A	Aroclor-1268 (PCB-1268)	NELAP	PA	07/23/2008
EPA 8082	A	Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	03/26/2012
EPA 8151	A	2,4,5-T	NELAP	PA	12/12/2005
EPA 8151	A	2,4,5-TP (Silvex)	NELAP	PA	12/12/2005
EPA 8151	A	2,4-D	NELAP	PA	12/12/2005
EPA 8151	A	2,4-DB (Butoxon)	NELAP	PA	12/12/2005
EPA 8151	A	Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	12/12/2005
EPA 8151	A	Dicamba	NELAP	PA	12/12/2005
EPA 8151	A	Dichloroprop (Dichlorprop)	NELAP	PA	01/24/2007
EPA 8151	A	Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8151	A	MCPA	NELAP	PA	12/12/2005
EPA 8151	A	MCPP (Mecoprop)	NELAP	PA	12/12/2005
EPA 8151	A	Pentachlorophenol (PCP)	NELAP	PA	12/12/2005
EPA 8151	A	Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	12/12/2005
EPA 8260	B, C	VOCs by GC/MS	NELAP	PA	03/26/2012
EPA 8260	D	VOCs by GC/MS	NELAP	PA	11/04/2019
EPA 8260	B, C	1,3-Dichloro-2-butene	NELAP	PA	01/19/2016

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C	3,3'-Dimethyl-1-butanol	NELAP	PA	04/17/2009
EPA 8260	B, C	Crotonaldehyde	NELAP	PA	10/30/2014
EPA 8260	B, C	Cyclohexanone	NELAP	PA	06/07/2012
EPA 8260	B, C	Dimethyl ether	NELAP	PA	06/07/2012
EPA 8260	B, C	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	04/17/2009
EPA 8260	B, C	Ethylene oxide	NELAP	PA	10/30/2014
EPA 8260	B, C	Gasoline-range organics (GRO)	NELAP	PA	06/08/2006
EPA 8260	B, C	n-Propylamine	NELAP	PA	12/12/2005
EPA 8260	B, C	tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	04/17/2009
EPA 8260	B, C	tert-Butyl formate	NELAP	PA	04/17/2009
EPA 8260	B, C, D	1,1,1,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1,1-Trichloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1,2,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1,2-Trichloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,1-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2,3-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2,3-Trimethylbenzene	NELAP	PA	01/19/2016
EPA 8260	B, C, D	1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2,4-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Dichloro-1,1,2-trifluoroethane	NELAP	PA	03/19/2015
EPA 8260	B, C, D	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,2-Diethylbenzene	NELAP	PA	01/19/2016
EPA 8260	B, C, D	1,3,5-Trichlorobenzene	NELAP	PA	01/19/2016
EPA 8260	B, C, D	1,3,5-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,3-Butadiene (Divinyl)	NELAP	PA	01/19/2016
EPA 8260	B, C, D	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,3-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,3-Diethylbenzene	NELAP	PA	01/19/2016
EPA 8260	B, C, D	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	2,2-Dichloropropane	NELAP	PA	05/02/2006
EPA 8260	B, C, D	2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	05/02/2006
EPA 8260	B, C, D	2-Chloroethyl vinyl ether	NELAP	PA	12/12/2005

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C, D	2-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	2-Hexanone	NELAP	PA	12/12/2005
EPA 8260	B, C, D	2-Nitropropane	NELAP	PA	01/19/2011
EPA 8260	B, C, D	4-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Acetone	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Acetonitrile	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Acrolein (Propenal)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Acrylonitrile	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Allyl chloride (3-Chloropropene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Benzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Benzyl chloride	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Bromobenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Bromochloromethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Bromodichloromethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Bromoform	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Carbon disulfide	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Carbon tetrachloride	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Chlorobenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Chloroethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Chloroform	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Cyclohexane	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Dibromochloromethane	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Dibromomethane	NELAP	PA	05/02/2006
EPA 8260	B, C, D	Dichlorodifluoromethane (Freon 12)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Diethyl ether (Ethyl ether)	NELAP	PA	02/01/2011
EPA 8260	B, C, D	Diisopropyl ether (DIPE)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Ethanol	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Ethyl acetate	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Ethyl methacrylate	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Ethyl tert-butyl ether (ETBE)	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Ethylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	NELAP	PA	03/04/2015
EPA 8260	B, C, D	Heptane	NELAP	PA	01/20/2012
EPA 8260	B, C, D	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Isopropyl alcohol (2-Propanol)	NELAP	PA	01/18/2011
EPA 8260	B, C, D	Isopropylbenzene (Cumene)	NELAP	PA	05/02/2006
EPA 8260	B, C, D	Methacrylonitrile	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Methyl acetate	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Methyl bromide (Bromomethane)	NELAP	PA	12/12/2005

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The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C, D	Methyl chloride (Chloromethane)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Methyl iodide (Iodomethane)	NELAP	PA	05/25/2007
EPA 8260	B, C, D	Methyl tert-butyl ether (MTBE)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Methylcyclohexane	NELAP	PA	01/21/2009
EPA 8260	B, C, D	Methylene chloride (Dichloromethane)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Methylmethacrylate	NELAP	PA	05/25/2007
EPA 8260	B, C, D	Naphthalene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Pentachloroethane	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Propionitrile (Ethyl cyanide)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Styrene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Tetrahydrofuran (THF)	NELAP	PA	01/18/2011
EPA 8260	B, C, D	Toluene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Trichlorofluoromethane (Freon 11)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Vinyl acetate	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Vinyl chloride (Chloroethene)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	Xylenes, total	NELAP	PA	12/12/2005
EPA 8260	B, C, D	cis-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	cis-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	m+p-Xylene	NELAP	PA	04/17/2009
EPA 8260	B, C, D	n-Butyl acetate	NELAP	PA	01/19/2016
EPA 8260	B, C, D	n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	04/17/2009
EPA 8260	B, C, D	n-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	n-Hexane	NELAP	PA	01/20/2012
EPA 8260	B, C, D	n-Propylbenzene	NELAP	PA	01/24/2007
EPA 8260	B, C, D	o-Xylene	NELAP	PA	04/17/2009
EPA 8260	B, C, D	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	01/24/2007
EPA 8260	B, C, D	sec-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	tert-Amyl methyl ether (TAME)	NELAP	PA	01/24/2007
EPA 8260	B, C, D	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	12/12/2005
EPA 8260	B, C, D	tert-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	trans-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	trans-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260	B, C, D	trans-1,4-Dichloro-2-butene	NELAP	PA	07/03/2007
EPA 8260 SIM	D	VOCs by GC/MS	NELAP	PA	09/29/2020
EPA 8260 SIM	B, C, D	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/04/2007
EPA 8270	C, D	SOCs by GC/MS	NELAP	PA	03/26/2012
EPA 8270	E	SOCs by GC/MS	NELAP	PA	06/25/2020
EPA 8270	C, D	1,2,3,4-Tetrachlorobenzene	NELAP	PA	07/03/2007
EPA 8270	C, D	1,2,3,4-Tetrahydronaphthalene	NELAP	PA	04/17/2009
EPA 8270	C, D	1,2,3,5-Tetrachlorobenzene	NELAP	PA	07/03/2007

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Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D	1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005
EPA 8270	C, D	1,4-Phenylenediamine	NELAP	PA	12/12/2005
EPA 8270	C, D	2-Butoxyethanol	NELAP	PA	02/07/2012
EPA 8270	C, D	Aramite	NELAP	PA	12/12/2005
EPA 8270	C, D	Benzenethiol	NELAP	PA	04/17/2009
EPA 8270	C, D	Disulfoton	NELAP	PA	12/12/2005
EPA 8270	C, D	Famphur	NELAP	PA	12/12/2005
EPA 8270	C, D	Kepone	NELAP	PA	12/12/2005
EPA 8270	C, D	Methapyrilene	NELAP	PA	12/12/2005
EPA 8270	C, D	N,N-Dimethylacetamide	NELAP	PA	04/17/2009
EPA 8270	C, D	N,N-Dimethylformamide	NELAP	PA	04/17/2009
EPA 8270	C, D	Phthalic anhydride	NELAP	PA	01/21/2009
EPA 8270	C, D	Tetraethyl lead	NELAP	PA	03/07/2012
EPA 8270	C, D	a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	12/12/2005
EPA 8270	C, D	a-Methylstyrene	NELAP	PA	04/17/2009
EPA 8270	C, D	bis(2-Chloromethyl) ether	NELAP	PA	01/21/2009
EPA 8270	C, D	tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	04/17/2009
EPA 8270	C, D, E	1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	04/17/2009
EPA 8270	C, D, E	1,2,4,5-Tetrachlorobenzene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,2-Diphenylhydrazine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	04/17/2009
EPA 8270	C, D, E	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	04/17/2009
EPA 8270	C, D, E	1,4-Naphthoquinone	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	1-Methylnaphthalene	NELAP	PA	04/17/2009
EPA 8270	C, D, E	1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl) ether)	NELAP	PA	01/19/2011
EPA 8270	C, D, E	2,2'-oxybis(1-Chloropropane)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,3,4,6-Tetrachlorophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4,5-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4,6-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4-Dichlorophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4-Dimethylphenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4-Dinitrophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2,6-Dichlorophenol	NELAP	PA	12/12/2005

