Sampling and Analysis Plan
for the
Remedial Investigation/Feasibility Study

Colonial Creosote
Bogalusa, Washington Parish, Louisiana
EPA Identification No. LAN000607134

Remedial Action Contract 2 Full Service
Contract: EP-W-06-004
Task Order: 0141-RICO-A6Z7

Prepared for

U.S. Environmental Protection Agency
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30 September 2016

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30 September 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

α	alpha
β	beta
µg/L	microgram(s) per liter
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COPC	chemical of potential concern
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
CSM	conceptual site model
DESR	Data Evaluation Summary Report
dioxins	polychlorinated dibenzodioxins
DQA	data quality assessment
DQO	data quality objective
Dynamac	Dynamac Corporation
EA	EA Engineering, Science, and Technology, Inc., PBC
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FS	Feasibility Study
furans	polychlorinated dibenzofurans
GPS	global positioning system
H_o	null hypothesis
H_a	alternative hypothesis
IDW	investigation-derived waste
LAC	Louisiana Administrative Code
LCS	laboratory control sample
LDEQ	Louisiana Department of Environmental Quality
MD	matrix duplicate
MDL	method detection limit
mg/kg	milligram(s) per kilogram
MS	matrix spike

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

MSD	matrix spike duplicate
ng/kg	nanogram(s) per kilogram
NPL	National Priorities List
NRCS	U.S. Department of Agriculture, Natural Resource Conservation Service
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	polychlorinated biphenyl
pg/L	picogram(s) per liter
PSQ	principal study question
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAC	Remedial Action Contract
RAGS	Risk Assessment Guidance for Superfund
RI	Remedial Investigation
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
Site	Colonial Creosote
SOP	standard operating procedure
SPLP	synthetic precipitation leaching procedure
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TOM	Task Order Monitor
VOC	volatile organic compound

DISTRIBUTION LIST

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1. PROJECT DESCRIPTION AND MANAGEMENT

EA Engineering, Science, and Technology, Inc., PBC (EA) has been authorized by the U.S. Environmental Protection Agency (EPA), under Remedial Action Contract (RAC) No. EP-W-06-004, Task Order 0141-RICO-A6Z7, to conduct a combined Remedial Investigation (RI)/Feasibility Study (FS) for the Colonial Creosote site (herein referred to as the site) located in Bogalusa, Louisiana. EA has prepared this Sampling and Analysis Plan (SAP), Revision 00 in accordance with: (1) specifications provided in the EPA Statement of Work dated 28 April 2016 (EPA 2016a); (2) the EPA-approved Work Plan dated 17 June 2016 (EA 2016a); and (3) technical direction from EPA during the conference call held on 8 September 2016. The project activities will be conducted under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

EPA has indicated that this task order will be incrementally funded; therefore, the scope of work discussed in this SAP will be implemented in phases as funding becomes available. This SAP has been developed with this strategy in mind and presents phases for field implementation. The field implementation phases can be combined or rearranged as directed by EPA to correspond with the available funding.

This SAP is a combined document including the information necessary for a Quality Assurance Project Plan (QAPP) and Field Sampling Plan. It details data collection methods, proposed sample locations and frequency, sampling equipment and procedures, and analytical methods required to collect sufficient data to perform an RI/FS for the site. Combining the QAPP and Field Sampling Plan into the SAP allows for a streamlined planning process, while ensuring that the data collected are of sufficient quality for the intended use.

Upon implementation, this SAP will be used in conjunction with the site-specific Health and Safety Plan (EA 2016b) and Site Management Plan (EA 2016c). The Health and Safety Plan specifies employee training, protective equipment, personal air monitoring procedures, medical surveillance requirements, standard operating procedures (SOPs), and contingency planning procedures. The Site Management Plan discusses site access, security, pollution control, contingency procedures, management responsibilities, and waste disposal.

This SAP was prepared in accordance with EA's Quality Management Plan (EA 2014) and meets requirements set forth in *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* (EPA 2001a) and *Guidance for Quality Assurance Project Plans (QA/G-5)* (EPA 2002a).

This SAP details the project specific data quality objectives (DQOs) and describes procedures to ensure that the DQOs are met and that the quality of data (represented by precision, accuracy, representativeness, completeness, comparability, and sensitivity [PARCCS]) is known and documented. The SAP presents the project description, project organization and responsibilities, and quality assurance (QA) objectives associated with the sampling and analytical services to be provided in support of the RI/FS. Table 1 demonstrates how this SAP complies with elements of a QAPP outlined in EPA guidance (EPA 2001a, 2002a).

TABLE 1. ELEMENTS OF EPA QA/R-5 IN RELATION TO THIS SAMPLING AND ANALYSIS PLAN

EPA QA/R-5 QAPP Element	EA SAP
A1 Title and Approval Sheet	Title and Approval Sheet
A2 Table of Contents	Table of Contents
A3 Distribution List	Distribution List
A4 Project/Task Organization	1.0 Project Description and Management
A5 Problem Definition/Background	1.1 Problem Definition and Background
A6 Project/Task Description	1.2 Description of Project Objectives and Tasks
A7 Quality Objectives and Criteria	1.3 Data Quality Objectives 1.4 Quality Assurance Objectives for Measurement Data
A8 Special Training/Certification	1.5 Special Training and Certification
A9 Documents and Records	1.6 Documents and Records
B1 Sampling Process Design	2.1 Sampling Process Design 2.2 Consent for Property Access
B2 Sampling Methods	2.3 Sampling Methodology 2.4 Sample Processing 2.7 Sample Designation
B3 Sample Handling and Custody	2.8 Sample Container, Volume, Preservation, and Holding Time Requirements 2.9 Sample Handling and Custody
B4 Analytical Methods	2.10 Analytical Methods Requirements
B5 Quality Control	2.11 Quality Control Requirements
B6 Instrument/Equipment Testing, Inspection, and Maintenance	2.11.4 Instrument and Equipment Testing, Inspection, and Maintenance Requirements
B7 Instrument/Equipment Calibration and Frequency	2.12 Instrument Calibration and Frequency
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B9 Non-direct Measurements	2.14 Data Acquisition Requirements (Non-direct Measurements)
B10 Data Management	2.15 Data Management
C1 Assessment and Response Actions	3.1 Assessment and Response Actions
C2 Reports to Management	3.2 Reports to Management
D1 Data Review, Verification, and Validation	4.1 Data Review and Reduction Requirements
D2 Validation and Verification Methods	4.2 Validation and Verification Methods
D3 Reconciliation with User Requirements	4.3 Reconciliation with Data Quality Objectives

Note:
EA - EA Engineering, Science, and Technology, Inc., PBC
EPA - U.S. Environmental Protection Agency
QAPP - Quality Assurance Project Plan
SAP - Sampling and Analysis Plan

The overall QA objectives are as follows:

- Attain quality control (QC) requirements for analyses specified in this SAP
- Obtain data of known quality to support goals set forth for this project.

The EPA Region 6 Task Order Monitor (TOM), Ms. Ursula Lennox, is responsible for the project oversight. The Contracting Officer for EPA Region 6 is Mr. Michael Pheeny. The Project Officer for EPA Region 6 is Ms. Rena McClurg. Upon EPA direction, EA will perform RI/FS tasks in accordance with this SAP. The EA Project Manager, Ms. Sheena Styger, is responsible for implementing activities required by this Task Order. Figure 1 presents the project organization for this Task Order.

1.1 PROBLEM DEFINITION AND BACKGROUND

This section describes the following:

- Purpose of the investigation and sampling events
- Site background and description
- Previous site investigations.

Additional details regarding the site background, description, and previous investigations are provided in the *Conceptual Site Model Technical Memorandum* (EA 2016d).

1.1.1 Purpose of the Investigation and Sampling Events

The purpose of this investigation is to collect multi-media environmental samples (e.g., soil, sediment, ground water, surface water) and site characterization data as necessary to support an RI/FS. The RI/FS process will allow EPA to select a remedy for the site that eliminates, reduces, or controls risks to human health and the environment. The goal is to collect the minimum amount of data sufficient to support a Record of Decision.

1.1.2 Site History

The Colonial Creosoting Company, owned by American Creosote of Louisville, Kentucky, constructed a wood treatment plant on the site property in approximately 1911 (Dynamac Corporation [Dynamac] 2012). Operations included bark removal, wood preserving, storage of materials (e.g., creosote), and storage of completed products (e.g., wood paving blocks, treated wood). The facility closed in 1953, and in March 1957, the property, including two office buildings but not the wood treatment plant, was sold to the owners of Lakeview Sand and Gravel Company, Inc. Removal of the wood treatment plant was intended by the Colonial Creosoting Company; however, records regarding the plant removal have not been located (Dynamac 2012).

In June 1988, Lakeview Sand and Gravel Company Inc. changed its name to Bogalusa Concrete to reflect the change in operations at the site from wood treatment to a batch concrete plant (Dynamac 2012). In July 1990, the title of the property was exchanged by Mr. Henderson (or his heirs) and Mr. Simmons with Associated Brokers for shares in Associated Brokers

(Dynamac 2012). Bogalusa Concrete continued to operate at the site under a lease agreement with Associated Brokers until the concrete plant was abandoned in 2008 (Dynamac 2012). The property is currently still owned by Associated Brokers (Dynamac 2012).

1.1.3 Site Description

The site is located in the southeast portion of Bogalusa, Washington Parish, Louisiana. The 32-acre facility property is bound on the west and northwest by a railroad spur for the Illinois Central Gulf Railroad and undeveloped land to the east and south (Figure 2). Residential communities are located between 0.2 to 0.5 miles to the east, south, and west of the site, and fisheries are located in downstream waters. The property is accessed from Hickory Avenue, whose west end abuts the northern corner of the property.

Most of the structural facilities associated with the former site operations have been removed. Remaining features on-site include the one vacant office building, one above-ground storage tank, and a few partial structures associated with either the wood treatment facility, the sand and gravel company, or concrete operations (Figure 3).

Review of the 1953 aerial photo and Sanborn maps provided the basis for the identification of the following areas of interest (Figure 3):

- Treatment Area
- Reservoir
- Settling Pond
- Drying Area
- Lumber Piles
- Common Drainage Ditch
- Yellow Branch Creek.

The site is considered a single Operational Unit for the purpose of conducting the RI/FS. Note that area of interest boundaries may be modified after further site investigation activities. It is also important to note that area of interest boundaries do not necessary correspond to risk assessment exposure area boundaries. Additional characterization of the site is needed in order to determine appropriate exposure area boundaries.

1.1.4 Significant Site Investigations

The *Conceptual Site Model Technical Memorandum* (EA 2016d) provides a summary of site visits, notable regulatory inspections, and prior CERCLA activities that occurred at the site. The most recent field activities at the site included sampling and evaluation in order to complete the 2012 Site Inspection and 2014 Expanded Site Inspection Addendum (Dynamac 2012, CSS-Dynamac 2015).

In 2012, Dynamac completed a Site Inspection at the site for EPA. Soil samples were collected from 14 locations from 0 to 2 feet below ground surface (bgs) to identify potential source material at the site. Surface water and sediment samples were collected from 10 locations to

assess the potential migration of contamination in the surface water pathway. The sampling events took place on 20 and 21 March 2012. Samples were analyzed for Target Analyte List (TAL) metals including mercury, and semivolatile organic compounds (SVOCs) (Dynamac 2012).

An Expanded Site Inspection was conducted in December 2012 for the EPA; however, the results are not included or discussed in this document. An Expanded Site Inspection Addendum was conducted in May 2014 for EPA. The Expanded Site Inspection Addendum states, "due to the possibility of data of unknown quality collected during the [Expanded Site Investigation]… samples were recollected [during the Expanded Site Inspection Addendum] to ensure that data of known and documented quality would be used by EPA in their decision making process" (CSS-Dynamac 2015). Soil and sediment samples were recollected from on-site areas used for operation and waste disposal. Sediment samples were recollected on- and off-site to determine if a release to wetlands has or is occurring. The Expanded Site Inspection Addendum sampling event took place on 13 and 14 May 2014. Samples were analyzed for SVOCs.

1.1.5 2015 Hazard Ranking System Documentation Record

The results from the Expanded Site Inspection Addendum were used by EPA to prepare a Hazard Ranking System Documentation Record for the site in 2015. The Hazard Ranking System Documentation Record is the principal mechanism that the EPA uses to place sites on the National Priorities List (NPL). The report documented the presence of contaminant source material in the common drainage ditch, treatment area, reservoir, settling pond, drying area, and lumber piles. Surface water migration pathways were documented to be of concern.

1.1.6 2015 National Priorities List

The site was proposed for listing on the NPL on 16 March 2015 (Volume 80 Federal Register 15973) and was placed on the list effective 21 September 2015 (Volume 80 Federal Register 58623).

1.2 DESCRIPTION OF PROJECT OBJECTIVES AND TASKS

This section describes the project objectives and tasks for this SAP.

1.2.1 Project Objectives

The primary objectives of the RI/FS are to characterize source material, determine the nature and extent of contamination, evaluate fate and transport of contamination and the migration pathways, conduct human health and ecological risk assessments, and evaluate remedial alternatives for areas and media that pose an unacceptable risk. Sufficient information needs to be gathered so that the EPA, in case of unacceptable risk at the site, can select a remedy that eliminates, reduces, or controls risks to human health and the environment.

The following components are considered key to conducting an RI/FS for the site:

- Data Collection—Collection of data in order to define the nature and extent of contamination, understand fate and transport of contaminants, and develop remedial alternatives.

- Risk Assessments—Completion of risk assessments for human health and the environment to characterize and quantify the current and potential risks that would prevail if no remedial action were taken.

- RI Report—Preparation of a report that accurately establishes site characteristics, including identification of source materials, definition of the nature and extent of contamination, and evaluation of migration pathways.

- Remedial Alternatives Technical Memorandum—Preparation of a report that establishes remedial action objectives, identifies general response actions, identifies and screens applicable remedial technologies against effectiveness, implementability, and cost and presents appropriate remedial alternatives also screened against effectiveness, implementability, and cost.

- Remedial Alternatives Evaluation Technical Memorandum—Preparation of a report that assesses individual alternatives against seven criteria including overall protection of human health and the environment, compliance with Applicable or Relevant and Appropriate Requirements, long-term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, short-term effectiveness, implementability (technical and administrative), and cost.

- FS Report—Preparation of a report that provides a detailed analysis of alternatives against the seven criteria, both individually and comparatively, and includes cost estimates for retained remedial alternatives.

- Project Close-out—Necessary activities to close out the Task Order in accordance with contract requirements.

1.2.2 Project Tasks

The following RI/FS components may be completed upon EPA direction:

- Project planning and support
- Community involvement
- Field investigation/data acquisition
- Sample analysis
- Analytical support and data validation
- Data evaluation
- Risk assessment
- RI report preparation
- Remedial alternatives screening and evaluation

- FS report preparation
- Post-RI/FS support
- Task order closeout.

1.3 DATA QUALITY OBJECTIVES

The following sections present the DQOs for this project. The statement of work issued by the EPA (2016a), the EPA-approved Work Plan (EA 2016a), and the *Conceptual Site Model Technical Memorandum* (EA 2016d) form the basis for the DQO assessment. This DQO assessment follows EPA's 7-step DQO process (Figure 4), which is outlined in *Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G-4)* (EPA 2006a) and *Systematic Planning: A Case Study for Hazardous Waste Site Investigations (QA/CS-1)* (EPA 2006b).

1.3.1 Purpose and Goal

The purpose of defining the DQOs is to support decision making by applying a systematic planning and statistical hypothesis testing methodology to decide between alternatives. The goal is to develop an analytic approach and data collection strategy that was effective and efficient.

1.3.2 Step 1 – State the Problem

The first step in systematic planning process, and therefore the DQO process, is to define the problem that has initiated the study. As environmental problems are often complex combinations of technical, economic, social, and political issues, it is critical to the success of the process to separate each problem, define it completely, and express it in an uncomplicated format.

The most important activities in DQO Step 1 are as follows:

- Give a concise description of the problem
- Identify a leader and members of the planning team
- Develop a conceptual site model (CSM) of the environmental hazard to be investigated
- Determine resources (i.e., budget, personnel, and schedule).

1.3.2.1 Problem Description

Historical wood treatment activities at the site have resulted in the release of contaminants. The nature and extent of media impacted by site chemicals of potential concern (COPCs), possible migration of impacted media, and risks associated with impacted media are unknown. The initial COPCs at the site include SVOCs and TAL metals. Because sources of the materials used in the wood treatment process are unknown, the following analyte groups will also be considered COPCs until data indicates they are not present above risk screening levels: volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (dioxins), and polychlorinated dibenzofurans (furans).

1.3.2.2 Planning Team Members and Stakeholders

A proven effective approach to formulating a problem and establishing a plan for obtaining information that is necessary to resolve the problem is to involve a team of experts and stakeholders that represent a diverse, multidisciplinary background. Such a team provides the ability to develop a concise description of complex problems, and multifaceted experience and awareness of potential data uses. Planning team members (including the leader) and stakeholders are presented below.

Planning Team Members

- Ursula Lennox, EPA Region 6 TOM
- Jon Rauscher, EPA Region 6 Risk Assessor
- Kenneth Shewmake, EPA Region 6 Risk Assessor
- Janetta Coats, EPA Region 6 Community Involvement
- David Abshire, EPA Region 6
- Patrick Young, EPA Region 6
- Barry Forsythe, U.S. Fish and Wildlife Service
- Brigette Firmin, U.S. Fish and Wildlife Service
- Kent Becher, U.S. Geological Survey
- Regina Atterberry Philson, Louisiana Department of Environmental Quality (LDEQ)
- John Halk, LDEQ
- Edwin Akujobi, LDEQ
- Sheena Styger, EA Project Manager.

Stakeholders

- EPA Region 6 Superfund Division Management
- EPA Headquarters
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- LDEQ Underground Storage Tank and Remediation Division
- City of Bogalusa, Louisiana
- Other interested parties (e.g., local residents).

If additional planning team members and/or stakeholders are identified as the RI/FS progresses, they will be incorporated into the decision-making process as appropriate.

1.3.2.3 Conceptual Site Model

It is critical to carefully develop an accurate CSM of the environmental problem, as this model will serve as the basis for subsequent inputs and decisions. A summary of the CSM is provided below; additional details are included in the technical memorandum (EA 2016d) and are not repeated here for brevity.

Chemical Release Scenario, Source(s), and Chemicals of Potential Concern

Historical wood treatment activities at the site have resulted in the release of contaminants. Previously collected soil and sediment data (Dynamac 2012, CSS-Dynamac 2015) suggest that releases of creosote may have occurred in the former treatment area, settling pond, reservoir, and lumber pile areas (Figure 3). Metals were detected in samples collected from the media sampled, but because metals are naturally occurring, a more rigorous study will be necessary to determine if elevated concentrations (above background) are due to site activities. None of the other COPCs (i.e., VOCs, PCBs, dioxins, and furans) have been tested for at the site.

Spatial and Temporal Distribution of Chemicals of Potential Concern

The nature and extent of media impacted by site COPCs is unknown. Potential migration pathways of impacted media via: (1) surface water transport, (2) leaching to ground water, (3) ground water transport, (4) ground water to surface water transport, (5) air particulate migration, and (6) soil vapor to air migration have not been fully evaluated.

Current and Future Land and Ground Water Use

Historically, the site has been used for industrial/commercial activities. Adjacent land use also includes residential and likely trespasser uses. Currently there are no known land use restrictions.

There are four water wells located approximately 1,000 feet from the site, one is 95 feet in depth and the other three are greater than 1,000 feet in depth. The lack of water wells in close proximity to the site suggests that shallow ground water is not currently used by nearby residents for drinking water (Figure 5). Currently there are no known water use restrictions.

Site Stratigraphy, Vadose Zone Soil, Hydrogeology, and Surface Water Bodies

The site overlies the Southern Hills Regional Aquifer System, which includes complexly interbedded, unconsolidated sand, silt, and clay strata that regionally dip and thicken towards the Gulf of Mexico. Site soils have been mapped by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS) as sandy loam (NRCS 2016a, 2016b). Site-specific details regarding stratigraphy and hydrogeology are currently unknown. A drainage ditch that is only a few feet wide passes along the southern boundary of the former facility property (Figure 3). The ditch drains to Yellow Branch Creek to the south and east, a freshwater perennial stream that is part of the Lower Pearl Watershed.

Remedial Activities Conducted To Date

As discussed in Section 1.1.6, the site has only recently been placed on the NPL. Investigation activities necessary to complete the Hazard Ranking System Documentation Record have been completed (discussed in Sections 1.1.4 and 1.1.5). No other remedial activities have been conducted at the site.

Human Health Receptors and Exposure Pathways

Human receptors identified for this site include commercial/industrial workers and trespassers under current and future use scenarios. Construction workers and residents have been identified as potential future receptors at the site. Exposure routes include ingestion, dermal contact, and inhalation as indicated in the preliminary human health CSM (Figure 17 of the *Conceptual Site Model Technical Memorandum*, EA 2016d). Potential unacceptable risks to human health as a result of exposure to COPCs in site-related media are not known.