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Acetylaminofluorene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Chlorophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Methylnaphthalene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Methylphenol (o-Cresol)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	2-Picoline (2-Methylpyridine)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	3+4-Methylphenol (m+p-Cresol)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	3,3'-Dichlorobenzidine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	3,3'-Dimethylbenzidine	NELAP	PA	07/03/2007
EPA 8270	C, D, E	3-Methylcholanthrene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	3-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Aminobiphenyl	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Bromophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Chloro-3-methylphenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Chloroaniline	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Chlorophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	4-Nitroquinoline-1-oxide	NELAP	PA	07/03/2007
EPA 8270	C, D, E	5-Nitro-o-toluidine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	6-Methylchrysene	NELAP	PA	01/19/2011
EPA 8270	C, D, E	7,12-Dimethylbenz(a)anthracene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Acenaphthene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Acenaphthylene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Acetophenone	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Aniline	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Anthracene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Atrazine	NELAP	PA	01/22/2007
EPA 8270	C, D, E	Benzaldehyde	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Benzidine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzo[a]anthracene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzo[a]pyrene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzo[b]fluoranthene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzo[ghi]perylene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzo[k]fluoranthene	NELAP	PA	12/12/2005

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	Benzoic acid	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Benzyl alcohol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Caprolactam	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Carbazole	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Chlorobenzilate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Di-n-butyl phthalate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Di-n-octyl phthalate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Diallate (cis or trans)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dibenz[a,h]acridine	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Dibenz[a,j]acridine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dibenzo[a,h]anthracene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dibenzofuran	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Diethyl phthalate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dimethoate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dimethyl phthalate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Dimethylaminoazobenzene (4-Dimethylaminoazobenzene)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Diphenylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Ethyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Fluoranthene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Fluorene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Hexachlorobenzene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Hexachlorocyclopentadiene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Hexachloroethane	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Hexachloropropene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Indene	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Indeno(1,2,3-cd)pyrene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Isodrin	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Isophorone	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Isosafrole	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Methyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Methyl parathion (Parathion, methyl)	NELAP	PA	05/25/2007
EPA 8270	C, D, E	N-Nitrosodi-n-butylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosodi-n-propylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosodiethylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosodimethylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosodiphenylamine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosomethylethylamine	NELAP	PA	12/12/2005

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	N-Nitrosomorpholine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosopiperidine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	N-Nitrosopyrrolidine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Naphthalene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Nitrobenzene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	O,O,O-Triethyl phosphorothioate	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	05/25/2007
EPA 8270	C, D, E	Pentachlorobenzene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Pentachloronitrobenzene (PCNB)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Pentachlorophenol (PCP)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Phenacetin	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Phenanthrene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Phenol	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Phorate (Thimet)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Pronamide (Kerb)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Pyrene	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Pyridine	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Quinoline	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Safrole	NELAP	PA	12/12/2005
EPA 8270	C, D, E	Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	04/17/2009
EPA 8270	C, D, E	Thionazine (Thionazin, Zinophos)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	bis(2-Chloroethoxy)methane	NELAP	PA	12/12/2005
EPA 8270	C, D, E	bis(2-Chloroethyl) ether	NELAP	PA	12/12/2005
EPA 8270	C, D, E	bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	12/12/2005
EPA 8270	C, D, E	p-(Dimethylamino)azobenzene	NELAP	PA	04/17/2009
EPA 8270 SIM	E	SOCs by GC/MS	NELAP	PA	09/29/2020
EPA 8270 SIM	C, D, E	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	08/01/2018
EPA 8270 SIM	C, D, E	1-Methylnaphthalene	NELAP	PA	07/25/2011
EPA 8270 SIM	C, D, E	2-Methylnaphthalene	NELAP	PA	05/23/2012
EPA 8270 SIM	C, D, E	Acenaphthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Acenaphthylene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[a]anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[a]pyrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[b]fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[ghi]perylene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[k]fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Dibenzo[a,h]anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Fluorene	NELAP	PA	12/04/2007

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270 SIM	C, D, E	Indeno(1,2,3-cd)pyrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Naphthalene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Phenanthrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Pyrene	NELAP	PA	12/04/2007
EPA 8290	A	PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	03/04/2015
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	03/26/2012
EPA 8290	A	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	08/06/2010
EPA 8290	A	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	08/06/2010
EPA 8290	A	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total TCDD	NELAP	PA	06/30/2010
EPA 8290	A	Total TCDF	NELAP	PA	06/30/2010
EPA 8290	A	Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	03/26/2012
EPA 8315		Carbonyl compounds by HPLC	NELAP	PA	12/12/2005
EPA 8315	A	2,5-Dimethylbenzaldehyde	NELAP	PA	12/12/2005
EPA 8315	A	Acetaldehyde	NELAP	PA	12/12/2005
EPA 8315	A	Formaldehyde	NELAP	PA	12/12/2005
EPA 8330	B	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	07/29/2015
EPA 8330	B	1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8330	B	1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8330	B	2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	12/12/2005
EPA 8330	B	2,4-Diamino-6-nitrotoluene	NELAP	PA	07/29/2015
EPA 8330	B	2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	06/11/2007
EPA 8330	B	2,6-Diamino-4-nitrotoluene	NELAP	PA	07/29/2015
EPA 8330	B	2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	06/11/2007
EPA 8330	B	2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330	B	2-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330	B	3,5-Dinitroaniline	NELAP	PA	07/29/2015
EPA 8330	B	3-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330	B	4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330	B	4-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330	B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	12/12/2005
EPA 8330	B	Nitrobenzene	NELAP	PA	06/11/2007
EPA 8330	B	Nitroglycerin	NELAP	PA	01/24/2007
EPA 8330	B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	12/12/2005
EPA 8330	B	Pentaerythritol tetranitrate (PETN)	NELAP	PA	05/02/2006
EPA 8330	B	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	12/12/2005
EPA 9012	A, B	Total cyanide	NELAP	PA	05/24/2011
EPA 9040	C	pH	NELAP	PA	12/12/2005
EPA 9050	A	Conductivity	NELAP	PA	01/27/2014
EPA 9050		Conductivity	NELAP	PA	12/12/2005
EPA 9056	A	Anions by IC	NELAP	PA	03/19/2015
EPA 9056	A	Bromide	NELAP	PA	12/12/2005
EPA 9056	A	Chloride	NELAP	PA	12/12/2005
EPA 9056	A	Fluoride	NELAP	PA	12/12/2005
EPA 9056	A	Nitrate as N	NELAP	PA	12/12/2005
EPA 9056	A	Nitrite as N	NELAP	PA	01/19/2005
EPA 9056	A	Sulfate	NELAP	PA	12/12/2005
EPA 9060	A	Total organic carbon (TOC)	NELAP	PA	12/12/2005
EPA 9066		Total phenolics	NELAP	PA	12/12/2005
HACH 10360	1.2	Oxygen (dissolved)	NELAP	PA	06/01/2020
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	07/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	07/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	1.1	C9-C10 Aromatics	NELAP	PA	07/29/2015
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	2.1	C5-C8 Aliphatics	NELAP	PA	07/16/2018
MA DEP VPH	2.1	C9-C10 Aromatics	NELAP	PA	07/16/2018
MA DEP VPH	2.1	C9-C12 Aliphatics	NELAP	PA	07/16/2018

Annmarie Beach

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
OIA 1677-09		Available cyanide	NELAP	PA	10/09/2013
OIA 1677-09		Free cyanide	NELAP	PA	10/09/2013
RSK-175		Acetylene (Ethyne)	NELAP	PA	01/20/2012
RSK-175		Carbon dioxide	NELAP	PA	11/19/2015
RSK-175		Ethane	NELAP	PA	06/29/2010
RSK-175		Ethene	NELAP	PA	06/29/2010
RSK-175		Isobutane (2-Methylpropane)	NELAP	PA	11/19/2015
RSK-175		Methane	NELAP	PA	06/29/2010
RSK-175		Propane	NELAP	PA	06/29/2010
RSK-175		n-Butane	NELAP	PA	12/22/2011
SM 2120 B		Color	NELAP	PA	07/21/2020
SM 2310 B		Acidity as CaCO3	NELAP	PA	03/27/2018
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	01/19/2005
SM 2340 C		Total hardness as CaCO3	NELAP	PA	04/17/2007
SM 2510 B		Conductivity	NELAP	PA	12/12/2005
SM 2540 B		Residue, total	NELAP	PA	04/17/2007
SM 2540 C		Residue, filterable (TDS)	NELAP	PA	04/17/2007
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	04/17/2007
SM 2540 F		Residue, settleable	NELAP	PA	04/17/2007
SM 2550 B		Temperature, deg. C	NELAP	PA	08/30/2019
SM 3500-Cr B	20-22	Chromium VI	NELAP	PA	05/24/2007
SM 3500-Fe B	20-22	Ferrous iron	NELAP	PA	06/15/2009
SM 4500-Cl F		Total residual chlorine	NELAP	PA	01/11/2012
SM 4500-Cl- C		Chloride	NELAP	PA	04/17/2007
SM 4500-F- B		Preliminary distillation of fluoride	NELAP	PA	04/28/2010
SM 4500-F- C		Fluoride	NELAP	PA	01/19/2005
SM 4500-H+ B		pH	NELAP	PA	04/17/2007
SM 4500-NH3 B		Ammonia distillation	NELAP	PA	04/17/2007
SM 4500-NH3 C		Ammonia as N	NELAP	PA	07/05/2018
SM 4500-NH3 D		Ammonia as N	NELAP	PA	04/17/2007
SM 4500-O G		Oxygen (dissolved)	NELAP	PA	04/17/2007
SM 4500-P B		Preliminary treatment of phosphate samples	NELAP	PA	04/28/2010
SM 4500-P E		Orthophosphate as P	NELAP	PA	06/25/2020
SM 4500-P F		Phosphorus, total	NELAP	PA	07/21/2020
SM 4500-S2- D		Sulfide	NELAP	PA	04/17/2007
SM 4500-S2- F		Sulfide	NELAP	PA	04/17/2007
SM 4500-SO3 B		Sulfite, SO3	NELAP	PA	04/17/2007
SM 4500-SiO2 C	20-22	Silica, as SiO2	NELAP	PA	05/25/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	05/24/2007
SM 5210 B		Biochemical oxygen demand (BOD)	NELAP	PA	04/04/2005