Ecological Receptors and Exposure Pathways

Ecological receptors potentially present at the site include plants, terrestrial invertebrates, wildlife (birds, mammals, etc.), and aquatic and benthic organisms. Exposure routes include direct contact/dermal contact, inhalation, and ingestion as indicated in the preliminary ecological CSM (Figure 18 of the *Conceptual Site Model Technical Memorandum*, EA 2016d). Potential unacceptable risks to ecological receptors as a result of exposure to COPCs in site-related media are not known.

1.3.2.4 Determine Resources

Resources should be identified by the planning team so that constraints (e.g., budget, time, etc.) associated with collecting/evaluating data can be anticipated during the project life cycle.

EPA has indicated that this task order will be incrementally funded. Therefore the activities, both field and report preparation, can be completed as funding becomes available. The field implementation phases can be combined or rearranged as directed by EPA to correspond with the available funding.

EA personnel, team subcontracted personnel, and/or subcontracted personnel with appropriate oversight will perform data collection tasks. EA will utilize the services of the EPA's Region 6 Laboratory, the EPA Contract Laboratory Program (CLP), or a subcontracted commercial laboratory depending on the needs of the RI/FS and the availability of each the laboratory's services. Data validation of EPA Region 6 Laboratory and EPA CLP laboratory data will be validated by EPA or EPA contractors. Subcontracted commercial laboratory data will be validated by EA personnel or subcontracted personnel.

The EPA will perform a review of each required deliverable and provide comments as necessary. EPA will also solicit comments from other planning team members or stakeholders as appropriate.

1.3.3 Step 2 – Identify the Goal of the Study

Step 2 of the DQO process involves identifying the key questions that the study attempts to address, along with alternative actions or outcomes that may result based on the answers to these key questions. These two items are combined to develop decision statements, which are critical for defining decision performance criteria later in Step 6 of the DQO process.

The most important activities in DQO Step 2 are as follows:

- Identify principal study questions (PSQs)
- Consider alternative actions that can occur upon answering the questions
- Develop decision statement(s) and organize multiple decisions.

1.3.3.1 Principal Study Questions

The PSQs define the questions to be answered by the RI. The PSQs are as follows:

- What are the possible sources for contamination?
- What is the nature and extent of contamination?
- What are the migration pathways for transport of these contaminants?
- Are concentrations of site COPCs significantly greater than background?
- What is the potential risk to human health and ecological receptors from exposure to site related COPCs?

1.3.3.2 Alternative Actions

The alternative actions provide PSQ alternatives in the FS, as follows. Potential alternative actions, which will be evaluated in the FS, include, but are not limited to, the following:

- Remove or remediate the source areas
- Restrict access to limit exposure
- Mitigate migration pathways
- Address other migration/exposure pathways impacting receptors by employing engineering or institutional controls.

1.3.3.3 Decision Statement

For decision-making problems, the PSQs and alternative actions are combined to develop decision statements, which are critical for defining decision performance criteria later in DQO Step 6.

The decision statements are as follows:

- Determine the source of contamination.
- Determine the nature and extent of contamination.

- Determine the migration pathways of contaminants.
- Determine whether or not the concentrations of COPCs are significantly greater than background.
- Determine if exposure to site-related COPCs poses potential unacceptable risks to human health or ecological receptors.

1.3.4 Step 3 – Identify Information Inputs

Step 3 of the DQO process determines the types and sources of information needed to resolve: (1) the decision statement or produce the desired estimates; (2) whether new data collection is necessary; (3) the information basis the planning team will need for establishing appropriate analysis approaches and performance or acceptance criteria; and (4) whether appropriate sampling and analysis methodology exists to properly measure environmental characteristics for addressing the problem.

The most important activities in DQO Step 3 are as follows:

- Identify types and sources of information needed to resolve decisions or produce estimates.
- Identify the basis of information that will guide or support choices to be made in later steps of the DQO process.
- Select appropriate sampling and analysis methods for generating the information.

1.3.4.1 Necessary Information and Sources

A variety of sources and types of information form the basis for resolving the decision statements. The decision statements are supported by the following:

Determine the Source of Contamination

The current dataset (Dynamac 2012, CSS-Dynamac 2015) and historical information provides an indication where potential source areas exist at the site. However, limited data are available. Additional chemical analyses of soil, sediment, surface water, and ground water samples are needed to evaluate sources of contamination.

Determine the Nature and Extent of Contamination

As indicated above, the current dataset provides an indication of SVOC and metal concentrations in soil, sediment, and surface water. However, numerous areas are not delineated horizontally or vertically, a number of COPCs have not been tested for at the site, and no ground water samples have been collected. The following additional information is needed to determine the nature and extent of contamination:

- Chemical analyses of sediment and surface water
- Collection of surface soil and soil samples from depth for chemical analyses
- Installation of monitor wells and chemical analyses of ground water samples.

Determine the Migration Pathways of Contaminants

Migration pathways of contaminants at the site are not fully understood. The geology and hydrogeology of the site are poorly understood. The following additional information is needed to determine the migration pathways of contamination:

Surface Water Transport

- Observations of the direction of surface water flow
- Measurement of flow in water bodies (e.g., cubic feet per second)
- Total suspended solids testing.

Leaching to Ground Water and Ground Water Transport

- Detailed lithologic descriptions of soil borings
- Geotechnical testing of vadose zone soil and aquifer matrix material
- Synthetic precipitation leaching procedure (SPLP) testing (e.g., of source material)
- Water level measurements of various water bearing zones
- If multiple water bearing zones, collocated monitor wells to determine head gradient
- Aquifer testing (e.g., pump tests).

Soil Vapor to Air Migration

- Chemical analyses of volatiles in soil and ground water.

Chemical analyses of soil vapor (i.e., air) may be needed to evaluate the soil vapor to air migration pathway, however soil and ground water data will be reviewed prior to making this determination. At this time, soil vapor samples are not planned.

Determine whether or not the Concentrations of Chemicals of Potential Concern are Significantly Greater than Background

Background or ambient concentrations of SVOCs, metals, PCBs, dioxins, and furans in soil and sediment, and total and dissolved metals in surface water are necessary to provide a dataset for comparison to site data. Upgradient ground water samples will be needed if ground water is impacted.

Determine if Exposure to Site-Related Chemicals of Potential Concern Poses Potential Unacceptable Risks to Human Health or Ecological Receptors

As indicated above, the current dataset provides an indication of SVOC and metal concentrations in soil, sediment, and surface water. However, the dataset is too small to complete a meaningful risk assessment, a number of COPCs have not been tested for at the site, and no ground water samples have been collected. The following additional information is needed to determine potential unacceptable risk:

- Chemical analyses of soil, sediment, surface water, and ground water
- Ecological habitat survey
- Threatened and endangered species survey
- Wetlands delineation.

1.3.4.2 Basis of Information

The basis of information will guide or support choices to be made in later steps of the DQO process. The basis of information is supported by the following:

Determine the Source of Contamination

For the first phase of sampling, a grid will be used to identify locations of soil borings and sediment and surface water samples will be spaced between existing sample locations. Subsequent phases of sampling will use the previously collected data to determine where additional samples may be needed.

Determine the Nature and Extent of Contamination

For the first phase of sampling, a grid will be used to identify locations of soil borings and sediment and surface water samples will be spaced between existing sample locations. Subsequent phases of sampling will use the previously collected data to determine where additional samples may be needed and where monitor wells will be placed.

Analytical results will be compared to EPA screening criteria (i.e., Regional Screening Levels [EPA 2016b] and ecological screening levels [EPA 2015a]) to determine if additional sampling during subsequent phases is necessary.

Determine the Migration Pathways of Contaminants

The Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act* (EPA 1988) describes the process for evaluating migration pathways.

Determine whether or not the Concentrations of Chemicals of Potential Concern are Significantly Greater than Background

Statistical approaches, including the background evaluation, will be consistent with EPA guidance, including, but not limited to: ProUCL 5.1 User Guide (EPA 2015b); *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA 2002b); and *Role of Background in CERCLA Cleanup Program* (EPA 2002c).

Determine if Exposure to Site-Related Chemicals of Potential Concern Poses Potential Unacceptable Risks to Human Health or Ecological Receptors

Samples collected to determine the nature and extent of contamination at the site will be used in conjunction with background samples to complete the risk assessments. A human health risk

assessment will be conducted in accordance with the EPA's guidance which includes, but is not limited to:

- *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual* (EPA 1989)
- *RAGS for Superfund Volume I: Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991)
- *RAGS, Volume I: Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (EPA 2001b)
- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA 2002d)
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (EPA 2002e)
- *RAGS, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2004)
- *RAGS, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (EPA 2009a).

An ecological risk assessment will be conducted in accordance with the EPA's guidance which includes, but is not limited to:

- *Ecological RAGS: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (EPA 1997)
- *Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA 1999).

1.3.4.3 Sampling and Analysis Methods

An extensive field investigation has been proposed to collect multimedia data. Table 2 presents a list of parameters that are anticipated to be collected for this project and a brief description of why. Corresponding analytical methods are presented in Section 2.7.

TABLE 2. SAMPLING PARAMETERS AND RATIONALE FOR COLLECTION

Parameter	Media: Soil	Media: Sediment	Media: Surface Water	Media: Ground Water	Rationale for Collection
SVOCs	X	X	X	X	These parameters will be collected to evaluate concentrations of COPCs in various media types. The analyte groups were selected based on historical site activities and to evaluate commonly analyte groups not previously tested for at the site that may be present.
Metals	X	X	X	X	
Dissolved Metals			X	X	
VOCs	X	X	X	X	
PCBs as Aroclors	X	X			
Dioxins and Furans	X	X			
SPLP SVOCs	X				These parameters will be collected to evaluate the potential for COPCs in soil to leach into ground water.
SPLP Metals	X				
SPLP VOCs	X				
pH	X	X	X	X	These parameters will be used to evaluate the toxicity of divalent metals to ecological receptors.
AVS/SEM		X			
TDS			X	X	TDS is a measure of the amount of organic and inorganic dissolved substances in water. It will be used to classify ground water as Class 1, 2, or 3 as defined by LDEQ.
TSS			X		These parameters are a measure of solid materials suspended in water and will be used to evaluate general water quality.
Turbidity			X	X	
TOC	X	X	X	X	These parameters are used to evaluate monitored natural attenuation in ground water. TOC is also used to estimate risk of divalent metals to aquatic ecological receptors.
DOC				X	
Anions				X	Anion results will be used, if needed, to evaluate ionic strength, mineral saturation indices, competition for anion adsorption sites, and calculate cation-anion balance.
Hardness			X	X	Hardness is a measure of the amount of dissolved calcium and magnesium in water. It will be used to evaluate general water quality and calculate metal ecological risk screening values.
Alkalinity			X	X	Alkalinity is a measure of HCO_3/CO_3^{2-} concentration which is a major anion in shallow ground water. Alkalinity will be used, if needed, to evaluate ionic strength, mineral saturation indices, and competition for anion adsorption sites.
Temperature			X	X	Temperature affects mineral solubility and reaction rates.
Dissolved Oxygen			X	X	An oxidation capacity component.
ORP			X	X	Redox processes affect dissolved metal concentrations. ORP will be used to evaluate mineral solubilities and understand ground water/soil interactions.
Conductivity			X	X	An indicator of total ion concentration.
Geotechnical[1]	X				Geotechnical parameters will be used to characterize the vadose zone and water bearing zones at the site. This information will be used to understand the fate and transport of ground water contaminants and may be used during development of remedial alternatives.

Note:
[1] Includes moisture content, bulk density, porosity, effective porosity, particle size, atterberg limits, hydraulic conductivity, and percent organic matter.

AVS – acid volatile sulfide
COPC – chemical of potential concern
dioxins – polychlorinated dibenzodioxins
DOC – dissolved organic carbon
furans – polychlorinated dibenzofurans
LDEQ – Louisiana Department of Environmental Quality
ORP – oxidation reduction potential
PCB – polychlorinated biphenyl
SEM – simultaneously extracted metals
SPLP – synthetic precipitation leaching procedure
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
TSS – total suspended solids
VOC – volatile organic compound

1.3.5 Step 4 – Define the Boundaries of the Study

In Step 4 of the DQO process, the target population of interest and spatial/temporal features pertinent for decision making should be identified. The most important activities in DQO Step 4 are as follows:

- Define the target population of interest.
- Specify temporal or spatial boundaries and other practical constraints associated with sample/data collection.

1.3.5.1 Target Population

The target population consists of soil, sediment, surface water, and ground water. The following descriptions of the target population are segregated by media below.

Generally soil is not considered mobile because ground cover or vegetation often precludes migration. Mobility of soil due to storm water or particulate migration can lead to a slight temporal aspect to characterization. However for the purpose of this investigation, soil is not considered to be mobile enough to have a significant temporal aspect. The distribution of soil is from the surface to either the bottom of impacted soil, until the water table is encountered, or refusal.

Sediment is considered mobile during heavy rain events. The fine grain materials are routinely subject to storm water migration and may be transported some distance from the source. Therefore, a minor temporal aspect to the concentration of sediments in a particular location may occur over time. The distribution of sediments is thought to be from several inches to several feet thick in most areas. Typically sediments contained within the banks of waterways often have higher deposition rates near bends or where surface water flow is reduced.

Surface water is mobile with a high temporal aspect.

Limited information is available to assess ground water mobility. The mobility of ground water is dependent on preferential pathways, the type of aquifer, and other site-specific parameters. For example, the shallow ground water directly beneath the site may be less mobile than the deeper ground water due to limited connectivity between permeable zones. Aquifers may or may not have a temporal aspect related to season, when infiltration, water usage, or other factors vary.

1.3.5.2 Spatial Boundaries

This investigation will evaluate the areas of interest within the former facility boundary, the common drainage ditch, portions of the Yellow Branch downstream of the site (Figure 3), and additional areas identified during this investigation, as appropriate.

1.3.6 Step 5 – Develop the Analytical Approach

Step 5 of the DQO process involves developing an analytic approach that will guide how to analyze the study results and draw conclusions from the data. It is the intention of this step to integrate the outputs from the previous four steps with the parameters developed in this step.

The most important activities in DQO Step 5 are as follows:

- Specify the appropriate population parameters for making decisions.
- Choose a workable action level and generate an "If … then … else" decision rule which involves it.

1.3.6.1 Population Parameters

The population parameter is defined as the value used in the decision statement to evaluate a decision point. The population parameter will be used as an exposure point concentration (EPC) in the risk assessments. A population parameter will be determined for each chemical in each exposure area for each sample group (e.g., surface soil from 0 to 2 feet bgs). Maximum detected concentrations will be used first in a screening to determine if a chemical should be retained as a site COPC. If the maximum detected concentrations is below screening criteria, the chemical will not be retained as a site COPC. If COPCs are identified, the 95 percent upper confidence limit of the mean will be calculated using ProUCL Version 5.1 (EPA 2015b, 2015c) to be used as the EPC in the risk assessments.

Background statistical evaluations for soil, surface water, and sediment will also be conducted. Two-population tests or site specific background threshold values will be used to determine if an exposure area is significantly greater than background.

1.3.6.2 Action Level Decision Rule

As discussed in the previous steps of the DQO process, additional data is needed to characterize the site and complete the risk assessments in order to make a decision for the site. EPA Regional Screening Levels (EPA 2016b) and ecological screening criteria (EPA 2015a) will be used as screening criteria. Appendix A provides human health and ecological screening criteria. The following decision rule is associated with the screening criteria:

- If maximum site concentrations exceed risk based screening values, a risk assessment will be performed.
- Else, if maximum site concentrations do not exceed risk based concentrations, it will be concluded that the site does not present risk to human health and the environment.

Analytical data of appropriate sensitivity for the risk assessment will be needed to answer the decision rule. EPA Regional Screening Levels (EPA 2016b) and ecological screening criteria (EPA 2015a) will be used as a basis to select analytical methods. Analytical methods should be selected that have reporting limits (RLs) that are lower than screening criteria. However, some

screening criteria are so low that they may be unachievable or may result in unnecessary laboratory costs (e.g., 2,3,7,8-tetrachlorodibenzodioxin Tap Water Regional Screening Level of 0.12 picograms per liter [pg/L] or Residential Soil Regional Screening Level of 4.8 nanograms per kilogram [ng/kg]). Therefore, standard Contract-required Quantitation Limits (CRQLs) will be requested for samples analyzed by the EPA Region 6 Laboratory or CLP Laboratories for the following analyses in order to obtain RLs below or close to the screening levels:

- SIM Semivolatiles (the majority of PAH CRQLs are 0.1 micrograms per liter [µg/L] or 0.0033 milligrams per kilogram [mg/kg])
- Low Semivolatiles (the majority of analyte CRQLs are 5 or 10 µg/L or 0.17 mg/kg)
- Trace Volatiles for Water (the majority of analyte CRQLs are equal to 0.5 µg/L)
- Low Volatiles for Soil (the majority of analyte CRQLs are equal to 0.005 mg/kg)
- Inductively coupled plasma mass spectrometry (ICP-MS) Metals for Water and Soil (nutrients [i.e., Ca, Na, Mg, K] may be analyzed by inductively coupled plasma atomic emission spectroscopy [ICP-AES])
- Aroclors for Water and Soil (CRQLs are 1 µg/L or 0.033 mg/kg)
- Chlorinated Dibenzo-p-dioxins/Chlorinated Dibenzofurans for Water and Soil (the 2,3,7,8-TCDD CRQLs are 10 pg/L or 1 ng/kg).

It is important to note that mineral or chemical interference may lead to elevated sample quantitation limits. Table 3 presents a truncated list of COPCs and their associated screening levels, which provide justification for selection of the SIM, trace, and low level analyses.

TABLE 3. TRUNCATED LIST OF SCREENING LEVELS

Parameter	EPA Regional Screening Levels		EPA Region 4 Ecological Screening Values		
	Tap Water (µg/L)[1]	Resident Soil (mg/kg)[1]	Surface Water[2] (µg/L)	Sediment ESV[3] (mg/kg)	Soil (mg/kg)
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	53	360	15	1.61 (total PAHs)	29 (total LMW PAHs) and 1.1 (total HMW PAHs)
Anthracene	180	1,800	0.02		
Benz(a)anthracene	0.012	0.16	4.7		
Benzo(a)pyrene	0.0034	0.016	0.06		
Benzo(b)fluoranthene	0.034	0.16	2.6		
Benzo(k)fluoranthene	0.34	1.6	0.64		
Chrysene	3.4	16	4.7		
Dibenz(a,h)anthracene	0.0034	0.016	0.28		
Fluoranthene	80	240	0.8		
Fluorene	29	240	19		
Indeno(1,2,3-cd)pyrene	0.034	0.16	0.28		
2-Methylnaphthalene	3.6	24	4.7		
Naphthalene	0.17	3.8	21		
Pyrene	12	180	4.6		
Other Organics Commonly Found in Creosote					
Benzene	0.46	1.2	160	0.113	0.12
Ethylbenzene	1.5	5.8	61	0.272	0.27
Toluene	110	490	62	0.145	0.15
Xylenes	19	58	27 (total)	0.103 (total)	0.1 (total)
Cresol, m-	93	320	62	0.93	0.09
Cresol, o-	93	320	67	0.1	0.1
Cresol, p-	190	630	53	0.078	0.08
Phenol	580	1,900	160	0.12	0.79
Metals					
Antimony	0.78	3.1	190	2	0.27
Arsenic	0.052	0.68	148 (arsenic III)	9.8	18
Barium	380	1,500	220	20	330
Beryllium	2.5	16	11	--	10
Cadmium	0.92	7.1	0.25	1	0.36
Total Chromium	100 (MCL)	12,000	74 (chromium III)	43.4	28
Cobalt	0.6	2.3	19	50	13
Copper	80	310	9	31.6	28
Lead	15	400	2.5	35.8	11
Manganese	43	180	93	460	220
Mercury	0.063	1.1	0.77 (aquatic)	0.18	0.1
Nickel	39	150	52	22.7	38
Silver	9.4	39	0.06	1	4.2
Thallium	0.02	0.078	6	--	0.22
Vanadium	8.6	39	27	--	7.8

Note:
[1] Cancer risk of 10^{-6} or noncancer hazard index of 0.1, whichever is lower.
[2] Chronic freshwater screening values
[3] Freshwater screening values

-- – not applicable
EPA – U.S. Environmental Protection Agency
ESV – ecological screening value for step 2
HI – hazard index
HMW – high molecular weight
LMW – low molecular weight
MCL – Maximum Contaminant Level
PAH – polycyclic aromatic hydrocarbon

Site Remedial Action

Ultimately, the action levels (i.e., cleanup goals) for the site will likely be either: (1) risk-based goals developed during the risk assessments; (2) EPA guidance or federally-mandated ground water criteria such as Maximum Contaminant Levels; or (3) site-specific background concentrations. Site-specific background concentrations will be developed for soil, sediment, and surface water during the course of the investigation.