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
SM 5210 B		Carbonaceous BOD (CBOD)	NELAP	PA	05/14/2018
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	05/24/2007
SM 5540 C		Surfactants as MBAS	NELAP	PA	04/17/2007
SOP (00037) T-PFAS-WI14355	13	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	1H, 1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	1H, 1H, 2H, 2H-Perfluorododecane sulfonic acid (10:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	1H, 1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	1H, 1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Hexafluoropropylene oxide dimer acid (HFPO-DA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	N-Ethylperfluorooctanesulfonamide (EtFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	N-Methylperfluorooctanesulfonamide (MeFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	N-ethylperfluoro-1-octanesulfonamido ethanol (N-EtFOSE)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	N-methylperfluoro-1-octanesulfonamido ethanol (N-MeFOSE)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorobutanoic acid (PFBA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorodecane sulfonic acid (PFDS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorodecanoic acid (PFDA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorododecane sulfonic acid (PFDoS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorododecanoic acid (PFDoA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluoroheptanesulfonic acid (PFHpS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluoroheptanoic acid (PFHpA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorohexadecanoic acid (PFHxDA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorohexanoic acid (PFHxA)	NELAP	PA	11/03/2020

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ED_006371_00001599-00685

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
SOP (00037) T-PFAS-WI14355	13	Perfluorononane sulfonic acid (PFNS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorononanoic acid (PFNA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorooctadecanoic acid (PFODA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorooctane sulfonamide (PFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorooctanoic acid (PFOA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluoropentane sulfonic acid (PFPeS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluoropentanoic acid (PFPeA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorotetradecanoic acid (PFTA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluorotridecanoic acid (PFTrDA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	Perfluoroundecanoic acid (PFUnA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	n-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI14355	13	n-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NELAP	PA	11/03/2020
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
AK-103		Residual-range organics (RRO)	NELAP	PA	03/19/2015
ASTM D3987-12		Shake extraction of solid waste with water	NELAP	PA	08/30/2019
ASTM D3987-85		Shake extraction of solid waste with water	NELAP	PA	07/21/2017
EPA 1010	A	Ignitability	NELAP	PA	11/19/2015
EPA 1010		Ignitability	NELAP	PA	01/19/2005
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	07/05/2018

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	07/05/2018
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	07/05/2018
EPA 1613	B	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	07/05/2018
EPA 1613	B	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	07/05/2018
EPA 1613	B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	07/05/2018
EPA 1613	B	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	07/05/2018
EPA 1668	A, C	PCBs as congeners by HRGC/HRMS	NELAP	PA	03/04/2015
EPA 1668	A, C	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012

Annmarie Beach

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012

Annmarie Beach

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668	A, C	2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668	A, C	2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 1668	A, C	3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4',5-Trichlorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4,5-Trichlorobiphenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668	A, C	3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668	A, C	3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668	A, C	4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668	A, C	4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668	A, C	Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 300.0	2.1	Bromide	NELAP	PA	03/09/2016
EPA 300.0	2.1	Chloride	NELAP	PA	11/27/2019
EPA 300.0	2.1	Fluoride	NELAP	PA	10/16/2012
EPA 300.0	2.1	Nitrate as N	NELAP	PA	11/27/2019
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/16/2012
EPA 300.0	2.1	Sulfate	NELAP	PA	10/16/2012
EPA 3050	B	Acid digestion of solids	NELAP	PA	04/04/2005
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	04/04/2005
EPA 351.2		Kjeldahl nitrogen, total (TKN)	NELAP	PA	08/30/2019
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	04/04/2005
EPA 3540	C	Soxhlet extraction	NELAP	PA	04/04/2005
EPA 3546		Microwave extraction	NELAP	PA	09/25/2009
EPA 3550	B	Ultrasonic extraction	NELAP	PA	04/04/2005
EPA 3550	C	Ultrasonic extraction	NELAP	PA	03/04/2015
EPA 3580	A	Waste dilution	NELAP	PA	06/25/2020
EPA 3620	B	Florisil cleanup	NELAP	PA	04/04/2005
EPA 3620	C	Florisil cleanup	NELAP	PA	09/04/2018
EPA 3630	C	Silica gel cleanup	NELAP	PA	04/04/2005
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	04/04/2005
EPA 365.1		Phosphorus, total	NELAP	PA	11/19/2015
EPA 3660	B	Sulfur cleanup	NELAP	PA	04/04/2005
EPA 3665	A	Sulfuric acid/permanganate clean-up	NELAP	PA	04/04/2005
EPA 5030		Bulk purge-and-trap (methanol)	NELAP	PA	12/04/2007
EPA 5035	A	Closed-system purge-and-trap (bisulfate option)	NELAP	PA	09/04/2018

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 5035	A	Closed-system purge-and-trap (methanol option)	NELAP	PA	09/04/2018
EPA 5035	A	Closed-system purge-and-trap (unpreserved)	NELAP	PA	09/04/2018
EPA 5035		Closed-system purge-and-trap (bisulfate option)	NELAP	PA	12/12/2005
EPA 5035		Closed-system purge-and-trap (methanol option)	NELAP	PA	04/04/2005
EPA 5035		Closed-system purge-and-trap (unpreserved)	NELAP	PA	04/04/2005
EPA 6010	B, C	Metals by ICP/AES	NELAP	PA	03/26/2012
EPA 6010	D	Metals by ICP/AES	NELAP	PA	07/09/2018
EPA 6010	B, C, D	Aluminum	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Antimony	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Arsenic	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Barium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Beryllium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Boron	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Cadmium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Calcium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Chromium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Cobalt	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Copper	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Iron	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Lead	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Lithium	NELAP	PA	01/20/2012
EPA 6010	B, C, D	Magnesium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Manganese	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Molybdenum	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Nickel	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Potassium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Selenium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Silica, as SiO2	NELAP	PA	01/20/2012
EPA 6010	B, C, D	Silver	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Sodium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Strontium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Sulfur	NELAP	PA	12/19/2011
EPA 6010	B, C, D	Tellurium	NELAP	PA	02/04/2016
EPA 6010	B, C, D	Thallium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Thorium	NELAP	PA	11/19/2015
EPA 6010	B, C, D	Tin	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Titanium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Tungsten	NELAP	PA	11/19/2015
EPA 6010	B, C, D	Vanadium	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Zinc	NELAP	PA	01/19/2005
EPA 6010	B, C, D	Zirconium	NELAP	PA	07/29/2015
EPA 6020	A	Metals by ICP/MS	NELAP	PA	03/26/2012

Annmarie Beach

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Laboratory Scope of Accreditation

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(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 6020	B	Metals by ICP/MS	NELAP	PA	07/09/2018
EPA 6020		Metals by ICP/MS	NELAP	PA	01/19/2005
EPA 6020	A, B	Aluminum	NELAP	PA	04/29/2010
EPA 6020	A, B	Antimony	NELAP	PA	01/19/2005
EPA 6020	A, B	Arsenic	NELAP	PA	01/19/2005
EPA 6020	A, B	Barium	NELAP	PA	01/20/2012
EPA 6020	A, B	Beryllium	NELAP	PA	01/19/2005
EPA 6020	A, B	Cadmium	NELAP	PA	01/19/2005
EPA 6020	A, B	Calcium	NELAP	PA	04/29/2010
EPA 6020	A, B	Chromium	NELAP	PA	01/19/2005
EPA 6020	A, B	Cobalt	NELAP	PA	04/29/2010
EPA 6020	A, B	Copper	NELAP	PA	01/19/2005
EPA 6020	A, B	Iron	NELAP	PA	04/29/2010
EPA 6020	A, B	Lead	NELAP	PA	01/19/2005
EPA 6020	A, B	Magnesium	NELAP	PA	04/29/2010
EPA 6020	A, B	Manganese	NELAP	PA	04/29/2010
EPA 6020	A, B	Molybdenum	NELAP	PA	07/25/2011
EPA 6020	A, B	Nickel	NELAP	PA	04/04/2005
EPA 6020	A, B	Potassium	NELAP	PA	04/29/2010
EPA 6020	A, B	Selenium	NELAP	PA	04/04/2005
EPA 6020	A, B	Silver	NELAP	PA	02/23/2010
EPA 6020	A, B	Sodium	NELAP	PA	04/29/2010
EPA 6020	A, B	Strontium	NELAP	PA	04/29/2010
EPA 6020	A, B	Thallium	NELAP	PA	01/19/2005
EPA 6020	A, B	Tin	NELAP	PA	04/29/2010
EPA 6020	A, B	Titanium	NELAP	PA	04/29/2010
EPA 6020	A, B	Uranium (mass)	NELAP	PA	11/19/2015
EPA 6020	A, B	Vanadium	NELAP	PA	01/07/2010
EPA 6020	A, B	Zinc	NELAP	PA	02/01/2011
EPA 680		Decachlorobiphenyl	NELAP	PA	01/19/2016
EPA 680		Dichlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Heptachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Hexachlorbiphenyls	NELAP	PA	01/19/2016
EPA 680		Monochlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Nonachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Octachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Pentachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Tetrachlorobiphenyls	NELAP	PA	01/19/2016
EPA 680		Trichlorobiphenyls	NELAP	PA	01/19/2016
EPA 6850		Perchlorate	NELAP	PA	01/19/2011
EPA 7.3.3.2		Reactive cyanide	NELAP	PA	12/12/2005
EPA 7.3.4.2		Reactive sulfide	NELAP	PA	12/12/2005