The decision rule for cleanup at the site is as follows:

- If results of the risk assessment indicate there is a potential for unacceptable human health or ecological risks, and concentrations are above background concentrations, then the impacted media will be retained for remedial alternative development in order to select a remedy for the site.

- Else, if site concentrations indicate there is no potential for unacceptable human health or ecological risks, no further action will be taken.

1.3.7 Step 6 – Specify the Performance or Acceptance Criteria

Step 6 of the DQO process specifies the tolerable limits on decision errors. Data are subject to various types of errors (e.g., how samples were collected, how measurements were made, etc.). As a result, estimates or conclusions that are made from the collected data may deviate from what is actually true within the population. Therefore, there is a chance that an erroneous conclusion could be made or that the uncertainty in the estimates will exceed what is acceptable.

The performance or acceptance criteria for collected data will be derived to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels. Performance criteria and QA practices will guide the design of new data collection efforts. Acceptance criteria will guide the design of procedures to acquire and evaluate existing data.

The most important activities in DQO Step 6 are as follows:

- Recognizing the total study error and devising mitigation techniques to limit error.

- Specify the decision rule as a statistical hypothesis test, examine consequences of making incorrect decisions from the test, and place acceptable limits on the likelihood of making decision errors.

1.3.7.1 Total Study Error

Even though unbiased data collection methods may be used, the resulting data will still be subject to random and systematic errors at different stages of the collection process (e.g., from field sample collection to sample analysis). The combination of these errors is called the “total study error” (or “total variability”) associated with the collected data. There can be many

contributors to total study error, but there are typically two main components, sampling error and measurement error.

Sampling Error

Sampling error, sometimes called statistical sampling error, is influenced by the inherent variability of the population over space and time, the sample collection design, and the number of samples collected. It is usually impractical to measure the entire population space, and limited sampling may miss some features of the natural variation of the measurement of interest. Sampling design error occurs when the data collection design does not capture the complete variability within the population space, to the extent appropriate for making conclusions. Sampling error can lead to random error (i.e., random variability or imprecision) and systematic error (bias) in estimates of population parameters. In general, sampling error is larger than measurement error and consequently needs a larger proportion of resources to control.

Measurement Error

Sometimes called physical sampling error, measurement error is influenced by imperfections in the measurement and analysis protocols. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, data reduction, transmission, and storage.

The potential for measurement error will be mitigated by using accurate measurement techniques. Sampling techniques were selected to limit the measurement error, including the following:

- Sample collection procedures, sample processing, and field sample analysis protocols are standardized and documented in SOPs to ensure that the methodology remains consistent and limits the potential for measurement error.

- Field teams will be trained and will perform specific tasks (e.g., sample collection or processing) throughout the field sampling effort to limit the potential for measurement error.

- Potential for measurement error in the sample analysis will be limited by the analysis of QC samples (e.g., duplicates).

- Data management procedures and sample tracking software (i.e., Scribe) will limit the potential for data reduction, transmission, and storage errors.

1.3.7.2 Statistical Hypothesis Testing and Decision Errors

Decision-making problems are often transformed into one or more statistical hypothesis tests that are applied to the collected data. Data analysts make assumptions on the underlying distribution

of the parameters addressed by these hypothesis tests, in order to identify appropriate statistical procedures for performing the chosen statistical tests.

Due to the inherent uncertainty associated with the collected data, the results of statistical hypothesis tests cannot establish with certainty whether a given situation is true. There will be some likelihood that the outcome of the test will lead to an erroneous conclusion (i.e., a decision error).

When a decision needs to be made, there are typically two possible outcomes: either a given situation is true, or it is not. Although it is impossible to know whether an outcome is really true, data are collected and statistical hypothesis testing is performed to make an informed decision. In formulating the statistical hypothesis test, one of the two outcomes is labeled the "baseline condition" and is assumed to represent the *de facto*, true condition going into the test, and the other situation is labeled the "alternative condition." The baseline condition is retained until the information (data) from the sample indicates that it is highly unlikely to be true.

The statistical theory behind hypothesis testing allows for defining the probability of making decision errors. However, by specifying the hypothesis testing procedures during the design phase of the project, the performance or acceptance criteria can be specified.

There are four possible outcomes of a statistical hypothesis test. Two of the four outcomes may lead to no decision error; there is no decision error when the results of the test lead to correctly adopting the true condition, whether it is the baseline or the alternative condition. The remaining two outcomes represent the two possible decision errors. The first is a false rejection decision error, which occurs when the data leads to decision that the baseline condition is false when, in reality, it is true. The second is a false acceptance decision error, which occurs when the data are insufficient to change the belief that the baseline condition is true when, in reality, it is false.

In the statistical language of hypothesis testing, the baseline condition is called the "null hypothesis" (H_o) and the alternative condition is called the "alternative hypothesis" (H_a). A false rejection decision error, or a Type I error, occurs when the null hypothesis is rejected when it is actually true. The probability of this error occurring is called alpha (α) and is called the hypothesis test's level of significance. A false acceptance decision error, or a Type II error, occurs when the null hypothesis is not rejected when it is actually false. The probability that this error will occur is called beta (β). Frequently, a false rejection decision error is the more severe decision error, and therefore, criteria placed on an acceptable value of alpha (α) are typically more stringent than for beta (β). Statisticians call the probability of rejecting the null hypothesis when it is actually false the statistical power of the hypothesis test. Statistical power is a measure of how likely the collected data will allow you to make the correct conclusion that the alternative condition is true rather than the default baseline condition and is a key concept in determining DQOs for decision-making problems. Note that statistical power represents the probability of "true rejection" (i.e., the opposite of false acceptance) and, therefore, is equal to $1-\beta$.

Decision errors can never be totally eliminated when performing a statistical hypothesis test. However, the primary aim of this step is to arrive at the upper limits on the probabilities of each of these two types of decision errors that the planning team finds acceptable.

Background Evaluation

COPCs in site media will be subject to a background evaluation to determine whether site concentrations are significantly greater than background. Two-population tests or site specific background threshold values will be used to determine if an exposure area is significantly greater than background. When two-population tests are utilized, the null hypothesis is the mean concentration of a contaminant that does not exceed (i.e., is not greater than or equal to) the mean background concentration and the alternative hypothesis is the mean concentration that does exceed the mean background concentration as follows:

H_o = Mean Media Analyte Concentration ≤ Mean Media Analyte Background

H_a = Mean Media Analyte Concentration > Mean Media Analyte Background

The null hypothesis is the mean concentration of a contaminant does not exceed (i.e., is not greater than or equal to) the action level and the alternative hypothesis is the mean concentration does exceed the action level as follows:

H_o = Mean Media Analyte Concentration ≤ Action Level

H_a = Mean Media Analyte Concentration > Action Level

For the statistical evaluations conducted for the site, the probability of a Type I error occurring will be established at 5 percent and a Type II error will be established at 10 percent.

1.3.8 Step 7 – Develop the Plan for Obtaining Data

In the Steps 1 through 6 of the DQO process, performance or acceptance criteria were developed. The goal of Step 7 is to develop a resource-effective sampling design for collecting and measuring environmental samples, or for generating other types of information needed to address the PSQs. In addition, this sampling design will lead to data that will achieve the performance and acceptance criteria.

The most important activity in DQO Step 7 is to use the information from Steps 1 through 6 of the DQO process to identify a sampling and analysis design that will answer the PSQs and achieve the performance or acceptance criteria.

Use of Historical Data

Samples collected during the 2012 Site Inspection were sent through EPA's CLP. Samples collected during the 2014 Expanded Site Inspection Addendum field event were sent to the EPA Region 6 Laboratory. Samples from both events were collected and analyzed in accordance with approved Quality Assurance Sampling Plans (Dynamac 2012, CSS-Dynamac 2015). Electronic

data deliverables (EDDs) have been provided by the EPA Region 6 Laboratory and Sample Management Office. Therefore, because these samples were collected and analyzed in accordance with EPA-approved QA plans and original EDDs are available, these data will be used in the RI/FS deliverables, including both the RI report and risk assessments.

Collection of Additional Data

As noted in Section 1, EPA has indicated that task order will incrementally funded and therefore the plans discussed in this SAP will be implemented in phases as funding is available. This SAP has been developed with this strategy in mind and presents phases for field implementation. The field implementation phases can be combined or rearranged as directed by EPA to correspond with the available funding. Proposed field investigation phases to collect additional data are presented below:

Phase One – Soil, Sediment, and Surface Water

The Phase One field activities will include the collection of the following samples:

- Soil Samples
  - Forty soil borings to an approximate depth of 30 feet bgs
  - Eight soil borings to an approximate depth of 4 feet bgs
- Sediment and Surface Water Samples
  - Ten collocated sediment and surface water samples
- Background/Ambient Condition Samples
  - Ten collocated sediment and surface water samples from upstream in the Yellow Branch Creek
  - Ten soil samples from currently undeveloped property adjacent to the Yellow Branch Creek
  - Ten collocated sediment and surface water samples from Bogue Lusa Creek
  - Ten soil samples from currently undeveloped property adjacent to the Bogue Lusa Creek.

Details regarding the locations and analyses for samples collected during Phase One are presented in Section 2.1. The collection of sediment, surface water, and background samples are contingent upon obtaining access from property owners.

Phase Two – Monitor Wells and Contaminant Delineation

The Phase Two field activities will include the installation of up to 16 monitor wells. Monitor well locations and depths will be determined following review of the subsurface soil analytical results. A SAP Addendum will provide the proposed monitor well locations, soil sample intervals, and analyses.

Review of Phase One data will provide an indication if additional soil, sediment, or surface water samples need to be collected in order to delineate the nature and extent of contamination. These additional samples could be collected during Phase Two. If needed, a SAP Addendum will provide details regarding proposed locations and analyses.

Phase Three – Monitor Well Sampling and Aquifer Testing

Phase Three field activities will include the installation of monitor wells to be sampled as per details provided in Section 2.1. Adjustments to the sampling plans may be made based on results from the prior field investigation events. It is recommended that following monitor well sampling, aquifer testing be performed. Plans and procedures for aquifer testing will be determined following review of monitor well installation well development datasheets. Details of this aquifer testing will be included in a SAP Addendum.

Phase Four – Well Survey and Private Water Well Sampling

Following installation and sampling of monitor wells, contaminant plume maps will be generated if ground water contamination is present. Using site-specific water level measurements, the direction of ground water flow will be determined. This information will be used to evaluate which, if any, known private water wells need to be sampled and which analyses would be required; this sampling will be performed during Phase Four field activities. This information will also be used to determine if door-to-door inquiries need to be made in order to identify wells not registered with the Louisiana Department of Natural Resources. Details of this portion of field work will be included in a SAP Addendum, if needed.

Phase Five - Ecological Characterization

Phase Five field activities will include plant and wildlife surveys to document species that may be located at the site. During field surveys, EA will identify, and list the observed species. Any state or federally listed rare, threatened, or endangered species, will be documented, photographed, and coordinates collected for their locations. If needed, wetland delineations can be performed.

1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

A well-defined QA/QC process is integral to the generation of analytical data of known and documented quality. The QC process includes those activities required during data collection to produce data of sufficient quality to support the decisions that will be made based on the data (e.g., decisions to be made prior to, during, and after site remedial actions) (EPA 2006a). After environmental data are collected, QA activities focus on evaluating the quality of the data in

order to determine the data usability with respect to support for remedial or enforcement decisions.

1.4.1 Data Categories

In order to produce data suitable for decision-making, an appropriate analytical technique must be selected. The EPA Superfund program has developed two descriptive categories of analytical techniques: (1) field-based techniques; and (2) fixed-laboratory techniques. The type of data generated depends on the qualitative and quantitative DQOs developed for a project. Regardless of whether the data were analyzed utilizing field or laboratory techniques, the data must be of adequate quality for the decision-making process for which the data were collected. For this project, data from both types of techniques will be collected and used to support decisions made. Section 2 discusses the methods that will be used to analyze the samples.

Rigorous analytical methods (e.g., EPA CLP methods) are used to generate analyte-specific, definitive data. The definitive quality of the data is assured by: (1) using SOPs and QC processes during data collection; (2) documented control and traceability of reference standards, calibrations, and instrument performance; and (3) acceptable performance of field and laboratory QC procedures within the defined limits established for these procedures.

The majority of the fixed-laboratory analysis for samples collected during the RI/FS sampling event will be conducted by the EPA Region 6 Laboratory and/or an EPA-designated CLP laboratory. The EPA maintains a website regarding Superfund analytical services and the CLP. The website includes links to current analytical statements of work, fact sheets for analytical services, and analytical services guidance documents.

www.epa.gov/clp

Subcontracted commercial laboratories will provide analytical support for analyses that are not available through the EPA Region 6 Laboratory or CLP laboratories (e.g., total organic carbon).

1.4.2 Measurement Quality Objectives

The analytical results will be evaluated in accordance with PARCCS parameters to document the quality of the data and to ensure that the data are of sufficient quality to meet the project objectives. The sections below describe each of the PARCC parameters. Section 2.10 specifies the requirements that analytical data must meet to be considered acceptable for this project.

1.4.2.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Usually, combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD).

RPD is calculated as follows:

$$\text{RPD} = \frac{|A - B|}{(A + B)/2} \times 100\%$$

where: A = first duplicate concentration
B = second duplicate concentration

Field sampling precision is evaluated by analyzing field duplicate samples.

Laboratory analytical precision may be evaluated by analyzing laboratory duplicates (also called matrix duplicates [MDs]) or matrix spikes (MSs) and matrix spike duplicates (MSDs).

1.4.2.2 Accuracy

A program of sample spiking will be conducted to evaluate laboratory accuracy. This program may include the analysis of the MS and MSD samples, laboratory control samples (LCSs) or blank spikes, surrogate standards, and method blanks. Surrogate standards, where available, are added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

$$\text{Percent Recovery} = \frac{S - C}{T} \times 100\%$$

where: S = measured spike sample concentration
C = sample concentration
T = true or actual concentration of the spike

The objective for the accuracy of field measurements is to achieve and maintain factory specifications for the field equipment.

1.4.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent.

Representativeness of data will also be ensured through the consistent application of established field and laboratory procedures documented in SOPs.

1.4.2.4 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures and when none of the QC criteria that affect data usability are exceeded.

1.4.2.5 Comparability

Comparability expresses the confidence with which one dataset can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory SOPs and by using standard measurement units in reporting analytical data.

1.4.3 Sensitivity - Detection and Quantitation Limits

The analytical parameters and their quantitation limits for use on this project are determined under the EPA CLP Statements of Work or applicable method. The Contract-required Detection Limit (CRDL) is the minimum concentration of an analyte that can be reliably distinguished from background noise for a specific analytical method. The quantitation limit represents the lowest concentration of an analyte that can be accurately and reproducibly quantified in a sample matrix. CRQLs are contractually specified maximum quantitation limits for specific analytical methods and sample matrices, such as soil or water, and are typically several times the method detection limit (MDL) to allow for matrix effects.

For this project, analytical methods have been selected so that the CRQL for each target analyte is below the applicable screening criteria, wherever practical. For this project, samples results will be reported as estimated values if concentrations are less than CRQLs but greater than CRDLs. The CRDL for each analyte will be listed as the detection limit in the laboratory's EDD.

Data collected during the RI will undergo an evaluation of the RLs in conjunction with screening criteria. The following approaches will be used for this project.

- If the RL for a non-detect chemical is greater than its respective screening level, then it will be discussed in the uncertainty section of the risk assessment.

- If a chemical is reported in a field sample and in a method blank or field blank, it will be considered as a positive identification, if the field sample concentration is present at a concentration greater than 10 times the maximum blank concentration for common laboratory contaminants or 5 times the maximum blank concentration for other analytes. Common laboratory contaminants include acetone, methylene chloride, methyl ethyl ketone, phthalate esters, and toluene.

- Data with "estimated" qualifiers (e.g., J-qualifier) will be considered detected concentrations.

1.5 SPECIAL TRAINING AND CERTIFICATION

This section outlines the training and certification required to complete the activities described in this SAP. The following sections describe the requirements for the EA team and subcontractor personnel working onsite.

1.5.1 Health and Safety Training

EA field team personnel who work at hazardous waste project sites are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in 29 Code of Federal Regulations (CFR) 1910.120(e). These requirements include: (1) 40 hours of formal off-site instruction; (2) a minimum of 3 days of actual on-site field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training. Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized supervisor training.

Copies of the field team's health and safety training records, including course completion certifications for the initial and refresher health and safety training, and specialized supervisor training are maintained in electronic project files.

Additional health and safety details can be found in the site-specific Health and Safety Plan (EA 2016b).

1.5.2 Subcontractor Health and Safety Training

Subcontractors who work on-site will certify that their employees have been trained for work on hazardous waste project sites. Training will meet OSHA requirements defined in 29 CFR 1910.120(e). Subcontractors will attend a safety briefing and complete the Safety Meeting Sign-Off Sheet before they conduct on-site work (EA 2016b). This briefing is conducted by the EA Site Health and Safety Officer or other qualified person. Alternatively, the subcontractors may elect to conduct their own safety briefings; EA personnel may audit these briefings.

Before work begins at the project site, subcontractors will submit copies of the training certification for each employee that will be on-site. Copies of the subcontractor's health and safety training records will be maintained in electronic project files.

1.5.3 Monitor Wells, Geotechnical Boreholes, and Test Holes

In accordance with Louisiana Administrative Code (LAC), Title 56, Part I. Water Wells, Section 307 (LAC 56:I.307), "wells and holes shall be drilled or constructed by a licensed contractor (driller) who is duly licensed by the department [The Louisiana Department of Natural Resources, Office of Conservation] in accordance with the rules and regulations stated in LAC 46:LXXXIX." A licensed contractor/driller is defined in LAC 46:LXXXIX.105.B.

Prior to EA procurement of the services of a drilling company or personnel, potential subcontractors will be required to submit proof of current licenses and registrations in order to meet the requirements of LAC:56:I.307.

1.5.4 Land Survey

Land surveys including the location and elevation of monitor wells will be conducted by a surveyor registered in the State of Louisiana in accordance with LAC 46:LXI - Professional and Occupational Standards for Professional Engineers and Land Surveyors.

Prior to EA procurement of the services of a surveying company or personnel, potential subcontractors will be required to submit proof of current licenses and registrations in order to meet the requirements of LAC 46:LXI.

1.6 DOCUMENTS AND RECORDS

The following sections discuss the requirements for documenting field activities and for preparing laboratory data packages. This section also describes reports that will be generated as a result of this project.

1.6.1 Field Documentation

Field personnel will use permanently-bound field logbooks with sequentially numbered pages to record and document field activities and will follow SOP 016 (Appendix A) for completing field logbooks. The logbook will list the contract name and number; site name; and names of subcontractors, and service client. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of onsite personnel or visitors
- Weather conditions during the field activity
- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the SAP or other governing documents.

1.6.2 Laboratory Documentation

This section describes the data reporting requirements for laboratories (e.g., EPA Region 6, CLP, or commercial laboratories) that submit analytical data.

EPA Region 6 Laboratory

The EPA Region 6 Laboratory shall provide electronic reports in Adobe® portable document format (PDF) that include report narratives, QC summary reports, QC results, and chain-of-custody forms in accordance with their laboratory SOPs. A comma-separated values compatible EDD that provides a spreadsheet of sample results and QC data shall accompany the electronic report. Data received from the EPA Region 6 Laboratory will undergo validation and QC checks, as required, prior to delivery to EA.

Contract Laboratory Program Laboratories

CLP laboratories shall provide data packages in accordance with the current CLP Analytical Statements of Work at the time of sample analysis. CLP data shall be validated by the EPA Region 6 Environmental Services Branch, Environmental Services Assistance Team, Data Review Team. An electronic report in PDF format that includes sample and documentation of

data validation shall be provided. In addition, a comma-separated values compatible EDD that provides a spreadsheet of sample results shall accompany the electronic report.

Commercial Laboratories

EA will require subcontracted commercial laboratories to prepare and submit data packages in accordance with the general laboratory requirements and data package deliverable requirements detailed in Appendix B. Commercial laboratories will be required to deliver Level IV data packages for investigatory samples analyzed for potential COPCs. Data packages will include applicable documentation for independent validation of data and verification the data are suitable to meet the DQOs.

1.6.3 Reports Generated

Following the completion of the RI field program and receipt of validated data, the following reports will be completed:

- Data Evaluation Summary Report
- Screening Level Ecological Risk Assessment Report
- Human Health Risk Assessment Report
- RI Report
- Remedial Alternatives Technical Memorandum
- Remedial Alternatives Evaluation Technical Memorandum
- FS Report.

The specific requirements and elements of each of these reports are discussed in Section 1.2.1 and in the RI/FS work plan (EA 2016a).

2. DATA GENERATION AND ACQUISITION

This section describes the requirements regarding sample collection and generation of data (e.g., sampling procedures, analytical methods, field QC requirements, data management).

2.1 SAMPLING PROCESS DESIGN

For the activities associated with this SAP, main elements of the sampling design include the numbers and types of samples to be collected, sampling locations, sampling frequencies, and sample matrices. The primary objective of the sampling design is to collect data of sufficient quantity and quality to resolve the PSQs and support risk assessment and remedy evaluation. The purpose of the RI/FS is to determine the nature and extent of contamination and to gather sufficient information so that the EPA can select a remedy that eliminates, reduces, or controls risks to human health or the environment. This can be accomplished by answering the PSQs as follows:

- Determine the source of contamination.
- Determine the nature and extent of contamination.
- Determine the migration pathways for these contaminants.
- Determine whether the concentrations of COPCs are significantly greater than background.
- Determine if exposure to site-related COPCs poses potential unacceptable risks to human health or ecological receptors.

As identified in Step 7 of the DQO process (Section 1.3.8), additional data are needed to augment the historical dataset in order to answer the above PSQs. Five phases of field investigations were outlined in Section 1.3.8 and details regarding each are provided below.

Phase One – Soil, Sediment, and Surface Water

Additional soil data are needed to understand the nature and extent of contamination and to complete risk assessments. A sample grid is proposed for locations of new soil borings. The grid is based on a review of historical data and aerial photographs and is biased toward the portion of the property that is most likely to be impacted based on historical information and the results of previous sampling. Figure 6 provides historical soil boring locations and proposed soil boring locations. Forty boring locations are anticipated to be collected to a depth of 30 feet bgs and 8 boring locations are anticipated to be collected to a depth of 4 feet bgs. The quantities and analyses for soil borings are presented in Table 4.

Additional sediment and surface water samples are needed to understand the nature and extent of contamination and to complete risk assessments. Ten collocated sediment and surface water samples are proposed. Proposed sample locations fill in gaps from historical data. Figure 7

provides the location of previous samples and proposed samples. The quantities and analyses for sediment and surface water samples are presented in Table 5.

Background or ambient condition samples are needed to assess whether or not COPCs are above background conditions. Ten collocated sediment and surface water samples are recommended from upstream in the Yellow Branch Creek and from Bogue Lusa Creek. In addition, the properties adjacent to upstream sediment and surface water locations can be used to collected background soil samples. Figure 7 provides proposed sample locations. The quantities and analyses for background samples are presented in Tables 4 and 5.

Samples collected during Phase One will provide data to complete risk assessments and provide a better understanding of the conceptual site model. However, if delineation of site contaminants in soil, sediment, or surface water is not achieved following Phase One activities, additional delineation of contaminants may be needed in a subsequent phase.

TABLE 4. PHASE ONE SOIL SAMPLES

Matrix	Sample Depth(s)	Number of Samples	Parameters
Soil (40 locations to 30 feet and 8 locations to 4 feet)	0 to 6 inches	100 percent (estimated 48 samples)	SVOCs
			Metals
		30 percent (estimated 15 samples)	PCBs
			Dioxins and Furans
		10 percent (estimated 5 samples)	pH
	6 inches to 24 inches	100 percent (estimated 48 samples)	SVOCs
			Metals
		30 percent (estimated 15 samples)	PCBs
			Dioxins and Furans
	First subsurface interval (depth to be determined in the field; this interval will be collected above 10 feet below ground surface to ensure sufficient data is collected for the human health risk assessment)	100 percent (estimated 48 samples)	SVOCs
			Metals
		10 percent (estimated 5 samples)	PCBs
			Dioxins and Furans
		50 percent[1] (estimated 24 samples)	VOCs
	Second to fourth subsurface intervals, collected as needed (depths to be determined in the field)	100 percent (estimated 120 samples)	SVOCs
			Metals
		10 percent (estimated 12 samples)	PCBs
			Dioxins and Furans
		50 percent[1] (estimated 60 samples)	VOCs
	Three borings will be selected to have a collocated boring advanced to allow a sample from each lithology type in the vadose sample will be collected (e.g., sand, silt, clay)	3 borings each with 3 lithologies (9 samples of each test)	SPLP SVOCs
			SPLP Metals
			SPLP VOCs
			Geotechnical[2]
			pH
			TOC
Background Soil	0 to 12 inches	10 samples (Yellow Branch) 10 samples (Bogue Lusa)	SVOCs
			Metals
		3 samples (Yellow Branch) 3 samples (Bogue Lusa)	PCBs
			Dioxins and Furans

Note:
[1] Each soil boring will be field screened with a photoionization detector. Sample intervals with the three highest readings will be sent to the laboratory for analysis. If no VOCs are detected from a boring, samples may not be sent to the laboratory for VOC analysis from that location. Note VOCs are not scheduled for surface soil samples (0 to 24 inches) because the likelihood of VOCs remaining in surface soil over time is low at the site. High temperatures and frequent disturbance of surface soils due to activities of the concrete and aggregate companies that occupied the site after the wood treatment facility.
[2] Includes moisture content, bulk density, porosity, effective porosity, particle size, atterberg limits, hydraulic conductivity, and percent organic matter.

dioxins – polychlorinated dibenzodioxins
furans – polychlorinated dibenzofurans
PCB – polychlorinated biphenyls as Aroclors
SPLP – synthetic precipitation leaching procedure
SVOC – semivolatile organic compound
TOC – total organic carbon
VOC – volatile organic compound

TABLE 5. PHASE ONE SEDIMENT AND SURFACE WATER SAMPLES

Matrix	Sample Depth(s)	Number of Samples	Parameters
Sediment	0 to 6 inches	10	SVOCs
			Metals
			TOC
			AVS/SEM
		3	PCBs
			Dioxins and Furans
			VOCs
			pH
			Particle Size
Surface Water[1]	surface grab	10[2]	SVOCs
			Total Metals
			Dissolved Metals
		3[2]	VOCs
			TDS
			TSS
			Hardness
			Alkalinity
Background Sediment	0 to 6 inches	10 (Yellow Branch) 10 (Bogue Lusa)	SVOCs
			Metals
		3 (Yellow Branch) 3 (Bogue Lusa)	PCBs
			Dioxins and Furans
Background Surface Water[1]	surface grab	10 (Yellow Branch)	Total Metals
			Dissolved Metals

Note:
[1] Surface water field parameters that will be collected are listed in Section 2.2.3.
[2] Surface water sample locations will be collocated with sediment sample locations. If no water is present, surface water samples will not be collected.

AVS – acid volatile sulfides
dioxins – polychlorinated dibenzodioxins
furans – polychlorinated dibenzofurans
PCB – polychlorinated biphenyl as Aroclors
SEM – simultaneously extracted metals
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
TSS – total suspended solids
VOC – volatile organic compound

Phase Two – Monitor Wells and Contaminant Delineation

No ground water data have been collected at the site. Installation of up to 16 monitor wells is proposed for Phase Two of field activities. Monitor well locations and depths will be determined following review of the subsurface soil analytical results. A SAP Addendum will provide the proposed monitor well locations, soil sample intervals, and soil analyses, if necessary.

Review of Phase One data will also provide an indication if additional soil, sediment, or surface water samples need to be collected in order to delineate the nature and extent of contamination. These additional samples could be collected during Phase Two or any of the subsequent field phases. If needed, a SAP Addendum will provide details regarding proposed locations and analyses.

Phase Three – Monitor Well Sampling and Aquifer Testing

Installed monitor wells will be sampled and analyzed as provided in Table 6. Adjustments to the sampling plans may be made based on results from the prior field investigation events. It is recommended that following monitor well sampling, aquifer testing be performed. Plans and procedures for aquifer testing will be determined following review of monitor well installation well development datasheets. Details of this aquifer testing will be included in a SAP Addendum.

TABLE 6. PHASE THREE MONITOR WELL SAMPLES

Matrix	Number of Samples	Parameters
Ground Water[1]	16	SVOCs
		Total Metals
		Dissolved Metals
		VOCs
		TDS
		TOC
		DOC
		Ammonia
		Anions[2]
		Hardness
		Alkalinity

Note:
[1] Ground water field parameters that will be collected are listed in Section 2.2.5.
[2] Includes nitrate, nitrite, phosphate, chloride, fluoride, sulfate, and sulfide.

DOC – dissolved organic carbon
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
VOC – volatile organic compound

Phase Four – Well Survey and Private Water Well Sampling

Following installation and sampling of monitor wells, contaminant plume maps will be generated if ground water contamination is present. Using site-specific water level measurements, the gradient of ground water flow will be determined. This information will be used to evaluate which, if any, known private water wells need to be sampled and which analyses will be required. This information will also be used to determine if door-to-door inquiries need to be made in order to identify wells not registered with the Louisiana Department of Natural Resources. Details of this portion of field work will be included in a SAP Addendum, if needed.

Phase Five - Ecological Characterization

Plant and wildlife surveys will be conducted to document species that may be located at the site. During field surveys, EA will identify, and list the observed species. If encountered, state or federally listed rare, threatened, or endangered species, will be documented, photographed, and coordinates collected of their locations. If needed, wetland delineations may be performed. Details of this portion of field work will be included in a SAP Addendum, if needed.

2.2 SAMPLING METHODOLOGY

This section describes the procedures for sample collection. Table 7 lists the SOPs that will be implemented during the field program at the direction of EPA. The SOPs are provided in Appendix A.

Sample collection and handling procedures for samples will follow CLP protocols in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014), provided in Appendix A.

During sample collection, preparation, and field analysis, chain-of-custody will be maintained and documented as required in Section 2.9. Sample locations will be documented photographically and sketched in the field logbook; an accompanying photograph log will be completed in the field logbook (Section 1.6.1).

TABLE 7. LIST OF EA'S STANDARD OPERATING PROCEDURES

Number	Standard Operating Procedure Title
1	Labels
2	Chain-of-Custody Form
3	Subsurface/Utility Clearance
4	Sample Packing and Shipping
5	Field Decontamination
7	Surface Water Sampling
8	pH Measurement
9	Temperature Measurement
10	Water Level and Well Depth Measurements
11	Photoionization Detector
12	Specific Conductance Measurements
13	Monitoring Well Sample Collection
14	Collection of Production Well Samples
16	Surface Water, Groundwater, and Soil/Sediment Logbooks
19	Monitoring Well Installation
21	Sediment Sampling
22	Sediment and Benthic Sampling
23	Organic Vapor Analyzer
25	Soil Sampling
28	Well Boring and Abandonment
36	Turbidity Measurements
37	Dissolved Oxygen Measurements
38	Redox Potential Measurements
39	Sample Preservation and Container Requirements
42	Disposal of Investigation-derived Material
47	Direct-push Technology Sampling
48	Low-flow Sampling
59	Field Logbook

Note:
Redox - Reduction-oxidation

2.2.1 Collection of Soil Samples

Dual tube-direct push methodology with acetate sleeves will be used to collect continuous cores from the surface to the specified depth (e.g., 4 feet or 30 feet). Intervals of the continuous cores will be sampled at the following depths as indicated in Table 4:

- 0 to 6 inches
- 6 to 24 inches
- Above 10 feet bgs (e.g., 6-8 ft; depth determined in the field based on field screening, visual and olfactory evidence, and water levels; intervals with not cross lithologic boundaries)
- Up to 3 additional subsurface intervals as needed (depths determined in the field based on field screening, visual and olfactory evidence, and water levels; intervals with not cross lithologic boundaries).

A field geologist will log the material types within each boring in accordance with the Unified Soil Classification System. Soil cores will be field screened with the photoionization detector.

Subsurface sample intervals will be determined based on changes in lithology. Sample intervals will be composited in disposable aluminum pans with laboratory grade disposable scoops prior to placing in sample jars. With the exception of VOCs, which will be collected immediately upon removal of the soil core from the ground and prior to compositing of samples. Samples will be collected in accordance with SOP 025 (Appendix A).

Coordinates for soil boring locations will be obtained after sampling using a hand-held global position system (GPS) device. Boring locations may be adjusted based on existing field conditions to accommodate the existence of buried debris, concrete slabs, buried utilities, and permanent structures, as necessary. Following completion of sampling activities, borings will be abandoned in accordance with SOP 028 (Appendix A).

2.2.2 Collection of Sediment Samples

Sediment samples will likely be collected by either a sediment core sampler or laboratory grade disposable scoops. Sediment samples will be collected from 0 to 6 inches in depth and in accordance with SOP 021 (Appendix A). Coordinates for sediment locations will be obtained after sampling using a hand-held GPS device. A sample collection datasheet will be completed for each location (Appendix C).

2.2.3 Collection of Surface Water Samples

Surface water samples will be collected by pumping water from the sample location through dedicated Teflon™-lined polyethylene tubing using a peristaltic pump; the intake of the sample tubing will be placed 6 inches below the surface of the water. Filtered surface water samples (i.e., dissolved metals analyses) will be collected by pumping water through a 0.45-micron

disposable filter. Samples will be collected in accordance with SOP 021 (Appendix A). Coordinates for surface water locations will be obtained after sampling using a hand-held GPS device. A sample collection datasheet will be completed for each location (Appendix C).

Field parameters collected during surface water sample collection will include surface water flow rate, water temperature, pH, conductivity, total dissolved solids (TDS), oxidation-reduction potential (ORP), dissolved oxygen, and turbidity.

2.2.4 Monitor Well Installation

EA will supervise subcontractor installation, development, and surface completion of monitor wells. Monitor wells will be drilled and constructed in accordance with SOP 019 (Appendix A), LAC 56 – Public Works, and the *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook* (LDEQ and Louisiana Department of Transportation and Development 2000).

Before drilling each boring, the down-hole equipment, rig, and other equipment (as necessary) will be steam-cleaned or high-pressure washed using hot water, followed by a pressurized potable water rinse to minimize cross contamination. Decontamination of the equipment will follow general practices listed in SOPs 005 and 019 (Appendix A). Water derived from decontamination will be collected and temporarily stored at the staging area for profiling prior to disposal as discussed in Section 2.5.

The lithologic logs will be prepared by examining soil cuttings.

The monitor wells will be developed following the correct completion of each well. The monitor wells will be allowed to set 48 hours prior to well development.

2.2.5 Monitor Well Sampling

Monitor wells will be purged and sampled using low-flow (micro-purge) sampling protocol at a maximum flow rate of 0.5 liter per minute (SOP 048, Appendix A). Low-flow sampling requires that minimal drawdown is maintained throughout purging of the well to ensure that the water being purged is in fact entering the pump from the formation, and not as a result of lowering water levels within the well. Water level measurements will be collected periodically to confirm that drawdown is not occurring (SOP 010, Appendix A). The pump intake will be positioned near the middle of the screened water interval. Ground water sampling documentation will include records of the volume of water removed from the well, the depth of the pump intake, depth-to-water measurements prior to and at the completion of purging and sampling, and the identification and order of samples collected.

Ground water will continue to be purged until measurements of temperature and conductivity have stabilized to within 10 percent, and pH has stabilized to within 0.1 units. Other parameters will be monitored during purging, including turbidity, ORP, and dissolved oxygen, but will not be used as stabilizing criteria. Measurement of field parameters is further described in SOPs 008, 009, 012, 036, 037, 038, and 048 (Appendix A).

2.2.6 Tap Water Sampling

Tap water samples will be collected from private water wells, if deemed necessary based upon review of sampling results from Phase Three. Prior to the mobilization of the EA field team, each resident will be notified by EPA or EA, if directed by EPA, and given an approximate date and time of well sampling along with documentation of special requirements by the resident. EA will coordinate with EPA prior to site mobilization to identify the wells that are to be sampled and to ensure that the necessary access agreements are in place.

The private water wells will be purged and geochemical parameters monitored and logged using a calibrated water quality meter in accordance with SOP 014 (Appendix A). The parameters collected will include pH, temperature, and conductivity (SOPs 008, 009, and 012). These parameters will be measured for 15 minutes prior to sampling or until the readings have stabilized (temperature and conductivity within 10 percent, and pH within 0.1 units).

2.2.7 Ground Water Classification

Impacted ground water zone(s) will be classified in accordance with EPA and LDEQ requirements as determined by current or potential use, maximum sustainable well yield, and TDS concentration.

EPA classification of ground water as defined by the *Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy* (EPA 1986) and as specified in the *Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration* (EPA 2009b). EPA classifies ground water as outlined below:

- **Class I**—Special ground water
- **Class II**—Ground water currently and potentially a source for drinking water
- **Class III**—Ground water not a source of drinking water.

LDEQ Risk Evaluation/Corrective Action Program (LDEQ 2003) requires the following information to classify ground water as Class 1, 2, or 3 as defined by LDEQ:

- The current use of the aquifer determined by identifying the existing water wells and usage within one-mile radius of the site property boundaries (at a minimum, a well survey within the last 12 months and a 500-foot radius walking receptor survey).
- The maximum sustainable yield determined by well yield estimation methods or direct measurements.
- The background TDS concentration of the aquifer, as determined by EPA Method 160.1.

Method 160.1 is no longer commonly used by EPA and Standard Method 2540C will be used in substitution.

2.2.8 Land Survey (Global Positioning System/Vertical Survey)

During the RI field program, EA will survey sample locations and source area dimensions (e.g., pits) using portable GPS equipment. The determination of locations and top of casing elevations for newly installed monitor wells will be subcontracted to a local Registered Professional Licensed Surveyor in the State of Louisiana as specified in Section 1.5. Elevations for each new monitor well top of casing elevations will be measured and referenced to a relative benchmark. After field activities are complete, the survey data will be used to produce accurate maps illustrating the information collected.

2.3 SAMPLE PROCESSING

Samples for offsite laboratory analysis will be processed and packaged in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014; Appendix A) and/or SOP 004 (Appendix A), as applicable.

2.4 DECONTAMINATION

Re-usable field equipment utilized during the RI/FS field activities will be decontaminated prior to and after use in accordance with SOP 005 (Appendix A). The decontamination of field equipment will occur in buckets, plastic containers, or other similar containers with sealing lids, and the resulting fluid will be transferred to investigation-derived waste (IDW) containment vessels (e.g., 55-gallon drums) staged in a designated staging area. The decontamination fluids will be properly sampled and disposed of following local, state, and federal guidelines (Section 2.5).

2.5 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Decontamination water, purge water, drill cuttings, and unused portions of soil samples will be drummed, sealed, labeled, and stored at the designated staging area until profiled for acceptance at an approved disposal facility (SOP 042, Appendix A). IDW samples will be submitted to a subcontracted laboratory for disposal characterization. Landfill Disposal Restrictions will dictate sample quantities and analysis. Table 8 provides a minimum list of analyses that will be required for profiling.

Note, 40 CFR 261.31 defines hazardous waste number F034 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 use creosote formulations."*

Therefore it is likely that IDW generated at this site will need to be classified as a listed hazardous waste. Analytical results will determine if additional waste codes apply.

TABLE 8. INVESTIGATION-DERIVED WASTE SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives	Holding Time[b]
SOLIDS				
TCLP SVOCs[c]	SW-846 Methods 1311 and 8270C	(1) 16-oz. glass jar; polypropylene or phenolic cap; PTFE liner	Store at 4±2°C	14 days
TCLP Metals[d]	SW-846 Methods 1311, 6010B, and 7470A			
TCLP VOCs	SW-846 Methods 1311 and 8260B	(1) 8-oz. glass jar; polypropylene or phenolic cap; PTFE liner (zero headspace)	Store at 4±2°C	2 days
LIQUIDS				
SVOCs[c]	SW-846 Methods 8270C	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
Metals[d]	SW-846 Methods 6010B and 7470A	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
VOCs	SW-846 Methods 8260B	(3) 40-mL. amber glass vial; polypropylene or phenolic open-top screw-cap; PTFE septum	HCl to pH≤2; Store at ≤6°C	14 days
Corrosivity (pH)	SW-846 Method 9040B	(1) 500-mL. HDPE	Store at 4±2°C	14 days
Ignitability (flashpoint)	SW-846 Method 1010 or 1020			

Note:
[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.
[c] Analysis must include acenaphthene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene to evaluate whether or not concentrations exceed F034 treatment standards.
[d] Analysis must include arsenic and chromium to evaluate whether or not concentrations exceed F034 treatment standards.

°C – degrees Celsius
HDPE – high-density polyethylene
PTFE – polytetrafluoroethylene
SVOC – semivolatile organic compound
SW-846 – Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
TCLP – Toxicity characteristic leaching procedure
VOC – volatile organic compound

2.6 SAMPLE DESIGNATION

Each sampling location will be designated with a unique alphanumeric designation.

2.6.1 Investigatory and Background/Ambient Condition Samples

Samples will be designated with a series of fields that are separated by dashes.

- The first field indicates if the sample is from the site or downstream of the site and will start with the site spill identifier (i.e., A6Z7). If the samples are not site related, that is background or ambient condition samples, they will start with a four letter code indicating where they were collected (i.e., upstream Yellow Branch "YEBR," Bogue Lusa Creek "BOLU").

- The second field, a three digit number starting at 101, represents the sample location, which will increase sequentially with each successive location.

- The third field identifies the sample matrix, where:
  - SO = Soil
  - SE = Sediment
  - SW = Surface water
  - SF = Field filtered surface water.