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 7196	A	Chromium VI	NELAP	PA	07/09/2018
EPA 7199		Chromium VI	NELAP	PA	05/02/2006
EPA 7471	A, B	Mercury	NELAP	PA	10/17/2007
EPA 8011		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	07/05/2018
EPA 8011		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	07/09/2018
EPA 8015	B, C	Nonhalogenated organics by GC/FID	NELAP	PA	03/26/2012
EPA 8015	D	Nonhalogenated organics by GC/FID	NELAP	PA	07/29/2015
EPA 8015	B, C, D	Diesel-range organics (DRO)	NELAP	PA	04/04/2005
EPA 8015	B, C, D	Ethanol	NELAP	PA	01/19/2005
EPA 8015	B, C, D	Ethylene glycol	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Gasoline-range organics (GRO)	NELAP	PA	04/04/2005
EPA 8015	B, C, D	Isopropyl alcohol (2-Propanol)	NELAP	PA	12/04/2007
EPA 8015	B, C, D	Methanol	NELAP	PA	01/19/2005
EPA 8015	B, C, D	Triethylene glycol	NELAP	PA	07/05/2018
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	03/26/2012
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	01/01/2013
EPA 8081	A, B	2,4'-DDD	NELAP	PA	11/19/2015
EPA 8081	A, B	2,4'-DDE	NELAP	PA	11/19/2015
EPA 8081	A, B	2,4'-DDT	NELAP	PA	11/19/2015
EPA 8081	A, B	4,4'-DDD	NELAP	PA	01/19/2005
EPA 8081	A, B	4,4'-DDE	NELAP	PA	01/19/2005
EPA 8081	A, B	4,4'-DDT	NELAP	PA	01/19/2005
EPA 8081	A, B	Aldrin (HHDN)	NELAP	PA	01/19/2005
EPA 8081	A, B	Chlordane (tech.)	NELAP	PA	01/19/2005
EPA 8081	A, B	Dieldrin	NELAP	PA	01/19/2005
EPA 8081	A, B	Endosulfan I	NELAP	PA	01/19/2005
EPA 8081	A, B	Endosulfan II	NELAP	PA	01/19/2005
EPA 8081	A, B	Endosulfan sulfate	NELAP	PA	01/19/2005
EPA 8081	A, B	Endrin	NELAP	PA	01/19/2005
EPA 8081	A, B	Endrin aldehyde	NELAP	PA	01/19/2005
EPA 8081	A, B	Endrin ketone	NELAP	PA	01/19/2005
EPA 8081	A, B	Heptachlor	NELAP	PA	01/19/2005
EPA 8081	A, B	Heptachlor epoxide	NELAP	PA	01/19/2005
EPA 8081	A, B	Kepone	NELAP	PA	01/19/2005
EPA 8081	A, B	Methoxychlor	NELAP	PA	01/19/2005
EPA 8081	A, B	Mirex	NELAP	PA	01/19/2005
EPA 8081	A, B	Toxaphene (Chlorinated camphene)	NELAP	PA	01/19/2005
EPA 8081	A, B	alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	01/19/2005
EPA 8081	A, B	alpha-Chlordane	NELAP	PA	04/04/2005
EPA 8081	A, B	beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	01/19/2005
EPA 8081	A, B	delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	01/19/2005

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8081	A, B	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	01/19/2005
EPA 8081	A, B	gamma-Chlordane	NELAP	PA	04/04/2005
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	03/26/2012
EPA 8082		PCBs by GC/ECD	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1016 (PCB-1016)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1016 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1221 (PCB-1221)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1221 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1232 (PCB-1232)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1232 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1242 (PCB-1242)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1242 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1248 (PCB-1248)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1248 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1254 (PCB-1254)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1254 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1260 (PCB-1260)	NELAP	PA	01/02/2007
EPA 8082	A	Aroclor-1260 (in oil)	NELAP	PA	07/09/2018
EPA 8082	A	Aroclor-1262 (PCB-1262)	NELAP	PA	07/23/2008
EPA 8082	A	Aroclor-1268 (PCB-1268)	NELAP	PA	07/23/2008
EPA 8082	A	Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	03/26/2012
EPA 8151	A	2,4,5-T	NELAP	PA	01/19/2005
EPA 8151	A	2,4,5-TP (Silvex)	NELAP	PA	01/19/2005
EPA 8151	A	2,4-D	NELAP	PA	01/19/2005
EPA 8151	A	2,4-DB (Butoxon)	NELAP	PA	04/04/2005
EPA 8151	A	Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	01/19/2005
EPA 8151	A	Dicamba	NELAP	PA	01/19/2005
EPA 8151	A	Dichloroprop (Dichlorprop)	NELAP	PA	01/19/2005
EPA 8151	A	Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	01/19/2005
EPA 8151	A	MCPA	NELAP	PA	01/19/2005
EPA 8151	A	MCPP (Mecoprop)	NELAP	PA	05/02/2006
EPA 8151	A	Pentachlorophenol (PCP)	NELAP	PA	01/19/2005
EPA 8151	A	Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	01/19/2005
EPA 8260	B, C	VOCs by GC/MS	NELAP	PA	03/26/2012
EPA 8260	D	VOCs by GC/MS	NELAP	PA	11/04/2019
EPA 8260	B, C	2-Chloroethyl vinyl ether	NELAP	PA	01/19/2005
EPA 8260	B, C	3,3'-Dimethyl-1-butanol	NELAP	PA	04/17/2009
EPA 8260	B, C	4-Chloro-2-nitrophenol	NELAP	PA	05/02/2006
EPA 8260	B, C	Crotonaldehyde	NELAP	PA	10/30/2014

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	01/04/2006
EPA 8260	B, C	Ethylene oxide	NELAP	PA	10/30/2014
EPA 8260	B, C	Gasoline-range organics (GRO)	NELAP	PA	06/08/2006
EPA 8260	B, C	tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	04/17/2009
EPA 8260	B, C	tert-Butyl ethyl ether	NELAP	PA	05/25/2007
EPA 8260	B, C	tert-Butyl formate	NELAP	PA	04/17/2009
EPA 8260	B, C, D	1,1,1,2-Tetrachloroethane	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,1,1-Trichloroethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,1,2,2-Tetrachloroethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	05/02/2006
EPA 8260	B, C, D	1,1,2-Trichloroethane	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,1-Dichloroethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,1-Dichloropropene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,2,3-Trichlorobenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2,3-Trimethylbenzene	NELAP	PA	09/04/2018
EPA 8260	B, C, D	1,2,4-Trichlorobenzene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2,4-Trimethylbenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2-Dichloroethane	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,2-Dichloropropane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,3,5-Trimethylbenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,3-Dichloropropane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	2,2-Dichloropropane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	2-Chlorotoluene	NELAP	PA	05/02/2006
EPA 8260	B, C, D	2-Hexanone	NELAP	PA	06/25/2020
EPA 8260	B, C, D	2-Nitropropane	NELAP	PA	12/17/2012
EPA 8260	B, C, D	4-Chlorotoluene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	4-Methyl-2-pentanone (MIBK)	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Acetone	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Acetonitrile	NELAP	PA	01/04/2006
EPA 8260	B, C, D	Acrolein (Propenal)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Acrylonitrile	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Allyl chloride (3-Chloropropene)	NELAP	PA	01/19/2005

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Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C, D	Benzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Benzyl chloride	NELAP	PA	01/04/2006
EPA 8260	B, C, D	Bromobenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Bromochloromethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Bromodichloromethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Bromoform	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Carbon disulfide	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Carbon tetrachloride	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Chlorobenzene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Chloroethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Chloroform	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	04/17/2009
EPA 8260	B, C, D	Cyclohexane	NELAP	PA	06/29/2010
EPA 8260	B, C, D	Cyclohexanone	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Dibromochloromethane	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Dibromomethane	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Dichlorodifluoromethane (Freon 12)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Diisopropyl ether (DIPE)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Ethanol	NELAP	PA	01/04/2006
EPA 8260	B, C, D	Ethyl acetate	NELAP	PA	01/04/2006
EPA 8260	B, C, D	Ethyl methacrylate	NELAP	PA	01/04/2006
EPA 8260	B, C, D	Ethyl tert-butyl ether (ETBE)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Ethylbenzene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	Isopropyl alcohol (2-Propanol)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Isopropylbenzene (Cumene)	NELAP	PA	08/07/2005
EPA 8260	B, C, D	Methacrylonitrile	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Methyl acetate	NELAP	PA	06/29/2010
EPA 8260	B, C, D	Methyl bromide (Bromomethane)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Methyl chloride (Chloromethane)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Methyl iodide (Iodomethane)	NELAP	PA	05/02/2006
EPA 8260	B, C, D	Methyl tert-butyl ether (MTBE)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Methylcyclohexane	NELAP	PA	01/21/2009
EPA 8260	B, C, D	Methylene chloride (Dichloromethane)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Methylmethacrylate	NELAP	PA	05/02/2006
EPA 8260	B, C, D	Naphthalene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Pentachloroethane	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Propionitrile (Ethyl cyanide)	NELAP	PA	01/24/2007
EPA 8260	B, C, D	Styrene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Tetrahydrofuran (THF)	NELAP	PA	06/07/2012