- The fourth and fifth fields, "0-2" represent the top and bottom of the soil and sediment sample interval, measured in feet bgs for soil and sediment.

2.6.2 Quality Control Samples

QC samples will be designated as discussed below.

Field Duplicate Sample Designation

Field duplicate samples will be identified by substituting an "8" for the "1" at the beginning of the sample of number for sample designations described above. For example, the duplicate of sample A6Z7-SO-101-0-2 would be A6Z7-SO-801-0-2.

Aqueous Field, Trip, and Equipment Rinsate Blank Sample Designation

Aqueous field blank (FB), trip blank (TB), and equipment rinsate blank (ER) samples will be identified by two fields beginning with "QCFB," "QCTB," or "QCER" respectively, followed by a dash "-." then the date in the following format YYYYMMDD. For example a trip blank for samples submitted on 15 November 2016 would have the following sample identification number "QCTB-20161115." If two field, trip, or equipment rinsate blanks will be collected on the same day, an additional field will be added; for example: QCTB-20161115-1 and QCTB-20161115-2.

Matrix Spike/Matrix Spike Duplicate and Matrix Spike/Matrix Duplicate

Additional aliquots for the preparation of MS/MSD and MS/MD samples will not have specific sample identifiers, but will be identified on the chain-of-custody record.

2.7 SAMPLE CONTAINER, VOLUME, PRESERVATION, AND HOLDING TIME REQUIREMENTS

Tables 9 through 13 specify the required sample volume, container type, preservation technique, and holding time for each analysis by matrix that is to be conducted during each phase of sampling. Laboratory QC samples (e.g., MS/MSD) may require additional sample volume: it will be necessary to verify with the laboratory prior to shipment.

TABLE 9. SOIL ANALYTICAL METHODS AND SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives	Holding Time[b]
SVOC SIM	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner[c]	Store at ≤6°C	14 days
SVOCs	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner[c]	Store at ≤6°C	14 days
Metals (including Hg)	CLP ISM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	180 days (28 days for Hg)
VOCs	CLP SOM02.3	(3) 5-gram samplers (e.g., EnCore) and (1) 4-oz. glass jar	Store at ≤6°C	2 days[d]
PCBs as Aroclors	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	14 days
Dioxins and Furans	HRSM01.2	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at 4±2°C	360 days
SPLP SVOCs	CLP SOM02.3	(2) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	14 days
SPLP Metals	CLP ISM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	180 days (28 days for Hg)
SPLP VOCs	CLP SOM02.3	(1) 4-oz. glass jar; polyethylene or phenolic open-top cap; PTFE septa and (1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner[e]	Store at ≤6°C	14 days
Classification of Soils	ASTM D422 and ASTM D4318	(1) 12-inch, 3-inch diameter Shelby tube (minimum of 6 inches of intact core)	None	As soon as practicable
Organic Matter	ASTM D2974		None	
Atterberg Limits	ASTM D4318		None	
Hydraulic Conductivity	ASTM D5084		Preserve moisture	
Bulk Density	ASTM D7263		None	
Specific Gravity	ASTM D854		None	
pH	SW-846 9045C	(1) 4-oz. glass jar	None	Immediately upon laboratory receipt
TOC	Walkley Black or ASTM F1647-02A	(1) 4-oz. glass jar	Store at ≤6°C	28 days

Note:
[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.
[c] The EPA Region 6 Laboratory may only require one 8-ounce jar to analyze for the equivalent of SVOC SIM and SVOCs. SIM is requested in order to achieve reporting limits suitable to meet Data Quality Objectives.
[d] Freezing samples in the field will extend the holding time to 14 days; however samples will need to be shipped within 12 days of collection in order to allow the laboratory time to complete the analysis.
[e] Container requirements listed as directed from the EPA Region 6 Alternate ESAT Regional Project Officer.

°C – degrees Celsius
dioxins – polychlorinated dibenzodioxins
furans – polychlorinated dibenzofurans
Hg – mercury
PCB – polychlorinated biphenyl as Aroclors
PTFE - polytetrafluoroethylene
SIM – selected ion monitoring
SPLP – synthetic precipitation leaching procedure
SVOC – semivolatile organic compound
TOC – total organic carbon
VOC – volatile organic compound

TABLE 10. SEDIMENT ANALYTICAL METHODS AND SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives	Holding Time[b]
SVOC SIM	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner[c]	Store at ≤6°C	14 days
SVOCs	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner[c]	Store at ≤6°C	14 days
Metals (including Hg)	CLP ISM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	180 days (28 days for Hg)
VOCs	CLP SOM02.3	(2) 4-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	14 days
PCBs as Aroclors	CLP SOM02.3	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at ≤6°C	14 days
Dioxins and Furans	HRSM01.2	(1) 8-oz. glass jar; polyethylene or phenolic cap; PTFE liner	Store at 4±2°C	360 days
pH	SW-846; 9045C	(1) 4-oz. glass jar	None	Immediate
TOC	Lloyd Kahn	(1) 4-oz. glass jar	Store at 4±2°C	28 days
Particle Size	ASTM D422	(1) 16-ounce HDPE jar	None	None
AVS/SEM[d]	821-R-91-100	(1) 4-oz. glass jar (zero headspace)	Store at 4±2°C	21 days

Note:
[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.
[c] The EPA Region 6 Laboratory may only require one 8-ounce jar to analyze for the equivalent of SVOC SIM and SVOCs. SIM is requested in order to achieve reporting limits suitable to meet Data Quality Objectives.
[d] Only includes acid volatile sulfides, cadmium, copper, lead, nickel, and zinc.

°C – degrees Celsius
AVS – acid volatile sulfides
dioxins – dibenzo-p-dioxins
furans – polychlorinated dibenzofurans
HDPE – high-density polyethylene
Hg – mercury
PCB – polychlorinated biphenyl
PTFE - polytetrafluoroethylene
SEM – simultaneously extracted metals
SIM – selected ion monitoring
SVOC – semivolatile organic compound
TOC – total organic carbon
VOC – volatile organic compound

TABLE 11. SURFACE WATER ANALYTICAL METHODS AND SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives[b]	Holding Time[c]
SVOC SIM	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
SVOCs	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
Metals (including Hg)	CLP ISM02.3	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
Dissolved Metals[d] (including Hg)	CLP ISM02.3	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
VOCs	CLP SOM02.3	(3) 40-mL. amber glass vial; polypropylene or phenolic open-top screw-cap; PTFE septum	HCl to pH≤2; Store at ≤6°C	14 days
TOC	SM 5310	(1) 250-mL. glass bottle	HCl to pH≤2; Store at 4±2°C	28 days
TDS	SM 2540C	(1) 1-L. HDPE bottle; polyethylene cap and liner	Store at 4±2°C	7 days
TSS	SM 2540D	(1) 1-L. HDPE bottle; polyethylene cap and liner	Store at 4±2°C	7 days
Alkalinity	SM 2320B	(1) 125-mL. HDPE bottle	Store at 4±2°C	14 days
Hardness	SM 2340B	(1) 250-mL. HDPE bottle	HNO_3 to pH≤2; Store at 4±2°C	180 days

Note:
The following parameters will be measured in the field: pH, temperature, specific conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity.

[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Water samples should not be frozen per the CLP Field Sampler's Guide (EPA 2014).
[c] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.
[d] Field filtered with a disposable 0.45 micron filter.

°C – degrees Celsius
HCl – hydrochloric acid
HDPE – high-density polyethylene
Hg – mercury
HNO_3 – nitric acid
PTFE - polytetrafluoroethylene
SIM – selected ion monitoring
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
TSS – total suspended solids
VOC – volatile organic compound

TABLE 12. GROUND WATER ANALYTICAL METHODS AND SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives[b]	Holding Time[c]
SVOC SIM	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
SVOCs	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
Metals (including Hg)	CLP ISM02.3	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
Dissolved Metals[d] (including Hg)	CLP ISM02.3	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
VOCs	CLP SOM02.3	(3) 40-mL. amber glass vial; polypropylene or phenolic open-top screw-cap; PTFE septum	HCl to pH≤2; Store at ≤6°C	14 days
TOC	SM 5310	(1) 250-mL. glass bottle	HCl to pH≤2; Store at 4±2°C	28 days
DOC	SM 5310	(1) 250-mL. glass bottle	HCl to pH≤2; Store at 4±2°C	28 days
TDS	SM 2540C	(1) 1-L. HDPE bottle	Store at 4±2°C Store at 4±2°C	7 days
Ammonia	EPA 350.1	(1) 250-mL. glass bottle	H_2SO_4 to pH≤2 Store at 4°C	28 Days
Anions[d] (Nitrate-N, Nitrite-N, o-Phosphate-P)	Method 300	(1) 1-L. HDPE bottle	Store at 4±2°C	48 hours
Anions[d] (Chloride, Fluoride, Sulfate)	Method 300	(1) 1-L. HDPE bottle	Store at 4±2°C	28 days
Sulfide[d]	SM 4500-S^{2-}	(1) 250-mL. glass bottle	$ZnAc_2$ + NaOH to pH>9; Store at 4±2°C	7 days
Alkalinity, Total[d]	SM 2320B	(1) 125-mL. HDPE bottle	Store at 4±2°C	14 days
Hardness[d]	SM 2340B	(1) 250-mL. HDPE bottle	HNO_3 to pH≤2; Store at 4±2°C	180 days

Note:
The following parameters will be measured in the field: pH, temperature, specific conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity.

[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Water samples should not be frozen per the CLP Field Sampler's Guide (EPA 2014).
[c] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.
[d] Field filtered with a disposable 0.45 micron filter.

°C – degrees Celsius
H_2SO_4 – sulfuric acid
HCl – hydrochloric acid
HDPE – high-density polyethylene
Hg – mercury
HNO_3 – nitric acid
NaOH – sodium hydroxide
PTFE - polytetrafluoroethylene
SIM – selected ion monitoring
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
VOC – volatile organic compound
$ZnAc_2$ – zinc acetate

TABLE 13. EQUIPMENT RINSATE, FIELD BLANK, AND TRIP BLANK ANALYTICAL METHODS AND SAMPLE REQUIREMENTS

Parameter	Method	Volume and Container[a]	Preservatives	Holding Time[b]
SVOC SIM	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
SVOCs	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	7 days
Metals (including Hg)	CLP ISM02.3	(1) 1-L. HDPE cylinder-round bottle; polyethylene cap and liner	HNO_3 to pH≤2; Store at ≤6°C	180 days (28 days for Hg)
VOCs	CLP SOM02.3	(3) 40-mL. amber glass vial; polypropylene or phenolic open-top screw-cap; PTFE septum	HCl to pH≤2; Store at ≤6°C	14 days
PCBs as Aroclors	CLP SOM02.3	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at ≤6°C	14 days
Dioxins and Furans	HRSM01.2	(2) 1-L. amber round glass bottle; polypropylene or phenolic cap; PTFE liner	Store at 4±2°C	360 days

Note:
[a] It will be necessary to verify container requirements with the laboratory at the time of scheduling.
[b] Holding time is measured from the time of sample collection to the time of sample extraction and/or analysis.

°C – degrees Celsius
dioxins – dibenzo-p-dioxins
furans – polychlorinated dibenzofurans
HCl – hydrochloric acid
HDPE – high-density polyethylene
Hg – mercury
PCB – polychlorinated biphenyl
PTFE - polytetrafluoroethylene
HNO_3 – nitric acid
SIM – selected ion monitoring
SVOC – semivolatile organic compound
VOC – volatile organic compound

2.8 SAMPLE HANDLING AND CUSTODY

Each sample collected will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Sample integrity helps to ensure the legal defensibility of the analytical data and subsequent conclusions. Sample handling will follow CLP protocols as required in EPA's *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014).

The EA field team will use EPA's data management system known as "Scribe" to generate chain-of-custody records in the field. Applicable copies of generated Scribe files will be delivered to EPA data management personnel as required by CLP and Region protocols.

2.9 ANALYTICAL METHODS REQUIREMENTS

The source of analytical services to be provided will be determined in part by DQOs and the intended use of the resulting data. EPA-approved methods will be used for laboratory analyses of the samples.

EA will follow the analytical services request procedures that are outlined EA's Analytical Services Delivery Plan (EA 2005). If an analytical system fails, the EA QA officer will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining the need to re-prepare and reanalyze the samples.

Laboratories that are subcontracted by EA or EPA will conduct definitive laboratory analysis of samples. Tables 8 through 13 lists the laboratory analytical methods for this project. In cases, appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required quantitation limits.

2.9.1 Field Analytical Methods

EA will follow manufacturer-recommended procedures for operating field equipment.

2.9.2 Fixed-Laboratory Analytical Methods

Offsite fixed-laboratory analyses will be conducted by EPA Region 6 Laboratory, a designated CLP laboratory, or a subcontracted commercial laboratory. Samples submitted to the analytical laboratory will be analyzed in accordance methods identified in this SAP. Modifications to analytical methods that may be required to manage atypical matrices or to achieve low quantitation limits are not anticipated. Decisions regarding the use and type of method modifications will be made during the procurement of subcontracted laboratories, as different laboratories have equipment and SOPs that generate varying quantitation limits.

2.10 QUALITY CONTROL REQUIREMENTS

Various field and laboratory QC samples and measurements will be used to verify that analytical data meet the QA objectives. Field QC samples and measurements will be collected to assess the influence of sampling activities and measurements on data quality. Similarly, laboratory QC samples will be used to assess how the laboratory's analytical program influences data quality. This section describes the QC samples that are to be analyzed during the site sampling activities for: (1) each field and laboratory environmental measurement method; and (2) each sample matrix type. Table 14 presents the frequency of QC samples to be collected at the site.

TABLE 14. FREQUENCY OF FIELD QUALITY CONTROL SAMPLES

Field QC Sample	Frequency
Trip blank	1 per cooler containing investigative aqueous VOC samples
Field blank	1 per day
Field duplicate	1 per 10 samples (minimum 10 percent frequency)
Equipment rinsate blank	1 per non-dedicated equipment type per day or 1 per 20 samples
MS/MD[a] (inorganics)	1 per 20 samples or as directed by EPA
MS/MSD[a] (organics)	1 per 20 samples or as directed by EPA
Temperature blank	1 per cooler

Note:
[a] MS, MSD, and MD analyses are technically not field QC samples; however, they generally require that the field personnel collect additional volumes of samples and are, therefore, included on this table for easy reference. The analytical laboratory will be contacted to determine sample volume requirements.

EPA – U.S. Environmental Protection Agency
MD - matrix duplicate
MS - matrix spike
MSD - matrix spike duplicate
QC - quality control
VOC - volatile organic compound

2.10.1 Field Quality Control Requirements

Field QC samples will be collected and analyzed to assess the quality of data that are generated by sampling activities. These samples may include field duplicates, trip blanks, equipment rinsates, MS/MSD/MDs, and temperature blanks. QC samples collected in the field for fixed-laboratory analysis are presented in Table 14.

Field duplicates are independent samples that are collected as close as possible, in space and time, to the original investigative sample. Field duplicates can measure the influence of sampling and field procedures on the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. Immediately following collection of the original sample, the field duplicate is collected using the same collection method.

Field blanks are collected to assess: (1) impact from ambient air conditions during sample collection; (2) cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory; and (3) cleanliness of the sample containers and preservatives. Field blank samples consist of sample containers filled with analytically-certified, organic-free water. Field blank samples are typically collected during ground water sample collection for VOC analysis at a frequency of one field blank for each day of ground water sampling activities (specifically for VOC analysis). Field blanks may be collected for other media and analytes as dictated by site conditions during investigative sampling activities. If contaminant is present in the blank samples above the MDL, the result for associated field samples that contain the same contaminant will be qualified as potentially not detected if the concentration of the field sample is less than five times the concentration found in the blank.

Equipment rinsate blanks are collected when nondedicated or nondisposable sampling equipment is used to collect samples and put the samples into containers. These blanks assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring deionized water over the decontaminated surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated, but before the equipment is reused for sampling. If nondedicated or nondisposable equipment is used, equipment rinsate blanks will be collected.

Trip blanks are analyzed for VOCs only. VOC samples are susceptible to contamination by diffusion of organic contaminants through the Teflon-lined septum of the sample vial; therefore, a trip blank will be analyzed to monitor for possible sample VOC contamination. Also, the trip blank will screen for possible contamination of VOC samples during handling and shipment from the field to the laboratory.

Temperature blanks are containers of deionized or distilled water that are placed in each cooler shipped to the laboratory. Their purpose is to provide a container to test the temperature of the samples in the respective cooler.

2.10.2 Laboratory Quality Control Requirements

Laboratories that perform analytical work under this project must adhere to a QA program that is used to monitor and control laboratory QC activities. Each laboratory must have a written QA manual that describes the QA program in detail. The laboratory QA Manager is responsible for ensuring that laboratory internal QC checks are conducted in accordance with EPA methods and protocols, the laboratory's QA manual, and the requirements of this SAP.

Many of the laboratory QC procedures and requirements are described in EPA-approved analytical methods, laboratory method SOPs, and method guidance documents. The EPA methods specify the preparation and analysis of QC samples, and may include, but are not limited to, the following types: (1) LCSs; (2) method blanks; (3) MS, MSD, and MD samples; (4) surrogate spikes; and (5) standard reference materials or independent check standards.

2.10.2.1 Contract Laboratory Program Matrix Spike and Matrix Spike Duplicates

SVOCs, VOCs, and dioxins and furans analyzed through the CLP will not be analyzed for MS or MSD sample pairs. The EPA Region 6 Regional Sample Control Center provided the following rationale for opting out of traditional MS/MSD pairs for these analyses:

> *"Surrogates in laboratory work have evolved so that they are so similar to the targets, accuracy recoveries for these surrogates are nearly identical to the targets. The surrogates are nearly identical to the targets but the Mass Spectrometer can easily distinguish between the target and its surrogate. These deuterated surrogates are spiked into every sample in some lab procedures (dioxin/furans, PCB congeners, CLP SVOA, CLP VOA). Accuracy recoveries can then be harvested from every sample and the MS (and MSD) spiking of targets is not required. Since they are spiked into every compound a precision measurement is not required for extrapolation purposes… So for CLP work we do not recommend MS/MSD for the SVOA or VOA."*

2.10.3 Common Data Quality Indicators

This section describes how QA objectives for precision, accuracy, completeness, and sensitivity are measured, calculated, and reported.

2.10.3.1 Precision

Precision of many analyses is assessed by comparing analytical results of MS and MSD sample pairs for organic analyses, field duplicate samples, laboratory duplicate samples (MDs), and field replicate measurements. If precision is calculated from two measurements, it is normally measured as RPD (Section 1.4.2.1). If precision is calculated from three or more replicates, relative standard deviation is calculated. RPD acceptance criteria for this project are presented in Table 15.

TABLE 15. PRECISION QUALITY ASSURANCE INDICATOR CRITERIA

Indicator Parameter	Analytical Parameter	QC Sample	Acceptance Criteria for Laboratory Analysis
Precision (Relative Percent Difference)	SVOCs, Dioxins and Furans[a]	MS, MSD	30 percent RPD
		Field Duplicates	50 percent RPD
	PCBs as Aroclors	MS, MSD	30 percent RPD
		Field Duplicates	50 percent RPD
	VOCs	MS, MSD	30 percent RPD
		Field Duplicates	50 percent RPD
	Metals (aqueous)	MS, MSD or MD	20 percent RPD
		Field Duplicates	50 percent RPD
	Metals (solid)	MS, MSD, or MD	35 percent RPD
		Field Duplicates	50 percent RPD
	AVS/SEM, TSS, TDS, TOC, DOC, Sulfide, Anions, Hardness, Alkalinity	Field Duplicates	50 percent RPD

Note:
[a] Samples analyzed through the Contract Laboratory Program will not be analyzed for MS/MSDs per recommendation from EPA Region 6 Regional Sample Control Center.

AVS – acid volatile sulfides
dioxins – polychlorinated dibenzodioxins
DOC – dissolved organic carbon
furans – polychlorinated dibenzofurans
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
PCB – polychlorinated biphenyl
RPD – relative percent difference
SEM – simultaneously extracted metals
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
TSS – total suspended solids
VOC – volatile organic compound

2.10.3.2 Accuracy

The accuracy of many analytical methods may be assessed by using the results of MS and MSD samples for organic analyses, MS samples for inorganic analyses, surrogate spike samples, LCSs, standard reference materials, independent check standards, and measurements of instrument responses against zero and span gases.

For measurements in which spikes are used, percent recovery will be calculated as discussed in Section 1.4.2.2. Percent recovery criteria for this project are specified in Table 16.

TABLE 16. ACCURACY QUALITY ASSURANCE INDICATOR CRITERIA

Indicator Parameter	Analytical Parameter	QC Sample	Acceptance Criteria for Laboratory Analysis
Accuracy (Percent Recovery)	SVOCs, VOCs, Dioxins and Furans	LCS	Per current CLP SOW
		Blanks	Less than the CRQL
	PCBs as Aroclors	MS, MSD, LCS	Per current CLP SOW
		Blanks	Less than the CRQL
	Metals	MS, LCS	Per current CLP SOW
		Blanks	Less than the CRQL
	AVS/SEM, TSS, TDS, TOC, DOC, Sulfide, Anions, Hardness, Alkalinity	LCS	Per current laboratory control limits
		Blanks	Less than the RL

Note:
AVS – acid volatile sulfides
CLP – Contract Laboratory Program
CRQL - contract-required quantitation limit
dioxins – polychlorinated dibenzodioxins
DOC – dissolved organic carbon
furans – polychlorinated dibenzofurans
LCS – laboratory control sample
MS – matrix spike
MSD – matrix spike duplicate
PCB – polychlorinated biphenyl
RL – reporting limit
SEM – simultaneously extracted metals
SOW – statement of work
SVOC – semivolatile organic compound
TDS – total dissolved solids
TOC – total organic carbon
TSS – total suspended solids
VOC – volatile organic compound

2.10.3.3 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP, and when none of the QC criteria that affect data usability are exceeded.

When data validation is completed, the percent completeness value will be calculated by dividing the number of useable results by the total number of sample results planned for this investigation. The objective for data completeness is 90 percent.

Completeness will also be evaluated as part of the data quality assessment (DQA) process (EPA 2006c, 2006d). This evaluation will help determine whether limitations are associated with the decisions to be made based on the data collected.

2.10.3.4 Sensitivity

The achievement of MDLs depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality and to ensure that analyses meet the QA objectives that have been established for sensitivity (e.g., action levels).

2.10.4 Instrument and Equipment Testing, Inspection, and Maintenance Requirements

This section outlines testing, inspection, and maintenance procedures for field equipment and instruments and for laboratory instruments.

2.10.4.1 General Requirements

Testing, inspection, and maintenance methods and frequency will be based on: (1) the type of instrument; (2) the instrument's stability characteristics; (3) the required accuracy, sensitivity, and precision of the instrument; (4) the instrument's intended use, considering project-specific DQOs; (5) manufacturer's recommendations; and (6) other conditions that affect measurement or operational control. For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in (1) the instrument manufacturer's literature or operating manual, or (2) SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. This can occur when a field instrument is used to make critical measurements or when the analytical methods that are associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

2.10.4.2 Field Equipment and Instruments

Leased field equipment and instruments will be used to conduct site media sampling and preparation. The vendor will be responsible for thoroughly checking and calibrating field equipment and instruments before they are shipped or transported to the field. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments.

After the field equipment and instruments arrive in the field, they will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to ensure full operating capacity; if needed, batteries will be recharged or replaced.

Following use, field equipment will be decontaminated properly before being returned to the source. When the equipment is returned, copies of field notes regarding equipment problems will be included so that problems are not overlooked and necessary equipment repairs are performed.

2.10.4.3 Laboratory Instruments

Laboratories that analyze samples collected under the EPA Region 6 RAC II program shall have a preventive maintenance program that addresses: (1) testing, inspection, and maintenance procedures and (2) the maintenance schedule for each measurement system and required support activity. This program is usually documented by a SOP for each analytical instrument that is to be used. Typically, the program will be laboratory-specific; however, it should follow requirements outlined in EPA-approved guidelines. Some of the basic requirements and components of such a program are as follows:

- As a part of its QA/QC program, each laboratory will conduct a routine preventive maintenance program to minimize instrument failure and other system malfunction.

- An internal group of qualified personnel will maintain and repair instruments, equipment, tools, and gauges. Alternatively, manufacturers' representatives may provide scheduled instrument maintenance and emergency repair under a repair and maintenance contract.

- The laboratory will perform instrument maintenance on a regularly scheduled basis. The scheduled service of critical items should minimize the downtime of the measurement system. The laboratory will prepare a list of critical spare parts for each instrument. The laboratory will request the spare parts from the manufacturer and will store the parts.

- Testing, inspection, and maintenance procedures described in laboratory SOPs will be performed in accordance with manufacturer's specifications and the requirements of the specific analytical methods that are used.

- Maintenance and service must be documented in service logbooks (or the site-specific logbook) to provide a history of maintenance records. A separate service logbook should be kept for each instrument; however, due to the limited scope of this project, the service records will be maintained in the site-specific field logbook. Maintenance records will be traceable to the specific instrument, equipment, tool, or gauge.

- The laboratory will maintain and file records that are produced as a result of tests, inspections, or maintenance of laboratory instruments. These records will be available for review by internal and external laboratory system audits that are conducted under the EPA Region 6 RAC II program.

2.11 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the procedures for maintaining the accuracy of field equipment and laboratory instruments that are used for field tests and laboratory analyses. The equipment and instruments should be calibrated before each use or, when not in use, on a scheduled periodic basis.

2.11.1 Field Equipment

EA will perform calibration of field equipment during the site field activities specified herein. Calibration of the field equipment (e.g., multi-parameter water quality meter) will be conducted on a daily basis following manufacturer recommendations, and will be performed prior to sample analysis activities. Should readings appear to be questionable during sample analysis, EA will recalibrate the equipment as deemed necessary. The equipment calibration procedures described below will be followed.

Equipment will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications and with project-specific DQOs. Upon arrival of the field equipment, EA field personnel will examine it to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that calibration procedures are followed. Measuring and testing equipment may be calibrated either internally—

by using in-house reference standards—or externally—by agencies, manufacturers, or commercial laboratories. Calibration records will contain a reference identifying the source of the procedure and, where feasible, the actual procedure. Each piece of measuring and testing equipment will also be accompanied by an equipment use log. The equipment use log (which may be contained within the site-specific field logbook) will be kept current and may contain the following information: (1) date of use; (2) times of use; (3) operating and assisting technicians; (4) calibration status; and (5) comments.

2.11.2 Laboratory Instruments

Laboratory equipment that is used to analyze samples collected under the EPA Region 6 RAC II program will be calibrated on the basis of written SOPs that are maintained by the laboratory. Calibration records (including the dates and times of calibration and the names of the personnel performing the calibration) will be filed at the location at which the analytical work was performed and maintained by the laboratory personnel who performed QC activities. Subcontractor laboratories may conduct laboratory work under the EPA Region 6 RAC II program. The laboratory QA Manager is responsible for ensuring that laboratory instruments are calibrated in accordance with the requirements of this SAP.

The laboratories will follow the method-specific calibration procedures and requirements for laboratory measurements. Calibration procedures and requirements will also be provided, as appropriate, for laboratory support equipment, such as balances, mercury thermometers, pH meters, and other equipment that is used to take chemical and physical measurements.

2.12 REQUIREMENTS FOR INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The EA Project Manager is responsible for identifying the types and quantities of supplies and consumables that are needed for collecting the samples for this Task Order. The EA Project Manager is also responsible for determining acceptance criteria for these items. When supplies are received, the EA field personnel will check packing slips against purchase orders and inspect the condition of supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. Afterward, the item will be returned to the vendor for replacement or repair.

2.13 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

For this project, EA anticipates acquiring data from non-direct measurements such as databases, spreadsheets, and literature files.

2.14 DATA MANAGEMENT

A comprehensive data management program has been designed to assure that: (1) multiple information sources will result in similar datasets; and (2) data management practices will be adequate for the types of data processing required by a task order. Site team members will

follow these protocols to assure results will have uniform units of measure, analytical methods, and reporting forms.

Data for this project will be obtained from a combination of sources, including field measurements, subcontracted fixed laboratories, EPA Region 6 Laboratory, and CLP laboratories. The data-gathering process requires a coordinated effort and will be conducted by project staff members in conjunction with potential data producers. The data will be obtained from the analytical service provider, when appropriate, in the form of an EDD, in addition to the required hard copy analytical data package. Formal verification (or validation) of data will be conducted before associated results are presented or are used in subsequent activities.

Data tracking is essential to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain-of-custody. When the analytical service provider receives custody of the samples, the provider will send a sample acknowledgment to EA. The sample acknowledgment will confirm sample receipt, condition, and required analyses. The EPA tracking software (Scribe) will contain pertinent information about each sample and can track the data at each phase of the process. The tracking software carries the data through completion of the data validation.

EA will validate 10 percent of the investigative analytical data received from subcontract laboratories (other than the EPA Region 6 Laboratory or CLP laboratories) to ensure that the confirmatory data are accurate and defensible. A partial review will be conducted on the remaining 90 percent of the data received from subcontract laboratories. Data will be evaluated for usability by EA in accordance with EPA CLP guidelines for data review (EPA 2016c, 2016d).

As a part of the data validation process, EDDs will be reviewed against hard copy deliverables to ensure accurate transfer of data. In addition, the hard copy will be evaluated for errors in the calculation of results. After the data validation, qualifiers can be placed on the data to indicate the usability of the data. These qualifiers will be placed into an electronic data file. Upon approval of the dataset with the appropriate data qualifiers, the electronic data will be released to the EA Project Manager for reporting.

3. ASSESSMENT AND OVERSIGHT

This section describes the field and laboratory assessments that may be conducted during this project, the individuals responsible for conducting assessments, corrective actions that may be implemented in response to assessment results, and how quality-related issues will be reported to EA and EPA.

3.1 ASSESSMENT AND RESPONSE ACTIONS

Under the EPA Region 6 RAC II program, performance and system audits of field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the following:

- Performance and system audits
  - Audit personnel
  - Audit scope of work
  - Audit frequencies
  - Audit reports.

- Corrective action
  - Sample collection and field measurements
  - Laboratory analyses.

Nonconforming items and activities are those that do not meet the project requirements, procurement document criteria, and approved work procedures. Nonconformance may be detected and identified by the following personnel:

- Project personnel—During field operations, supervision of subcontractors, and field inspections

- Testing personnel—During preparation for and performance of tests, equipment calibration, and QC activities

- QA personnel—During the performance of audits, surveillance, and other QA activities.

Each nonconformance that affects quality will be documented by the person who identifies or originates the nonconformance. Documentation of nonconformance will include the following components:

- Description of nonconformance.

- Identification of personnel who are responsible for correcting the nonconformance and, if verification is required, for verifying satisfactory resolution.

- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted.

- Proposed schedule for completing corrective action and the corrective action taken.

Nonconformance documentation will be made available to the EA Project Manager, EA QA Officer, and subcontractor (e.g., subcontracted commercial laboratories) management personnel, as appropriate.

The field personnel and QA personnel, as appropriate, are responsible for notifying the EA Project Manager and the EA QA Officer of the nonconformance. In addition, the EA Project Manager and the project staff, as appropriate, will be notified of significant nonconformances that could affect the results of the work. The EA Project Manager is responsible for determining whether notification of EPA is required.

The completion of corrective actions for significant nonconformances will be documented by QA personnel during future auditing activities. Significant recurring nonconformance will be evaluated by project and QA personnel, as appropriate, to determine its cause. Appropriate changes will be instituted, under corporate or project procedures, to prevent recurrence. When such an evaluation is performed, the results will be documented.

3.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection operations requires timely assessment and review of measurement activities. It is essential that open communication, interaction, and feedback be maintained among project participants, including: (1) the EA QA Officer, EA Program Manager, EA Project Manager, technical staff, and laboratory subcontractors; and (2) the EPA Region 6 TOM and EPA QA Officer.

During the RI field program, EA will prepare weekly reports that summarize the following elements:

- Work progress since the last weekly report
- Site observations, problems, and decisions
- Problems that may impede planned progress
- Safety-related observations, incidents, or potential safety problems and the corrective action(s) taken to mitigate the problem(s)
- Corrective measures and procedures to regain the planned schedule, if required
- QA/QC activities (e.g., number of QC samples)
- Work scheduled for the next work period.

EA prepares monthly progress reports for each Task Order that is conducted under the EPA Region 6 RAC II program. These reports address QA issues that are specific to the Task Order and facilitate timely communication of such issues.

At the program level, the EA QA Officer prepares quarterly status reports of QA issues that are related to EA's work on the EPA Region 6 RAC II program. These reports are distributed to EA's President, Corporate QA Officer, Program Manager, and, upon request, the EPA Region 6 Project Officer. QA status reports address the following areas:

- Results of QA audits and other inspections, including quality improvement; opportunities that have been identified for further action
- Instrument, equipment, or procedural problems that affect QA
- Subcontractor performance issues
- Corrective actions
- Status of previously reported activities and quality improvement initiatives
- Work planned for the next reporting period.

It is the Data Manager's responsibility, in consult with the Site Manager and Sample Team Leader, to direct sample collection efforts. Also, the Data Manager is responsible for assigning QA/QC samples to the appropriate media in the appropriate quantities.

There are two independent checks on the Data Manager to ensure that sample data management is adequate and to ensure that the appropriate quality control samples are collected. The Sample Team Leader provides an initial check of the sampling program to ensure that the appropriate number and type of quality control samples are collected. In addition, it is the Site Manger's responsibility to provide oversight and independent technical review of the sample collection efforts on a daily and weekly basis.

4. DATA VALIDATION AND USABILITY

This section describes the procedures that are planned to review, verify, and validate field and laboratory data. Procedures for verifying that the data are sufficient to meet DQOs and measurement quality objectives for the project are also discussed. Section 4.1 focuses on data review and reduction requirements for work conducted under the EPA Region 6 RAC II program. Section 4.2 addresses data validation and verification requirements. Section 4.3 addresses reconciliation with DQOs.

4.1 DATA REVIEW AND REDUCTION REQUIREMENTS

Data reduction and review are essential functions for preparing data that can be used effectively to support project decisions and DQOs. These functions must be performed accurately and in accordance with EPA-approved procedures and techniques. Data reduction includes computations and data manipulations that produce the final results that are used during the investigation. Data review includes procedures that field or laboratory personnel conduct to ensure that measurement results are correct and acceptable in accordance with the QA objectives that are stated in this SAP. Field and laboratory measurement data reduction and review procedures and requirements are specified in previously discussed field and laboratory methods, SOPs, and guidance documents.

Field personnel will record, in a field logbook and/or on the appropriate field form, raw data from chemical and physical field measurements (SOP 016, Appendix A). The EA field staff has the primary responsibility for: (1) verifying that field measurements were made correctly; (2)confirming that sample collection and handling procedures specified in this project-specific SAP were followed; and (3) ensuring that field data reduction and review procedures requirements are followed. The EA field staff is also responsible for assessing preliminary data quality and for advising the data user of potential QA/QC problems with field data. If field data are used in a project report, data reduction methods will be fully documented in the report.

The EPA Region 6 Laboratory, CLP laboratory, and/or subcontracted commercial laboratory will complete data reduction for chemical and physical laboratory measurements and will complete an in-house review of laboratory analytical results. The laboratory QA Manager will be responsible for ensuring that laboratory data reduction and review procedures follow the requirements that are stated in this SAP. The laboratory QA Manager will also be responsible for assessing data quality and for advising the EA QA Officer of possible QA/QC problems with laboratory data.

4.2 VALIDATION AND VERIFICATION METHODS

Data that are used to support activities under the EPA Region 6 RAC II program must be valid for their intended purposes. This section outlines the basic data validation procedures that will be followed for field and laboratory measurements. The following sections identify personnel who are responsible for data validation and the general data validation process and EPA data validation guidance that will be followed.

4.2.1 Data Validation Responsibilities

When analytical services are provided by laboratories subcontracted by EA, EA is responsible for data validation. The EA QA Officer has primary responsibility for coordinating EA's data validation activities. EA will conduct full validation on 10 percent of subcontracted laboratory data for investigation samples. Partial validation will be conducted on the remaining 90 percent of subcontracted laboratory data. Data validation conducted by EA will be detailed in a data validation report.

Data validation and review will be completed by one or more experienced data reviewers. When data are generated by the EPA Region 6 Laboratory, it will be used as received from the laboratory, with no further validation. Data from CLP laboratories are validated by EPA's Environmental Services Assistance Team. Data validated by EPA will be summarized in a data validation report.

4.2.2 Data Validation Procedures

The validity of a dataset is determined by comparing the data with a predetermined set of QC limits. EA data reviewers will conduct a systematic review of the data for compliance with established QC limits (such as sensitivity, precision, and accuracy), on the basis of spike, duplicate, and blank sampling results that are provided by the laboratory. The data review will identify out-of-control data points or omissions. EA data reviewers will evaluate laboratory data for compliance using the following criteria:

- Method and project-specific analytical service requests
- Holding times
- Initial and continuing calibration acceptance criteria
- Field, trip, and method blank acceptance criteria
- Surrogate recovery
- Internal standards
- Field duplicates and MS and MSD acceptance criteria
- MD precision
- LCS accuracy
- Other laboratory QC criteria specified by the method or on the project-specific analytical service request form
- Compound identification and quantitation
- Overall assessment of data, in accordance with project-specific objectives.

EA will follow the most current EPA CLP guidelines for completing data validation for applicable test methods. General procedures in the CLP guidelines will be modified, as necessary, to fit the specific analytical method that is used to produce the data. In cases, data

validation requirements will depend on: (1) DQO levels that are defined in Section 1.3; (2) reporting requirements that are defined in Section 1.4; and (3) data deliverables that are requested from the laboratory, as discussed in Section 1.6. Nevertheless, the data will be evaluated in accordance with EPA's National Functional Guidelines (EPA 2016c, 2016d, 2016e).

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

The main purpose of a QA system is to define a process for collecting data that are of known quality, are scientifically valid, are legally defensible, and fully support decisions that will be based on the data. To achieve this purpose, the SAP requires that DQOs be fully defined. Other parts of the QA system must then be planned and implemented in a manner that is consistent with the DQOs. QA system components that follow directly from the DQOs include: (1) documentation and reporting requirements; (2) sample process design and sampling methods requirements; (3) analytical methods and analytical service requests; (4) QC requirements; and (5) data reduction and validation and reporting methods.

After environmental data have been collected, reviewed, and validated, the data will undergo a final evaluation to determine whether the DQOs specified in this SAP have been met. EA will follow EPA's DQA process to verify that the type, quality, and quantity of data that are collected are appropriate for their intended use (EPA 2006c, 2006d).

The DQA process involves: (1) verifying that the data have met the assumptions under which the data collection design and DQOs were developed; (2) taking appropriate corrective action if the assumptions have not been met; and (3) evaluating the extent to which the data support the decision that must be made so that scientifically valid and meaningful conclusions can be drawn from the data. To the extent possible, EA will follow DQA methods and procedures that have been outlined by EPA (EPA 2006c, 2006d).

Following the conclusion of the RI field program and receipt of fixed-laboratory data, the data evaluation will include:

- Data usability evaluation and field QA/QC—The usability of the laboratory analytical data in terms of the CLP data validation summaries and field QA/QC will be evaluated.

- Data Reduction and Tabulation—Soil borings, field sampling data, and analytical results will be reduced and tabulated.

- Data Evaluation Summary Report (DESR)—A DESR will be submitted that documents and summarizes the analytical data collected during this RI/FS, including the data quality and usability as related to the site-specific DQOs. The DESR shall also include previous data collected during previous site investigations (if made available) for statistical comparisons to the data collected during the RI/FS. Field QA/QC results will be summarized in context with fixed-laboratory sample results.

The analytical and field data will be complied into a format that is compatible with the EPA Region 6 requirements. EA will use the data to prepare the RI/FS deliverables.