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DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8260	B, C, D	Toluene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Trichlorofluoromethane (Freon 11)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Vinyl acetate	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Vinyl chloride (Chloroethene)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	Xylenes, total	NELAP	PA	01/19/2005
EPA 8260	B, C, D	cis-1,2-Dichloroethene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	cis-1,3-Dichloropropene	NELAP	PA	06/25/2020
EPA 8260	B, C, D	m+p-Xylene	NELAP	PA	01/24/2007
EPA 8260	B, C, D	n-Butyl acetate	NELAP	PA	01/19/2016
EPA 8260	B, C, D	n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	n-Butylbenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	n-Hexane	NELAP	PA	09/04/2018
EPA 8260	B, C, D	n-Propylbenzene	NELAP	PA	01/04/2006
EPA 8260	B, C, D	o-Xylene	NELAP	PA	01/24/2007
EPA 8260	B, C, D	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	01/24/2007
EPA 8260	B, C, D	sec-Butylbenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	tert-Amyl methyl ether (TAME)	NELAP	PA	07/03/2007
EPA 8260	B, C, D	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	01/19/2005
EPA 8260	B, C, D	tert-Butylbenzene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	trans-1,2-Dichloroethene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	trans-1,3-Dichloropropene	NELAP	PA	01/19/2005
EPA 8260	B, C, D	trans-1,4-Dichloro-2-butene	NELAP	PA	07/03/2007
EPA 8260	D	2-Chloroethyl vinyl ether	NELAP	PA	05/01/2020
EPA 8260 SIM	B, C	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	04/17/2009
EPA 8270	C, D	SOCs by GC/MS	NELAP	PA	03/26/2012
EPA 8270	E	SOCs by GC/MS	NELAP	PA	06/25/2020
EPA 8270	C, D	1,2,3,4-Tetrachlorobenzene	NELAP	PA	07/03/2007
EPA 8270	C, D	1,2,3,4-Tetrahydronaphthalene	NELAP	PA	12/04/2007
EPA 8270	C, D	1,2,3,5-Tetrachlorobenzene	NELAP	PA	07/03/2007
EPA 8270	C, D	1,2-Dinitrobenzene (1,2-DNB)	NELAP	PA	01/19/2005
EPA 8270	C, D	1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	01/04/2006
EPA 8270	C, D	1,4-Phenylenediamine	NELAP	PA	01/19/2005
EPA 8270	C, D	3,3'-Dimethoxybenzidine	NELAP	PA	04/17/2009
EPA 8270	C, D	Aramite	NELAP	PA	05/17/2005
EPA 8270	C, D	Benzenethiol	NELAP	PA	12/04/2007
EPA 8270	C, D	Disulfoton	NELAP	PA	07/01/2007
EPA 8270	C, D	Famphur	NELAP	PA	05/02/2006
EPA 8270	C, D	Kepone	NELAP	PA	05/02/2006
EPA 8270	C, D	Malononitrile	NELAP	PA	05/23/2013
EPA 8270	C, D	Methapyrilene	NELAP	PA	01/19/2005
EPA 8270	C, D	N,N-Dimethylacetamide	NELAP	PA	12/04/2007

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D	N,N-Dimethylformamide	NELAP	PA	12/04/2007
EPA 8270	C, D	Phthalic anhydride	NELAP	PA	01/21/2009
EPA 8270	C, D	Tetraethyl lead	NELAP	PA	03/07/2012
EPA 8270	C, D	a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	05/02/2006
EPA 8270	C, D	bis(2-Chloromethyl) ether	NELAP	PA	01/21/2009
EPA 8270	C, D	bis(2-Ethylhexyl) adipate (di(2-Ethylhexyl) adipate)	NELAP	PA	01/21/2009
EPA 8270	C, D	p-Chloronitrobenzene	NELAP	PA	01/21/2009
EPA 8270	C, D	tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	12/04/2007
EPA 8270	C, D, E	1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	12/04/2007
EPA 8270	C, D, E	1,2,4,5-Tetrachlorobenzene	NELAP	PA	04/04/2005
EPA 8270	C, D, E	1,2,4-Trichlorobenzene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1,2-Diphenylhydrazine	NELAP	PA	05/02/2006
EPA 8270	C, D, E	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/04/2007
EPA 8270	C, D, E	1,4-Naphthoquinone	NELAP	PA	01/19/2005
EPA 8270	C, D, E	1-Chloronaphthalene	NELAP	PA	01/04/2006
EPA 8270	C, D, E	1-Methylnaphthalene	NELAP	PA	12/04/2007
EPA 8270	C, D, E	1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	04/04/2005
EPA 8270	C, D, E	2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl) ether)	NELAP	PA	10/30/2014
EPA 8270	C, D, E	2,2'-oxybis(1-Chloropropane)	NELAP	PA	01/04/2006
EPA 8270	C, D, E	2,3,4,6-Tetrachlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4,5-Trichlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4,6-Trichlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4-Dichlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4-Dimethylphenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4-Dinitrophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,6-Dichlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Acetylaminofluorene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Chloronaphthalene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Chlorophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Methylnaphthalene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Methylphenol (o-Cresol)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	05/17/2005

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2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	2-Nitroaniline	NELAP	PA	04/04/2005
EPA 8270	C, D, E	2-Nitrophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	2-Picoline (2-Methylpyridine)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	3+4-Methylphenol (m+p-Cresol)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	3,3'-Dichlorobenzidine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	3,3'-Dimethylbenzidine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	3-Methylcholanthrene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	3-Nitroaniline	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Aminobiphenyl	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Bromophenyl phenyl ether	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Chloro-3-methylphenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Chloroaniline	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Chlorophenyl phenyl ether	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Nitroaniline	NELAP	PA	04/04/2005
EPA 8270	C, D, E	4-Nitrophenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	4-Nitroquinoline-1-oxide	NELAP	PA	07/03/2007
EPA 8270	C, D, E	5-Nitro-o-toluidine	NELAP	PA	04/04/2005
EPA 8270	C, D, E	6-Methylchrysene	NELAP	PA	12/04/2007
EPA 8270	C, D, E	7,12-Dimethylbenz(a)anthracene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Acenaphthene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Acenaphthylene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Acetophenone	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Aniline	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Anthracene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Atrazine	NELAP	PA	01/12/2007
EPA 8270	C, D, E	Benzaldehyde	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Benzidine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzo[a]anthracene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzo[a]pyrene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzo[b]fluoranthene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzo[ghi]perylene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzo[k]fluoranthene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzoic acid	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Benzyl alcohol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	05/17/2005
EPA 8270	C, D, E	Caprolactam	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Carbazole	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Chlorobenzilate	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Di-n-butyl phthalate	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Di-n-octyl phthalate	NELAP	PA	01/19/2005

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	Diallate (cis or trans)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Dibenz[a,h]acridine	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Dibenz[a,j]acridine	NELAP	PA	05/17/2005
EPA 8270	C, D, E	Dibenzo[a,h]anthracene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Dibenzofuran	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Diethyl phthalate	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Dimethoate	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Dimethyl phthalate	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Diphenylamine	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Ethyl methanesulfonate	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Fluoranthene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Fluorene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Hexachlorobenzene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Hexachlorocyclopentadiene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Hexachloroethane	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Hexachloropropene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Indene	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Indeno(1,2,3-cd)pyrene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Isodrin	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Isophorone	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Isosafrole	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Methyl methanesulfonate	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Methyl parathion (Parathion, methyl)	NELAP	PA	05/25/2007
EPA 8270	C, D, E	N-Nitrosodi-n-butylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosodi-n-propylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosodiethylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosodimethylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosodiphenylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosomethylethylamine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosomorpholine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosopiperidine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	N-Nitrosopyrrolidine	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Naphthalene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Nitrobenzene	NELAP	PA	01/04/2006
EPA 8270	C, D, E	O,O,O-Triethyl phosphorothioate	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	05/25/2007
EPA 8270	C, D, E	Pentachlorobenzene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Pentachloronitrobenzene (PCNB)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Pentachlorophenol (PCP)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Phenacetin	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Phenanthrene	NELAP	PA	01/19/2005

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Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8270	C, D, E	Phenol	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Phorate (Thimet)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	Pronamide (Kerb)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Pyrene	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Pyridine	NELAP	PA	04/04/2005
EPA 8270	C, D, E	Quinoline	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Safrole	NELAP	PA	01/19/2005
EPA 8270	C, D, E	Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	12/04/2007
EPA 8270	C, D, E	Thionazine (Thionazin, Zinophos)	NELAP	PA	05/02/2006
EPA 8270	C, D, E	bis(2-Chloroethoxy)methane	NELAP	PA	01/19/2005
EPA 8270	C, D, E	bis(2-Chloroethyl) ether	NELAP	PA	01/19/2005
EPA 8270	C, D, E	bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	01/19/2005
EPA 8270	C, D, E	p-(Dimethylamino)azobenzene	NELAP	PA	05/02/2006
EPA 8270 SIM	E	SOCs by GC/MS	NELAP	PA	09/29/2020
EPA 8270 SIM	C, D, E	1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	05/14/2018
EPA 8270 SIM	C, D, E	1-Methylnaphthalene	NELAP	PA	07/25/2011
EPA 8270 SIM	C, D, E	2-Methylnaphthalene	NELAP	PA	05/23/2012
EPA 8270 SIM	C, D, E	Acenaphthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Acenaphthylene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[a]anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[a]pyrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[b]fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[ghi]perylene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Benzo[k]fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Dibenzo[a,h]anthracene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Fluoranthene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Fluorene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Indeno(1,2,3-cd)pyrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Naphthalene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Phenanthrene	NELAP	PA	12/04/2007
EPA 8270 SIM	C, D, E	Pyrene	NELAP	PA	12/04/2007
EPA 8290	A	PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	03/04/2015
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	03/26/2012
EPA 8290	A	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	06/30/2010

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Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8290	A	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	08/06/2010
EPA 8290	A	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	06/30/2010
EPA 8290	A	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	08/06/2010
EPA 8290	A	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	06/30/2010
EPA 8290	A	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total TCDD	NELAP	PA	06/30/2010
EPA 8290	A	Total TCDF	NELAP	PA	06/30/2010
EPA 8290	A	Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	06/30/2010
EPA 8290	A	Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	06/30/2010
EPA 8290	A	Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	06/30/2010
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	03/26/2012
EPA 8315		Carbonyl compounds by HPLC	NELAP	PA	01/19/2005
EPA 8315	A	2,5-Dimethylbenzaldehyde	NELAP	PA	01/21/2009
EPA 8315	A	Acetaldehyde	NELAP	PA	01/21/2009
EPA 8315	A	Formaldehyde	NELAP	PA	01/19/2005
EPA 8318	A	3-Hydroxycarbofuran	NELAP	PA	04/04/2005
EPA 8318	A	Aldicarb (Temik)	NELAP	PA	04/04/2005
EPA 8318	A	Aldicarb sulfone	NELAP	PA	04/04/2005
EPA 8318	A	Aldicarb sulfoxide	NELAP	PA	12/12/2005
EPA 8318	A	Carbaryl (Sevin)	NELAP	PA	04/04/2005
EPA 8318	A	Carbofuran (Furaden)	NELAP	PA	04/04/2005
EPA 8318	A	Methiocarb (Mesurol)	NELAP	PA	04/04/2005
EPA 8318	A	Methomyl (Lannate)	NELAP	PA	04/04/2005
EPA 8318	A	N-Methylcarbamates by HPLC	NELAP	PA	10/15/2012
EPA 8318	A	Oxamyl (Vydate)	NELAP	PA	12/12/2005
EPA 8318	A	Propoxur (Baygon)	NELAP	PA	04/04/2005
EPA 8330	B	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	07/29/2015
EPA 8330	B	1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	01/19/2005
EPA 8330	B	1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	01/19/2005

Annmarie Beach

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
EPA 8330	B	2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	01/19/2005
EPA 8330	B	2,4-Diamino-6-nitrotoluene	NELAP	PA	07/29/2015
EPA 8330	B	2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	01/19/2005
EPA 8330	B	2,6-Diamino-4-nitrotoluene	NELAP	PA	07/29/2015
EPA 8330	B	2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	01/19/2005
EPA 8330	B	2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	01/19/2005
EPA 8330	B	2-Nitrotoluene	NELAP	PA	01/19/2005
EPA 8330	B	3,5-Dinitroaniline	NELAP	PA	07/29/2015
EPA 8330	B	3-Nitrotoluene	NELAP	PA	01/19/2005
EPA 8330	B	4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	01/19/2005
EPA 8330	B	4-Nitrotoluene	NELAP	PA	01/19/2005
EPA 8330	B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	01/19/2005
EPA 8330	B	Nitrobenzene	NELAP	PA	01/19/2005
EPA 8330	B	Nitroglycerin	NELAP	PA	10/09/2013
EPA 8330	B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	01/24/2006
EPA 8330	B	Pentaerythritol tetranitrate (PETN)	NELAP	PA	11/21/2005
EPA 8330	B	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	01/19/2005
EPA 9012	A, B	Total cyanide	NELAP	PA	05/24/2011
EPA 9045	C, D	pH	NELAP	PA	11/19/2008
EPA 9050	A	Conductivity	NELAP	PA	01/27/2014
EPA 9050		Conductivity	NELAP	PA	05/17/2005
EPA 9056	A	Anions by IC	NELAP	PA	07/05/2018
EPA 9056	A	Bromide	NELAP	PA	07/05/2018
EPA 9056	A	Chloride	NELAP	PA	11/27/2019
EPA 9056	A	Fluoride	NELAP	PA	07/05/2018
EPA 9056	A	Nitrate as N	NELAP	PA	11/27/2019
EPA 9056	A	Nitrite as N	NELAP	PA	07/05/2018
EPA 9056	A	Sulfate	NELAP	PA	07/05/2018
EPA 9071	B	Oil and grease	NELAP	PA	01/19/2005
EPA 9071	B	Total petroleum hydrocarbons (TPH)	NELAP	PA	11/19/2015
EPA 9095	A	Paint filter liquids test	NELAP	PA	01/24/2007
EPA 9095	B	Paint filter liquids test	NELAP	PA	11/19/2015
EPA Lloyd Kahn Method		Total organic carbon (TOC)	NELAP	PA	10/09/2013
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	07/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	07/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	1.1	C9-C10 Aromatics	NELAP	PA	07/15/2013
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	07/15/2013
MA DEP VPH	2.1	C5-C8 Aliphatics	NELAP	PA	07/16/2018

Annmarie Beach

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
MA DEP VPH	2.1	C9-C10 Aromatics	NELAP	PA	07/16/2018
MA DEP VPH	2.1	C9-C12 Aliphatics	NELAP	PA	07/16/2018
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
SM 2540 E		Fixed suspended solids	NELAP	PA	01/19/2016
SM 2540 E		Residue, volatile	NELAP	PA	01/19/2016
SM 2540 E		Volatile dissolved solids	NELAP	PA	01/19/2016
SM 2540 E		Volatile suspended solids	NELAP	PA	01/19/2016
SM 2540 G		Percent moisture in soil	NELAP	PA	11/19/2015
SM 2540 G		Residue, total	NELAP	PA	02/25/2014
SM 2540 G		Residue, volatile	NELAP	PA	11/19/2015
SM 2540 G		Total, fixed, and volatile residue	NELAP	PA	03/19/2015
SM 4500-NH3 B		Ammonia distillation	NELAP	PA	08/30/2019
SM 4500-NH3 C		Ammonia as N	NELAP	PA	08/30/2019
SM 5310 B		Total organic carbon (TOC)	NELAP	PA	10/09/2013
SOP (00037) T-PFAS-WI12031	10	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	1H, 1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	1H, 1H, 2H, 2H-Perfluorododecane sulfonic acid (10:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	1H, 1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	1H, 1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2-FTS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Hexafluoropropylene oxide dimer acid (HFPO-DA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	N-Ethylperfluorooctanesulfonamide (EtFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	N-Methylperfluorooctanesulfonamide (MeFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	N-ethylperfluoro-1-octanesulfonamido ethanol (N-EtFOSE)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	N-methylperfluoro-1-octanesulfonamido ethanol (N-MeFOSE)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorobutanesulfonic acid (PFBS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorobutanoic acid (PFBA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorodecane sulfonic acid (PFDS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorodecanoic acid (PFDA)	NELAP	PA	11/03/2020

Annmarie Beach

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 020-004 expiration date 01/31/2022. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2300

DEP Laboratory ID: 36-00037
EPA Lab Code: PA00009
TNI Code: TNI02128
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary State	Effective Date
SOP (00037) T-PFAS-WI12031	10	Perfluorododecane sulfonic acid (PFDoS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorododecanoic acid (PFDoA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluoroheptanesulfonic acid (PFHpS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluoroheptanoic acid (PFHpA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorohexadecanoic acid (PFHxDA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorohexanesulfonic acid (PFHxS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorohexanoic acid (PFHxA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorononane sulfonic acid (PFNS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorononanoic acid (PFNA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorooctadecanoic acid (PFODA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorooctane sulfonamide (PFOSA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorooctanesulfonic acid (PFOS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorooctanoic acid (PFOA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluoropentane sulfonic acid (PFPeS)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluoropentanoic acid (PFPeA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorotetradecanoic acid (PFTA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluorotridecanoic acid (PFTrDA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	Perfluoroundecanoic acid (PFUnA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	n-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NELAP	PA	11/03/2020
SOP (00037) T-PFAS-WI12031	10	n-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NELAP	PA	11/03/2020
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

Annmarie Beach

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

ED_006371_00001599-00707

JOHN BEL EDWARDS
GOVERNOR

CHUCK CARR BROWN, PH.D.
SECRETARY

State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

Read Receipt Requested

AI No. 83654
Activity No. ACC20200002
LELAP Lab ID # 03073
Accreditation Year FY 2021
Renewal due FY 2024

Ms. Terri Torres
Eurofins Frontier Global Sciences LLC
5755 8th St E
Tacoma, Washington 98424

Re: Scope of Accreditation

Dear Ms. Torres:

On June 18, 2020, the Louisiana Environmental Laboratory Accreditation Program (LELAP) received a request for an amendment to your Scope of Accreditation. LELAP amends the Scope issued June 15, 2020 and removes the parameters requested. Parameters removed are listed in the attached table.