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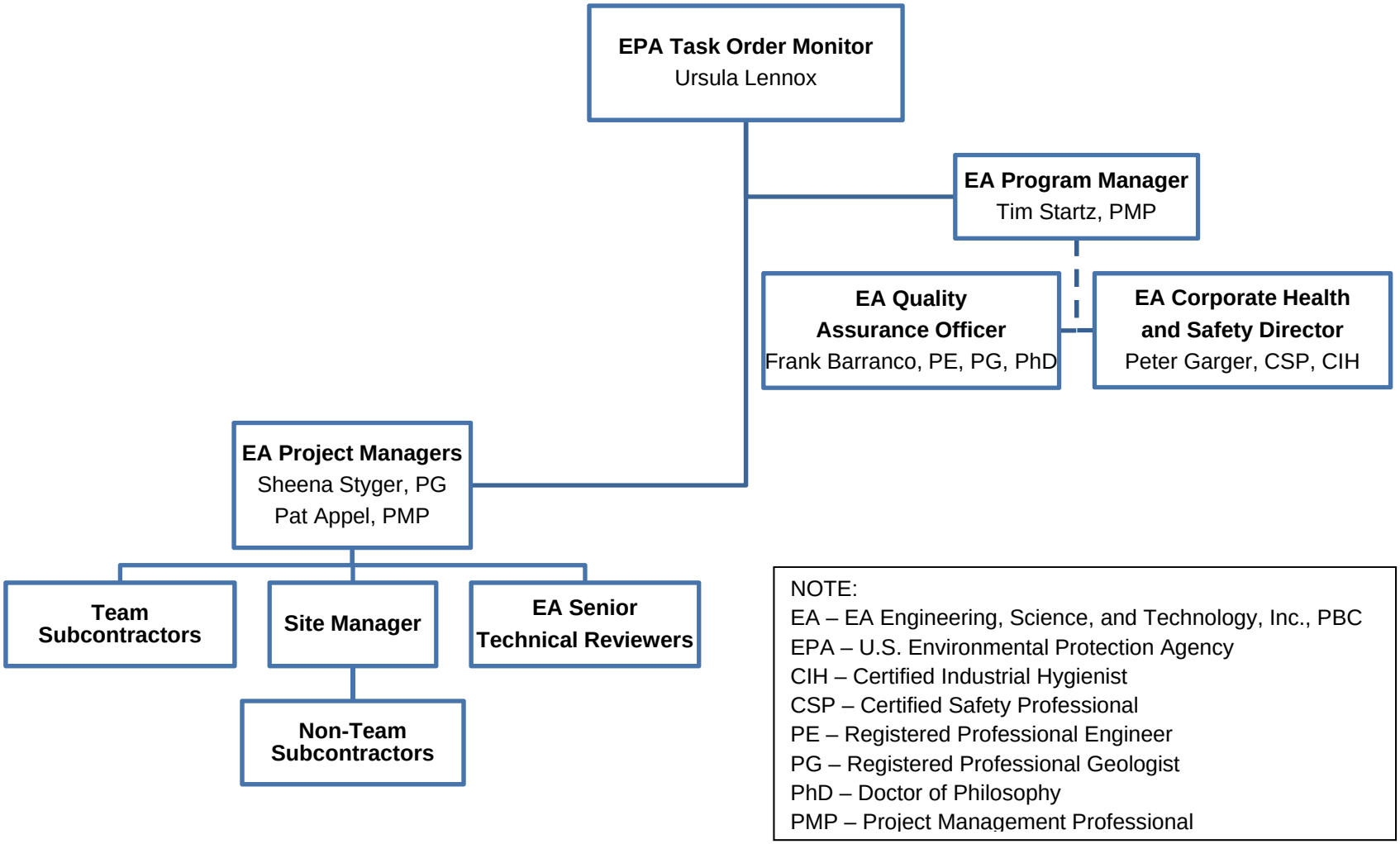
FIGURES



Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 1
Project Organization

Legend

Colonial Creosote Company Facility Boundary

Data Sources: Esri 2006, 2016; USDA 2015

0 500 1,000 2,000
Feet

Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 2.
Site Location

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Legend

- Former Facility Boundary

Exposure Areas

- Common Drainage Ditch
- Lumber Piles
- Reservoir
- Settling Pond
- Treatment Area
- Yellow Branch Creek

Data Sources: Esri 2006, 2016; USDA 2015

0 100 200 400
Feet

Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 3.
Site Layout

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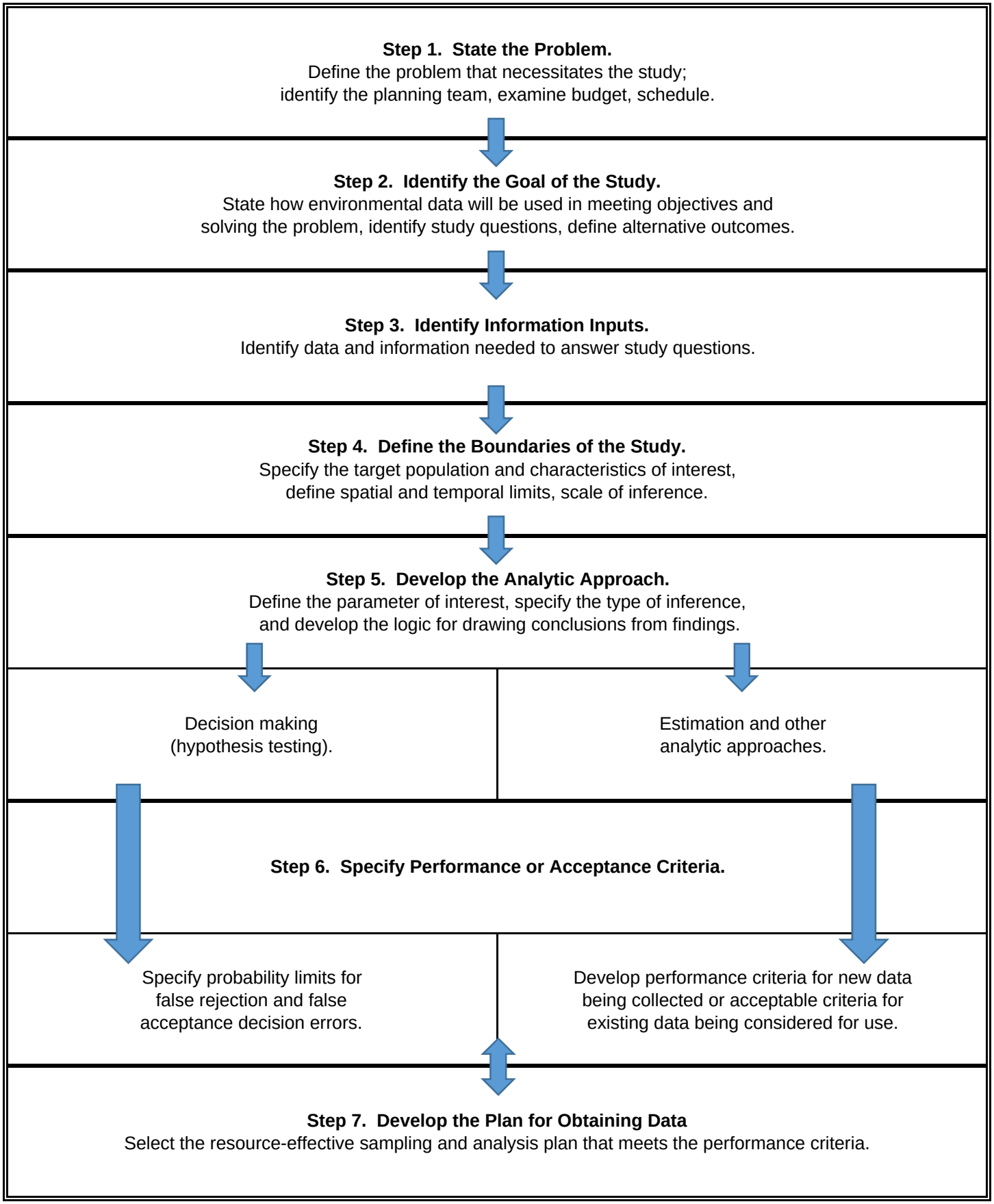
FIGURE 4 DATA QUALITY OBJECTIVE PROCESS



Source: U.S. Environmental Protection Agency. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process* . (QA/G-4). EPA/240/B-06/001. Office of Environmental Information. Washington, D.C. February.

Legend

Former Facility Boundary

Well Depth in feet below ground surface: LDNR Aquifer Name on Record

- 13-30: Southeast Louisiana Aquifer System Surficial Confining Unit or Upland Terrace Aquifer
- 30-60: Southeast Louisiana Aquifer System Surficial Confining Unit or Upland Terrace Aquifer
- 90-200: Southeast Louisiana Aquifer System Surficial Confining Unit or Upland Terrace Aquifer
- 200-1,000: Upland Terrance Aquifer, Lower Ponchatoula Aquifer, Kentwood Aquifer, or Covington Aquifer
- > 1,000: Hammond Aquifer, Amite Aquifer, Ramsay Aquifer, or Franklinton Aquifer

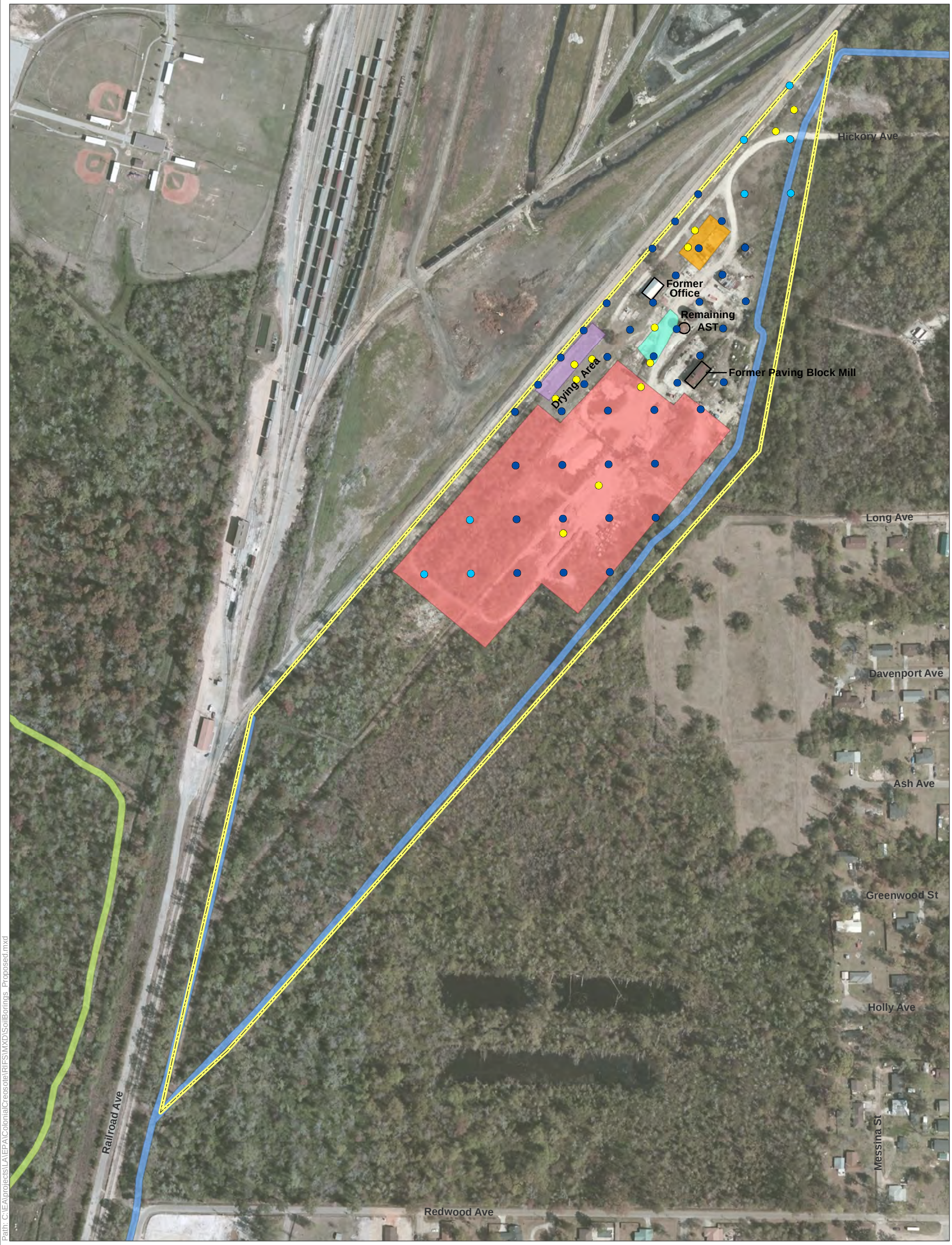
Data Sources: Esri 2006, 2016; LDNR 2016; USDA 2015

0 250 500 1,000
Feet

Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 5.
Active Water Wells Registered with the Louisiana Department of Natural Resources

Path: C:\EA\projects\LA\EPA\ColonialCreosote\RIFS\MXD\ActiveWaterWells.mxd



Legend

- Former Facility Boundary

Exposure Areas

- Common Drainage Ditch
- Lumber Piles
- Reservoir
- Settling Pond
- Treatment Area
- Yellow Branch Creek

Proposed Soil Boring Locations

- Previously Collected
- Proposed 4ft Boring
- Proposed 30ft Boring

Note:
Sample locations may be adjusted or deleted in the field to avoid obstructions (e.g., buildings, major iron structures)

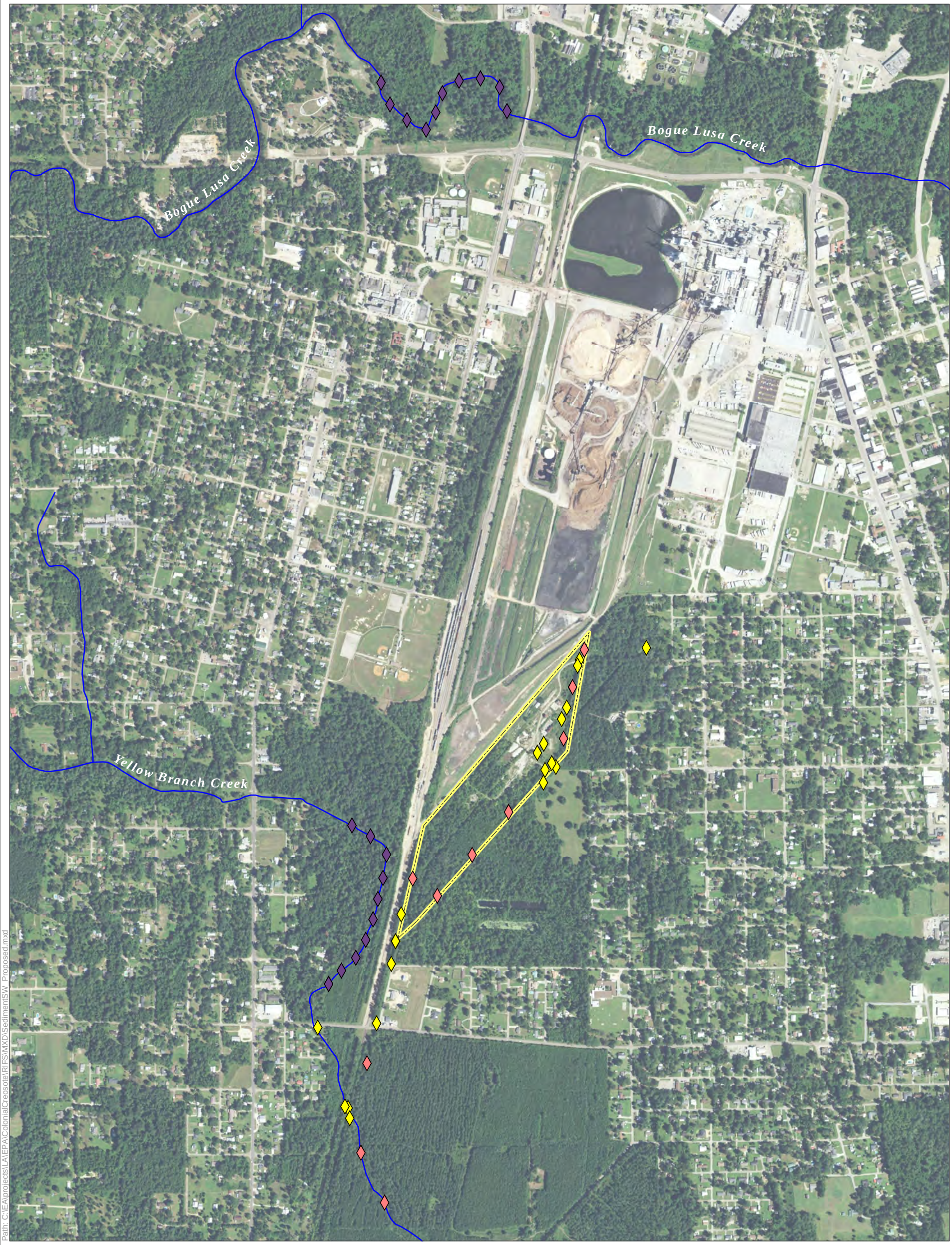
Data Sources: Esri 2006, 2016; USDA 2015

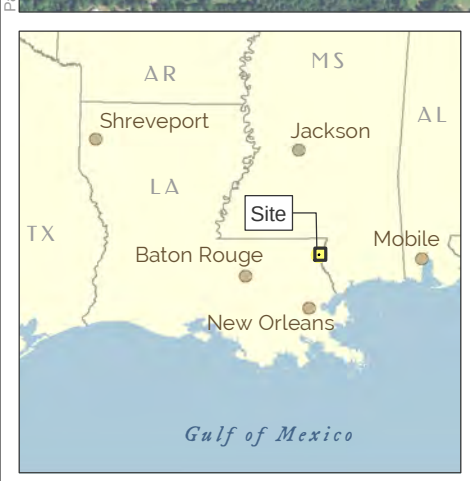
0 100 200 400
Feet

Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 6.
Proposed Soil Boring Locations

Path: C:\EA\projects\LA\EPA\ColonialCreosote\RIFS\MXD\SoilBorings_Proposed.mxd





Legend

- Stream
- Former Facility Boundary

Proposed Sediment and Surface Water Locations

- Previously Collected
- Proposed Location
- Proposed Background Location

Note:
Sample locations may be adjusted or deleted in the field to avoid obstructions (e.g., buildings, major iron structures)

Data Sources: Esri 2006, 2016; USDA 2015

0 250 500 1,000
Feet

Remedial Investigation/Feasibility Study
Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Figure 7.
Proposed Sediment and Surface Water Sample Locations

Path: C:\EA\projects\LA\EPA\ColonialCreosote\RIFS\MXD\SedimentSW_Proposed.mxd

Appendix A

Electronic Files (only provided in hardcopy for field samplers)

A-1 **EPA Regional Screening Levels**
A-2 **EPA Region 4 Ecological Screening Levels**
A-3 **EA Standard Operating Procedures**
A-4 **Contract Laboratory Program Guidance for Field Samplers**