The Louisiana Department of Environmental Quality's laboratory accreditation program, in accordance with Louisiana Administrative Code, Title 33, Part I, Subpart 3, Laboratory Accreditation, accredits this laboratory for Fiscal Year 2021. This accreditation does not constitute an endorsement of the suitability of the listed methods for any specific purpose. Accreditation of the environmental laboratory does not imply that a product, process, system, or person is approved by LELAP. The laboratory is accredited for the methods as identified on the application for accreditation; if the methods are partially identified on the application for accreditation, the laboratory is accredited for the versions listed on the current application or referenced in the laboratory standard operating procedure.

National Environmental Laboratory Accreditation Program (NELAP) accreditation is granted only for those methods/analytes for which "NELAP" is indicated as the type of accreditation. "STATE" is indicated as the type of accreditation for those methods/analytes for which accreditation by the Louisiana Environmental Laboratory Accreditation Program (LELAP) is granted. Accreditation is dependent on the laboratory's successful ongoing compliance with regulations as outlined in the Louisiana Administrative Code, Title 33, Part I, Subpart 3, Laboratory Accreditation, and with the standards adopted by the NELAP Accreditation Council.

The accreditation certificate is the property of the State of Louisiana. Should your accreditation be suspended or revoked, your laboratory must return the certificate of accreditation to the department and delete any electronic copies until your accreditation status is restored.

Louisiana Administrative Code, Title 33, Part I, Subpart 3, Laboratory Accreditation, and with the standards adopted by the NELAP Accreditation Council.

The accreditation certificate is the property of the State of Louisiana. Should your accreditation be suspended or revoked, your laboratory must return the certificate of accreditation to the department and delete any electronic copies until your accreditation status is restored.

LAC 33:I.5313.A and/or the 2009 TNI Standard require that the laboratory report include all relevant information. Therefore, the certificate number shall be placed in the upper right corner of all laboratory reports. If the test report includes results of any test for which the laboratory is not accredited, the unaccredited results must be clearly identified as such.

We request that you examine the scope of accreditation attachment for accuracy and completeness. If you find that an analyte for which you expected to be accredited is not listed, please examine your records to ensure that:

1. You have met the requirements for successful participation in proficiency test studies as outlined in LAC 33:I.4711 and in the 2009 TNI Standard.

2. In the case of accreditation by recognition, the requested analyte must be listed for the requested method and matrix on both the certificate issued by the Primary Accreditation Body ***and*** on the Louisiana application form.

If after reviewing this information, the scope and/or certificate are inaccurate, please notify us immediately.

If you have any questions, please contact your assigned assessor Mr. Joseph Kieffer, Environmental Scientist at (225) 219-3302.

Sincerely,

Paul Bergeron

Paul Bergeron
Environmental Scientist Manager
Permit Support and LELAP Section

8-13-2020
Date

CSN:PB:KHW:jk

STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY

Is hereby granting a Louisiana Environmental Laboratory Accreditation to

Eurofins Frontier Global Sciences LLC
5755 8th St E
Tacoma, Washington 98424

Agency Interest No. 83654
Activity No. ACC20200002

According to the Louisiana Administrative Code, Title 33, Part I, Subpart 3, LABORATORY ACCREDITATION, the State of Louisiana formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed in the attachment.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part I, Subpart 3 requirements and agrees to adapt to any changes in the requirements. It also acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part I and the 2009 TNI Standard by which the laboratory was assessed. Please contact the Department of Environmental Quality, Louisiana Environmental Laboratory Accreditation Program (LELAP) to verify the laboratory's scope of accreditation and accreditation status.

Accreditation by the State of Louisiana is not an endorsement or a guarantee of validity of the data generated by the laboratory. Accreditation of the environmental laboratory does not imply that a product, process, system, or person is approved by LELAP. To be accredited initially and maintain accreditation, the laboratory agrees to participate in two single-blind, single-concentration PT studies, where available, per year for each field of testing for which it seeks accreditation or maintains accreditation as required in LAC 33:I.4711.

Cheryl Sonnier Nolan
Administrator
Public Participation and Permit Support Services Division

Issued Date: 11 Aug 2020

Effective on Issue Date
Expiration Date: June 30, 2021
Certificate Number: 03073

ED_006371_00001599-00710

STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY

Effective Date: August 11, 2020

Eurofins Frontier Global Sciences LLC
AI Number: 83654
Activity No. ACC20200002
Expiration Date: June 30, 2021

5755 8th St E, Tacoma, Washington 98424

Certificate Number: 03073

Air Emissions

Analyte	Method Name	Method Code	Type	AB
1095 - Mercury	EPA 30B	10404203	NELAP	LA
3974 - Total Vapor Phase Mercury	EPA 30B	10404203	NELAP	LA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1000 - Aluminum	EPA 200.8	10014401	NELAP	LA
1005 - Antimony	EPA 200.8	10014401	NELAP	LA
1010 - Arsenic	EPA 200.8	10014401	NELAP	LA
1015 - Barium	EPA 200.8	10014401	NELAP	LA
1020 - Beryllium	EPA 200.8	10014401	NELAP	LA
1025 - Boron	EPA 200.8	10014401	NELAP	LA
1030 - Cadmium	EPA 200.8	10014401	NELAP	LA
1040 - Chromium	EPA 200.8	10014401	NELAP	LA
1050 - Cobalt	EPA 200.8	10014401	NELAP	LA
1055 - Copper	EPA 200.8	10014401	NELAP	LA
1075 - Lead	EPA 200.8	10014401	NELAP	LA
1090 - Manganese	EPA 200.8	10014401	NELAP	LA
1100 - Molybdenum	EPA 200.8	10014401	NELAP	LA
1105 - Nickel	EPA 200.8	10014401	NELAP	LA
1140 - Selenium	EPA 200.8	10014401	NELAP	LA
1150 - Silver	EPA 200.8	10014401	NELAP	LA
1165 - Thallium	EPA 200.8	10014401	NELAP	LA
1185 - Vanadium	EPA 200.8	10014401	NELAP	LA
1190 - Zinc	EPA 200.8	10014401	NELAP	LA
1000 - Aluminum	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1005 - Antimony	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1010 - Arsenic	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1015 - Barium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1020 - Beryllium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1025 - Boron	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1030 - Cadmium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1035 - Calcium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1040 - Chromium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1050 - Cobalt	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1055 - Copper	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1070 - Iron	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1075 - Lead	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1085 - Magnesium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1090 - Manganese	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1100 - Molybdenum	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1105 - Nickel	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1125 - Potassium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1140 - Selenium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1150 - Silver	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1155 - Sodium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1160 - Strontium	EPA 200.8, Rev.5.5	10014809	NELAP	LA

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

ED_006371_00001599-00711

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1165 - Thallium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1175 - Tin	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1180 - Titanium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1185 - Vanadium	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1190 - Zinc	EPA 200.8, Rev.5.5	10014809	NELAP	LA
1205 - Methyl Mercury	EPA 1630	10122608	NELAP	LA
1010 - Arsenic	EPA 1632	10123203	NELAP	LA
1000 - Aluminum	EPA 1638	10124002	NELAP	LA
1005 - Antimony	EPA 1638	10124002	NELAP	LA
1010 - Arsenic	EPA 1638	10124002	NELAP	LA
1015 - Barium	EPA 1638	10124002	NELAP	LA
1020 - Beryllium	EPA 1638	10124002	NELAP	LA
1025 - Boron	EPA 1638	10124002	NELAP	LA
1030 - Cadmium	EPA 1638	10124002	NELAP	LA
1035 - Calcium	EPA 1638	10124002	NELAP	LA
1040 - Chromium	EPA 1638	10124002	NELAP	LA
1050 - Cobalt	EPA 1638	10124002	NELAP	LA
1055 - Copper	EPA 1638	10124002	NELAP	LA
1070 - Iron	EPA 1638	10124002	NELAP	LA
1075 - Lead	EPA 1638	10124002	NELAP	LA
1085 - Magnesium	EPA 1638	10124002	NELAP	LA
1090 - Manganese	EPA 1638	10124002	NELAP	LA
1100 - Molybdenum	EPA 1638	10124002	NELAP	LA
1105 - Nickel	EPA 1638	10124002	NELAP	LA
1125 - Potassium	EPA 1638	10124002	NELAP	LA
1140 - Selenium	EPA 1638	10124002	NELAP	LA
1150 - Silver	EPA 1638	10124002	NELAP	LA
1155 - Sodium	EPA 1638	10124002	NELAP	LA
1160 - Strontium	EPA 1638	10124002	NELAP	LA
1165 - Thallium	EPA 1638	10124002	NELAP	LA
1175 - Tin	EPA 1638	10124002	NELAP	LA
1180 - Titanium	EPA 1638	10124002	NELAP	LA
1185 - Vanadium	EPA 1638	10124002	NELAP	LA
1190 - Zinc	EPA 1638	10124002	NELAP	LA
1010 - Arsenic	EPA 1640	10124400	NELAP	LA
1030 - Cadmium	EPA 1640	10124400	NELAP	LA
1040 - Chromium	EPA 1640	10124400	NELAP	LA
1050 - Cobalt	EPA 1640	10124400	NELAP	LA
1055 - Copper	EPA 1640	10124400	NELAP	LA
1075 - Lead	EPA 1640	10124400	NELAP	LA
1105 - Nickel	EPA 1640	10124400	NELAP	LA
1150 - Silver	EPA 1640	10124400	NELAP	LA
1190 - Zinc	EPA 1640	10124400	NELAP	LA
1095 - Mercury	EPA 1631E	10237204	NELAP	LA
1045 - Chromium VI	SM 3500-Cr B-2011	20066266	NELAP	LA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1205 - Methyl Mercury	EPA 1630	10122608	NELAP	LA
1095 - Mercury	EPA 1631B	10122802	NELAP	LA
1000 - Aluminum	EPA 1638	10124002	NELAP	LA
1005 - Antimony	EPA 1638	10124002	NELAP	LA
1010 - Arsenic	EPA 1638	10124002	NELAP	LA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1015 - Barium	EPA 1638	10124002	NELAP	LA
1020 - Beryllium	EPA 1638	10124002	NELAP	LA
1025 - Boron	EPA 1638	10124002	NELAP	LA
1030 - Cadmium	EPA 1638	10124002	NELAP	LA
1035 - Calcium	EPA 1638	10124002	NELAP	LA
1040 - Chromium	EPA 1638	10124002	NELAP	LA
1050 - Cobalt	EPA 1638	10124002	NELAP	LA
1055 - Copper	EPA 1638	10124002	NELAP	LA
1070 - Iron	EPA 1638	10124002	NELAP	LA
1075 - Lead	EPA 1638	10124002	NELAP	LA
1085 - Magnesium	EPA 1638	10124002	NELAP	LA
1090 - Manganese	EPA 1638	10124002	NELAP	LA
1100 - Molybdenum	EPA 1638	10124002	NELAP	LA
1105 - Nickel	EPA 1638	10124002	NELAP	LA
1125 - Potassium	EPA 1638	10124002	NELAP	LA
1140 - Selenium	EPA 1638	10124002	NELAP	LA
1150 - Silver	EPA 1638	10124002	NELAP	LA
1155 - Sodium	EPA 1638	10124002	NELAP	LA
1160 - Strontium	EPA 1638	10124002	NELAP	LA
1165 - Thallium	EPA 1638	10124002	NELAP	LA
1175 - Tin	EPA 1638	10124002	NELAP	LA
1180 - Titanium	EPA 1638	10124002	NELAP	LA
1185 - Vanadium	EPA 1638	10124002	NELAP	LA
1190 - Zinc	EPA 1638	10124002	NELAP	LA

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1095 - Mercury	EPA 1631B	10123009	NELAP	LA
1010 - Arsenic	EPA 1632	10123203	NELAP	LA
1005 - Antimony	EPA 1638	10124002	NELAP	LA
1010 - Arsenic	EPA 1638	10124002	NELAP	LA
1015 - Barium	EPA 1638	10124002	NELAP	LA
1020 - Beryllium	EPA 1638	10124002	NELAP	LA
1025 - Boron	EPA 1638	10124002	NELAP	LA
1030 - Cadmium	EPA 1638	10124002	NELAP	LA
1040 - Chromium	EPA 1638	10124002	NELAP	LA
1050 - Cobalt	EPA 1638	10124002	NELAP	LA
1055 - Copper	EPA 1638	10124002	NELAP	LA
1070 - Iron	EPA 1638	10124002	NELAP	LA
1075 - Lead	EPA 1638	10124002	NELAP	LA
1085 - Magnesium	EPA 1638	10124002	NELAP	LA
1090 - Manganese	EPA 1638	10124002	NELAP	LA
1100 - Molybdenum	EPA 1638	10124002	NELAP	LA
1105 - Nickel	EPA 1638	10124002	NELAP	LA
1125 - Potassium	EPA 1638	10124002	NELAP	LA
1140 - Selenium	EPA 1638	10124002	NELAP	LA
1150 - Silver	EPA 1638	10124002	NELAP	LA
1155 - Sodium	EPA 1638	10124002	NELAP	LA
1160 - Strontium	EPA 1638	10124002	NELAP	LA
1165 - Thallium	EPA 1638	10124002	NELAP	LA
1175 - Tin	EPA 1638	10124002	NELAP	LA
1180 - Titanium	EPA 1638	10124002	NELAP	LA
1185 - Vanadium	EPA 1638	10124002	NELAP	LA

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1190 - Zinc	EPA 1638	10124002	NELAP	LA
1205 - Methyl Mercury	FGS-070/CV-GC-AFS	60039705	NELAP	LA

Parameters removed from Eurofins Frontier Global Sciences LLC scope of accreditation:

LELAP

Mercury	FGS-136/CVAFS	AE
Aluminum	FGS-054/ICP-MS	NPW
Antimony	FGS-054/ICP-MS	NPW
Arsenic	FGS-054/ICP-MS	NPW
Barium	FGS-054/ICP-MS	NPW
Beryllium	FGS-054/ICP-MS	NPW
Boron	FGS-054/ICP-MS	NPW
Cadmium	FGS-054/ICP-MS	NPW
Calcium	FGS-054/ICP-MS	NPW
Calcium hardness as CaCO3	SM 2340 B	NPW
Calcium hardness as CaCO3	SM 2340 B-97	NPW
Calcium hardness as CaCO3	EPA 200.8	NPW
Chromium	FGS-054/ICP-MS	NPW
Chromium VI	EPA 7196A	NPW
Chromium VI	SM 3500-Cr B-97	NPW
Cobalt	FGS-054/ICP-MS	NPW
Copper	FGS-054/ICP-MS	NPW
Iron	FGS-054/ICP-MS	NPW
Lead	FGS-054/ICP-MS	NPW
Magnesium	FGS-054/ICP-MS	NPW
Mercury	FGS-069/CVAFS	NPW
Methyl Mercury	FGS-070/CV-GC-AFS	NPW
Molybdenum	FGS-054/ICP-MS	NPW
Nickel	FGS-054/ICP-MS	NPW
Potassium	FGS-054/ICP-MS	NPW
Selenium	FGS-054/ICP-MS	NPW
Silver	FGS-054/ICP-MS	NPW
Sodium	FGS-054/ICP-MS	NPW
Strontium	FGS-054/ICP-MS	NPW
Thallium	FGS-054/ICP-MS	NPW
Tin	FGS-054/ICP-MS	NPW
Titanium	FGS-054/ICP-MS	NPW
Total hardness as CaCO3	SM 2340 B	NPW
Total hardness as CaCO3	SM 2340 B-97	NPW
Total hardness as CaCO3	EPA 200.8	NPW
Vanadium	FGS-054/ICP-MS	NPW
Zinc	FGS-054/ICP-MS	NPW

Antimony	FGS-054/ICP-MS	SCM
Arsenic	FGS-054/ICP-MS	SCM
Barium	FGS-054/ICP-MS	SCM
Beryllium	FGS-054/ICP-MS	SCM
Boron	FGS-054/ICP-MS	SCM
Cadmium	FGS-054/ICP-MS	SCM
Calcium	FGS-054/ICP-MS	SCM
Chromium	FGS-054/ICP-MS	SCM
Cobalt	FGS-054/ICP-MS	SCM
Copper	FGS-054/ICP-MS	SCM
Iron	FGS-054/ICP-MS	SCM
Lead	FGS-054/ICP-MS	SCM
Magnesium	FGS-054/ICP-MS	SCM
Manganese	FGS-054/ICP-MS	SCM
Mercury	FGS-054/ICP-MS	SCM
Mercury	FGS-069/CVAFS	SCM
Methyl Mercury	FGS-070/CV-GC-AFS	SCM
Molybdenum	FGS-054/ICP-MS	SCM
Nickel	FGS-054/ICP-MS	SCM
Potassium	FGS-054/ICP-MS	SCM
Selenium	FGS-054/ICP-MS	SCM
Silver	FGS-054/ICP-MS	SCM
Sodium	FGS-054/ICP-MS	SCM
Strontium	FGS-054/ICP-MS	SCM
Thallium	FGS-054/ICP-MS	SCM
Tin	FGS-054/ICP-MS	SCM
Titanium	FGS-054/ICP-MS	SCM
Vanadium	FGS-054/ICP-MS	SCM
Zinc	FGS-054/ICP-MS	SCM
Antimony	FGS-054/ICP-MS	BT
Arsenic	FGS-054/ICP-MS	BT
Barium	FGS-054/ICP-MS	BT
Beryllium	FGS-054/ICP-MS	BT
Boron	FGS-054/ICP-MS	BT
Cadmium	FGS-054/ICP-MS	BT
Calcium	FGS-054/ICP-MS	BT
Chromium	FGS-054/ICP-MS	BT
Cobalt	FGS-054/ICP-MS	BT
Copper	FGS-054/ICP-MS	BT
Iron	FGS-054/ICP-MS	BT
Lead	FGS-054/ICP-MS	BT

Magnesium	FGS-054/ICP-MS	BT
Manganese	FGS-054/ICP-MS	BT
Mercury	FGS-054/ICP-MS	BT
Molybdenum	FGS-054/ICP-MS	BT
Nickel	FGS-054/ICP-MS	BT
Potassium	FGS-054/ICP-MS	BT
Selenium	FGS-054/ICP-MS	BT
Silver	FGS-054/ICP-MS	BT
Sodium	FGS-054/ICP-MS	BT
Strontium	FGS-054/ICP-MS	BT
Thallium	FGS-054/ICP-MS	BT
Tin	FGS-054/ICP-MS	BT
Titanium	FGS-054/ICP-MS	BT
Vanadium	FGS-054/ICP-MS	BT
Zinc	FGS-054/ICP-MS	BT