Appendix A-1

EPA Regional Screening Levels

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
8.7E-03	I			4.0E-03	I					1	0.1		Acephate	30560-19-1	2.5E+01	n	2.6E+02	c**					8.0E+00	n		1.8E-03	n	
		2.2E-06	I			9.0E-03	I	V		1		1.1E+05	Acetaldehyde	75-07-0	8.2E+00	n	3.4E+01	n	9.4E-01	n	3.9E+00	n	1.9E+00	n		3.8E-04	n	
				2.0E-02	I					1	0.1		Acetochlor	34256-82-1	1.3E+02	n	1.6E+03	n					3.5E+01	n		2.8E-02	n	
				9.0E-01	I	3.1E+01	A	V		1		1.1E+05	Acetone	67-64-1	6.1E+03	n	6.7E+04	n	3.2E+03	n	1.4E+04	n	1.4E+03	n		2.9E-01	n	
						2.0E-03	X			1	0.1		Acetone Cyanohydrin	75-86-5	2.8E+05	nm	1.2E+06	nm	2.1E-01	n	8.8E-01	n						
						6.0E-02	I	V		1		1.3E+05	Acetonitrile	75-05-8	8.1E+01	n	3.4E+02	n	6.3E+00	n	2.6E+01	n	1.3E+01	n		2.6E-03	n	
				1.0E-01	I			V		1		2.5E+03	Acetophenone	98-86-2	7.8E+02	n	1.2E+04	ns					1.9E+02	n		5.8E-02	n	
3.8E+00	C	1.3E-03	C							1	0.1		Acetylaminofluorene, 2-	53-96-3	1.4E-01	c	6.0E-01	c	2.2E-03	c	9.4E-03	c	1.6E-02	c		7.2E-05	c	
				5.0E-04	I	2.0E-05	I	V		1		2.3E+04	Acrolein	107-02-8	1.4E-02	n	6.0E-02	n	2.1E-03	n	8.8E-03	n	4.2E-03	n		8.4E-07	n	
5.0E-01	I	1.0E-04	I	2.0E-03	I	6.0E-03	I		M	1	0.1		Acrylamide	79-06-1	2.4E-01	c*	4.6E+00	c*	1.0E-02	c*	1.2E-01	c*	5.0E-02	c*		1.1E-05	c*	
				5.0E-01	I	1.0E-03	I	V		1		1.1E+05	Acrylic Acid	79-10-7	9.9E+00	n	4.2E+01	n	1.0E-01	n	4.4E-01	n	2.1E-01	n		4.2E-05	n	
5.4E-01	I	6.8E-05	I	4.0E-02	A	2.0E-03	I	V		1		1.1E+04	Acrylonitrile	107-13-1	2.5E-01	c**	1.1E+00	c**	4.1E-02	c**	1.8E-01	c**	5.2E-02	c**		1.1E-05	c**	
						6.0E-03	P			1	0.1		Adiponitrile	111-69-3	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n						
5.6E-02	C			1.0E-02	I					1	0.1		Alachlor	15972-60-8	9.7E+00	c**	4.1E+01	c*					1.1E+00	c*	2.0E+00	8.7E-04	c*	1.6E-03
				1.0E-03	I					1	0.1		Aldicarb	116-06-3	6.3E+00	n	8.2E+01	n					2.0E+00	n	3.0E+00	4.9E-04	n	7.5E-04
				1.0E-03	I					1	0.1		Aldicarb Sulfone	1646-88-4	6.3E+00	n	8.2E+01	n					2.0E+00	n	2.0E+00	4.4E-04	n	4.4E-04
										1	0.1		Aldicarb sulfoxide	1646-87-3											4.0E+00			8.8E-04
1.7E+01	I	4.9E-03	I	3.0E-05	I			V		1			Aldrin	309-00-2	3.9E-02	c**	1.8E-01	c*	5.7E-04	c	2.5E-03	c	9.2E-04	c*		1.5E-04	c*	
				5.0E-03	I	1.0E-04	X	V		1		1.1E+05	Allyl Alcohol	107-18-6	3.5E-01	n	1.5E+00	n	1.0E-02	n	4.4E-02	n	2.1E-02	n		4.2E-06	n	
2.1E-02	C	6.0E-06	C			1.0E-03	I	V		1		1.4E+03	Allyl Chloride	107-05-1	1.7E-01	n	6.9E-01	n	1.00E-01	n	4.40E-01	n	2.1E-01	n		6.7E-05	n	
				1.00E+00	P	5.0E-03	P			1			Aluminum	7429-90-5	7.7E+03	n	1.1E+05	nm	5.2E-01	n	2.2E+00	n	2.0E+03	n		3.0E+03	n	
				4.0E-04	I					1			Aluminum Phosphide	20859-73-8	3.1E+00	n	4.7E+01	n					8.0E-01	n			n	
				9.0E-03	I					1	0.1		Ametryn	834-12-8	5.7E+01	n	7.4E+02	n					1.5E+01	n		1.6E-02	n	
2.1E+01	C	6.0E-03	C							1	0.1		Aminobiphenyl, 4-	92-67-1	2.6E-02	c	1.1E-01	c	4.7E-04	c	2.0E-03	c	3.0E-03	c		1.5E-05	c	
				8.0E-02	P					1	0.1		Aminophenol, m-	591-27-5	5.1E+02	n	6.6E+03	n					1.6E+02	n		6.1E-02	n	
				2.0E-02	P					1	0.1		Aminophenol, p-	123-30-8	1.3E+02	n	1.6E+03	n					4.0E+01	n		1.5E-02	n	
				2.5E-03	I					1	0.1		Amitraz	33089-61-1	1.6E+01	n	2.1E+02	n					8.2E-01	n		4.2E-01	n	
						1.0E-01	I	V		1			Ammonia	7664-41-7					1.0E+01	n	4.4E+01	n						
				2.0E-01	I					1			Ammonium Sulfamate	7773-06-0	1.6E+03	n	2.3E+04	n					4.0E+02	n			n	
						3.0E-03	X	V		1		1.4E+04	Amyl Alcohol, tert-	75-85-4	8.2E+00	n	3.4E+01	n	3.1E-01	n	1.3E+00	n	6.3E-01	n		1.3E-04	n	
5.7E-03	I	1.6E-06	C	7.0E-03	P	1.0E-03	I			1	0.1		Aniline	62-53-3	4.4E+01	n	4.0E+02	c**	1.0E-01	n	4.4E-01	n	1.3E+01	c**		4.6E-03	c**	
4.0E-02	P			2.0E-03	X					1	0.1		Anthraquinone, 9,10-	84-65-1	1.3E+01	n	5.7E+01	c**					1.4E+00	c**		1.4E-02	c**	
				4.0E-04	I					0.15			Antimony (metallic)	7440-36-0	3.1E+00	n	4.7E+01	n					7.8E-01	n	6.0E+00	3.5E-02	n	2.7E-01
				5.0E-04	H					0.15			Antimony Pentoxide	1314-60-9	3.9E+00	n	5.8E+01	n					9.7E-01	n			n	
				4.0E-04	H					0.15			Antimony Tetroxide	1332-81-6	3.1E+00	n	4.7E+01	n					7.8E-01	n			n	
						2.0E-04	I			0.15			Antimony Trioxide	1309-64-4	2.8E+04	n	1.2E+05	nm	2.1E-02	n	8.8E-02	n						
																c**												
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C			1	0.03		Arsenic, Inorganic	7440-38-2	6.8E-01	R	3.0E+00	c*R	6.5E-04	c**	2.9E-03	c**	5.2E-02	c*	1.0E+01	1.5E-03	c*	2.9E-01
				3.5E-06	C	5.0E-05	I			1			Arsine	7784-42-1	2.7E-02	n	4.1E-01	n	5.2E-03	n	2.2E-02	n	7.0E-03	n			n	
				5.0E-02	I					1	0.1		Asulam	3337-71-1	3.2E+02	n	4.1E+03	n					1.0E+02	n		2.6E-02	n	
2.3E-01	C			3.5E-02	I					1	0.1		Atrazine	1912-24-9	2.4E+00	c*	1.0E+01	c					3.0E-01	c	3.0E+00	2.0E-04	c	1.9E-03
8.8E-01	C	2.5E-04	C							1	0.1		Auramine	492-80-8	6.2E-01	c	2.6E+00	c	1.1E-02	c	4.9E-02	c	6.7E-02	c		6.1E-04	c	
				4.0E-04	I					1	0.1		Avermectin B1	65195-55-3	2.5E+00	n	3.3E+01	n					8.0E-01	n		1.4E+00	n	
				3.0E-03	A	1.0E-02	A			1	0.1		Azinphos-methyl	86-50-0	1.9E+01	n	2.5E+02	n	1.0E+00	n	4.4E+00	n	5.6E+00	n		1.7E-03	n	
1.1E-01	I	3.1E-05	I					V		1			Azobenzene	103-33-3	5.6E+00	c	2.6E+01	c	9.1E-02	c	4.0E-01	c	1.2E-01	c		9.3E-04	c	
				1.0E+00	P	7.0E-06	P			1	0.1		Azodicarbonamide	123-77-3	8.6E+02	n	4.0E+03	n	7.3E-04	n	3.1E-03	n	2.0E+03	n		6.8E-01	n	
				2.0E-01	I	5.0E-04	H			0.07			Barium	7440-39-3	1.5E+03	n	2.2E+04	n	5.2E-02	n	2.2E-01	n	3.8E+02	n	2.0E+03	1.6E+01	n	8.2E+01
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Barium Chromate	10294-40-3	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
				3.0E-01	I			V		1			Benfluralin	1861-40-1	2.3E+03	n	3.5E+04	n					1.7E+02	n		5.6E+00	n	
				5.0E-02	I					1	0.1		Benomyl	17804-35-2	3.2E+02	n	4.1E+03	n					9.7E+01	n		8.5E-02	n	
				2.0E-01	I					1	0.1		Bensulfuron-methyl	83055-99-6	1.3E+03	n	1.6E+04	n					3.9E+02	n		1.0E-01	n	
				3.0E-02	I					1	0.1		Bentazon	25057-89-0	1.9E+02	n	2.5E+03	n					5.7E+01	n		1.2E-02	n	
4.0E-03	P			1.0E-01	I			V		1		1.2E+03	Benzaldehyde	100-52-7	1.7E+02	c**	8.2E+02	c*					1.9E+01	c*		4.1E-03	c*	
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V		1		1.8E+03	Benzene	71-43-2	1.2E+00	c**	5.1E+00	c**	3.6E-01	c**	1.6E+00	c**	4.6E-01	c**	5.0E+00	2.3E-04	c**	2.6E-03
1.0E-01	X			3.0E-04	X					1	0.1		Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1	1.9E+00	n	2.3E+01	c**					6.0E-01	n		1.7E-04	n	
				1.0E-03	P			V		1		1.3E+03	Benzenethiol	108-98-5	7.8E+00	n	1.2E+02	n					1.7E+00	n		1.1E-03	n	
2.3E+02	I	6.7E-02	I	3.0E-03	I				M	1	0.1		Benzidine	92-87-5	5.3E-04	c	1.0E-02	c	1.5E-05	c	1.8E-04	c	1.1E-04	c		2.8E-07	c	
				4.0E+00	I					1	0.1		Benzoic Acid	65-85-0	2.5E+04	n	3.3E+05	nm					7.5E+03	n		1.5E+00	n	
1.3E+01	I							V		1		3.2E+02	Benzotrichloride	98-07-7	5.3E-02	c	2.5E-01	c					3.0E-03	c		6.6E-06	c	
				1.0E-01	P					1	0.1		Benzyl Alcohol	100-51-6	6.3E+02	n	8.2E+03	n					2.0E+02	n		4.8E-02	n	
1.7E-01	I	4.9E-05	C	2.0E-03	P	1.0E-03	P	V		1		1.5E+03	Benzyl Chloride	100-44-7	1.1E+00	c**	4.8E+00	c**	5.7E-02	c**	2.5E-01	c**	8.9E-02	c**		9.8E-05	c**	
		2.4E-03	I	2.0E-03	I	2.0E-05	I			0.007			Beryllium and compounds	7440-41-7	1.6E+01	n	2.3E+02	n	1.2E-03	c**	5.1E-03	c**	2.5E+00	n	4.0E+00	1.9E+00	n	3.2E+00
				9.0E-03	P					1	0.1		Bifenox	42576-02-3	5.7E+01	n	7.4E+02	n					1.0E+01	n		7.6E-02	n	
				1.5E-02	I					1	0.1		Biphenthrin	82657-04-3	9.5E+01	n	1.2E+03	n					3.0E+01	n		1.4E+02	n	
8.0E-03	I			5.0E-01	I	4.0E-04	X	V		1			Biphenyl, 1,1'-	92-52-4	4.7E+00	n	2.0E+01	n	4.2E-02	n	1.8E-01	n	8.3E-02	n		8.7E-04	n	
				4.0E-02	I			V		1		1.0E+03	Bis(2-chloro-1-methylethyl) ether	108-60-1	3.1E+02	n	4.7E+03	ns					7.1E+01	n		2.6E-02	n	
				3.0E-03	P					1	0.1		Bis(2-chloroethoxy)methane	111-91-1	1.9E+01	n	2.5E+02	n					5.9E+00	n		1.3E-03	n	
1.1E+00	I	3.3E-04	I					V		1		5.1E+03	Bis(2-chloroethyl)ether	111-44-4	2.3E-01	c	1.0E+00	c	8.5E-03	c	3.7E-02	c	1.4E-02	c		3.6E-06	c	
2.2E+02	I	6.2E-02	I					V		1		4.2E+03	Bis(chloromethyl)ether	542-88-1	8.3E-05	c	3.6E-04	c	4.5E-05	c	2.0E-04	c	7.2E-05	c		1.7E-08	c	
				5.0E-02	I					1	0.1		Bisphenol A	80-05-7	3.2E+02	n	4.1E+03	n					7.7E+01	n		5.8E+00	n	
				2.0E-01	I	2.0E-02	H			1			Boron And Borates Only	7440-42-8	1.6E+03	n	2.3E+04	n	2.1E+00	n	8.8E+00	n	4.0E+02	n		1.3E+00	n	
				2.0E+00	P	2.0E-02	P	V		1			Boron Trichloride	10294-34-5	1.6E+04	n	2.3E+05	nm	2.1E+00	n	8.8E+00	n	4.2E+00	n			n	
				4.0E-02	C	1.3E-02	C	V		1			Boron Trifluoride	7637-07-2	3.1E+02	n	4.7E+03	n	1.4E+00	n	5.7E+00	n	2.6E+00	n			n	
7.0E-01	I			4.0E-03	I					1			Bromate	15541-45-4	9.9E-01	c*	4.7E+00	c					1.1E-01	c*	1.0E+01	8.5E-04	c*	7.7E-02
2.0E+00	X	6.0E-04	X					V		1		2.4E+03	Bromo-2-chloroethane, 1-	107-04-0	2.6E-02	c	1.1E-01	c	4.7E-03	c	2.0E-02	c	7.4E-03	c		2.1E-06	c	

TR=1E-0
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information													Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				8.0E-03	I	6.0E-02	I	V		1		6.8E+02	Bromobenzene	108-86-1	2.9E+01	n	1.8E+02	n	6.3E+00	n	2.6E+01	n	6.2E+00	n		4.2E-03	n	
						4.0E-02	X	V		1		4.0E+03	Bromochloromethane	74-97-5	1.5E+01	n	6.3E+01	n	4.2E+00	n	1.8E+01	n	8.3E+00	n		2.1E-03	n	
6.2E-02	I	3.7E-05	C	2.0E-02	I			V		1		9.3E+02	Bromodichloromethane	75-27-4	2.9E-01	c	1.3E+00	c	7.6E-02	c	3.3E-01	c	1.3E-01	c	8.0E+01(F)	3.6E-05	c	2.2E-02
7.9E-03	I	1.1E-06	I	2.0E-02	I			V		1		9.2E+02	Bromoform	75-25-2	1.9E+01	c**	8.6E+01	c*	2.6E+00	c	1.1E+01	c	3.3E+00	c*	8.0E+01(F)	8.7E-04	c*	2.1E-02
				1.4E-03	I	5.0E-03	I	V		1		3.6E+03	Bromomethane	74-83-9	6.8E-01	n	3.0E+00	n	5.2E-01	n	2.2E+00	n	7.5E-01	n		1.9E-04	n	
				5.0E-03	H			V		1			Bromophos	2104-96-3	3.9E+01	n	5.8E+02	n					3.5E+00	n		1.5E-02	n	
				2.0E-02	I					1	0.1		Bromoxynil	1689-84-5	1.3E+02	n	1.6E+03	n					3.3E+01	n		2.8E-02	n	
				2.0E-02	I			V		1			Bromoxynil Octanoate	1689-99-2	1.6E+02	n	2.3E+03	n					1.4E+01	n		1.2E-01	n	
3.4E+00	C	3.0E-05	I			2.0E-03	I	V		1		6.7E+02	Butadiene, 1,3-	106-99-0	5.8E-02	c**	2.6E-01	c**	9.4E-02	c**	4.1E-01	c**	1.8E-02	c*		9.9E-06	c*	
				1.0E-01	I			V		1		7.6E+03	Butanol, N-	71-36-3	7.8E+02	n	1.2E+04	ns					2.0E+02	n		4.1E-02	n	
				2.0E+00	P	3.0E+01	P	V		1		2.1E+04	Butyl alcohol, sec-	78-92-2	1.3E+04	n	1.5E+05	nms	3.1E+03	n	1.3E+04	n	2.4E+03	n		5.0E-01	n	
				5.0E-02	I			V		1			Butylate	2008-41-5	3.9E+02	n	5.8E+03	n					4.6E+01	n		4.5E-02	n	
2.0E-04	C	5.7E-08	C							1	0.1		Butylated hydroxyanisole	25013-16-5	2.7E+03	c	1.1E+04	c	4.9E+01	c	2.2E+02	c	1.5E+02	c		2.9E-01	c	
3.6E-03	P			3.0E-01	P					1	0.1		Butylated hydroxytoluene	128-37-0	1.5E+02	c*	6.4E+02	c*					3.4E+00	c*		1.0E-01	c*	
				5.0E-02	P			V		1		1.1E+02	Butylbenzene, n-	104-51-8	3.9E+02	ns	5.8E+03	ns					1.0E+02	n		3.2E-01	n	
				1.0E-01	X			V		1		1.5E+02	Butylbenzene, sec-	135-98-8	7.8E+02	ns	1.2E+04	ns					2.0E+02	n		5.9E-01	n	
				1.0E-01	X			V		1		1.8E+02	Butylbenzene, tert-	98-06-6	7.8E+02	ns	1.2E+04	ns					6.9E+01	n		1.6E-01	n	
				2.0E-02	A					1	0.1		Cacodylic Acid	75-60-5	1.3E+02	n	1.6E+03	n					4.0E+01	n		1.1E-02	n	
		1.8E-03	I	1.0E-03	I	1.0E-05	A			0.025	0.001		Cadmium (Diet)	7440-43-9	7.1E+00	n	9.8E+01	n										
		1.8E-03	I	5.0E-04	I	1.0E-05	A			0.05	0.001		Cadmium (Water)	7440-43-9					1.0E-03	n	4.4E-03	n	9.2E-01	n	5.0E+00	6.9E-02	n	3.8E-01
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Calcium Chromate	13765-19-0	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
				5.0E-01	I	2.2E-03	C			1	0.1		Caprolactam	105-60-2	3.1E+03	n	4.0E+04	n	2.3E-01	n	9.6E-01	n	9.9E+02	n		2.5E-01	n	
1.5E-01	C	4.3E-05	C	2.0E-03	I					1	0.1		Captafol	2425-06-1	3.6E+00	c**	1.5E+01	c*	6.5E-02	c	2.9E-01	c	4.0E-01	c**		7.1E-04	c**	
2.3E-03	C	6.6E-07	C	1.3E-01	I					1	0.1		Captan	133-06-2	2.4E+02	c**	1.0E+03	c*	4.3E+00	c	1.9E+01	c	3.1E+01	c**		2.2E-02	c**	
				1.0E-01	I					1	0.1		Carbaryl	63-25-2	6.3E+02	n	8.2E+03	n					1.8E+02	n		1.7E-01	n	
				5.0E-03	I					1	0.1		Carbofuran	1563-66-2	3.2E+01	n	4.1E+02	n					9.4E+00	n	4.0E+01	3.7E-03	n	1.6E-02
				1.0E-01	I	7.0E-01	I	V		1		7.4E+02	Carbon Disulfide	75-15-0	7.7E+01	n	3.5E+02	n	7.3E+01	n	3.1E+02	n	8.1E+01	n		2.4E-02	n	
7.0E-02	I	6.0E-06	I	4.0E-03	I	1.0E-01	I	V		1		4.6E+02	Carbon Tetrachloride	56-23-5	6.5E-01	c*	2.9E+00	c*	4.7E-01	c*	2.0E+00	c*	4.6E-01	c*	5.0E+00	1.8E-04	c*	1.9E-03
						1.0E-01	P	V		1		5.9E+03	Carbonyl Sulfide	463-58-1	6.7E+00	n	2.8E+01	n	1.0E+01	n	4.4E+01	n	2.1E+01	n		5.1E-02	n	
				1.0E-02	I					1	0.1		Carbosulfan	55285-14-8	6.3E+01	n	8.2E+02	n					5.1E+00	n		1.2E-01	n	
				1.0E-01	I					1	0.1		Carboxin	5234-68-4	6.3E+02	n	8.2E+03	n					1.9E+02	n		1.0E-01	n	
						9.0E-04	I			1			Ceric oxide	1306-38-3	1.3E+05	nm	5.4E+05	nm	9.4E-02	n	3.9E-01	n						
				1.0E-01	I			V		1			Chloral Hydrate	302-17-0	7.8E+02	n	1.2E+04	n					2.0E+02	n		4.0E-02	n	
				1.5E-02	I					1	0.1		Chloramben	133-90-4	9.5E+01	n	1.2E+03	n					2.9E+01	n		7.0E-03	n	
4.0E-01	H									1	0.1		Chloranil	118-75-2	1.3E+00	c	5.7E+00	c					1.8E-01	c		1.5E-04	c	
3.5E-01	I	1.0E-04	I	5.0E-04	I	7.0E-04	I	V		1	0.04		Chlordane	12789-03-6	1.7E+00	c**	7.7E+00	c**	2.8E-02	c**	1.2E-01	c**	2.0E-02	c**	2.0E+00	2.7E-03	c**	2.7E-01
1.0E+01	I	4.6E-03	C	3.0E-04	I					1	0.1		Chlordecone (Kepone)	143-50-0	5.4E-02	c*	2.3E-01	c	6.1E-04	c	2.7E-03	c	3.5E-03	c*		1.2E-04	c*	
				7.0E-04	A					1	0.1		Chlorfenvinphos	470 90 6	4.4E+00	n	5.7E+01	n					1.1E+00	n		3.1E-03	n	
				2.0E-02	I					1	0.1		Chlorimuron, Ethyl-	90982-32-4	1.3E+02	n	1.6E+03	n					3.9E+01	n		1.3E-02	n	
				1.0E-01	I	1.5E-04	A	V		1		2.8E+03	Chlorine	7782-50-5	1.8E-02	n	7.8E-02	n	1.5E-02	n	6.4E-02	n	3.0E-02	n		1.4E-05	n	
				3.0E-02	I	2.0E-04	I	V		1			Chlorine Dioxide	10049-04-4	2.3E+02	n	3.4E+03	n	2.1E-02	n	8.8E-02	n	4.2E-02	n			n	
				3.0E-02	I					1			Chlorite (Sodium Salt)	7758-19-2	2.3E+02	n	3.5E+03	n					6.0E+01	n	1.0E+03		n	
						5.0E+01	I	V		1		1.2E+03	Chloro-1,1-difluoroethane, 1-	75-68-3	5.4E+03	ns	2.3E+04	ns	5.2E+03	n	2.2E+04	n	1.0E+04	n		5.2E+00	n	
		3.0E-04	I	2.0E-02	H	2.0E-02	I	V		1		7.9E+02	Chloro-1,3-butadiene, 2-	126-99-8	1.0E-02	c	4.4E-02	c	9.4E-03	c	4.1E-02	c	1.9E-02	c		9.8E-06	c	
4.6E-01	H									1	0.1		Chloro-2-methylaniline HCl, 4-	3165-93-3	1.2E+00	c	5.0E+00	c					1.7E-01	c		1.5E-04	c	
1.0E-01	P	7.7E-05	C	3.0E-03	X					1	0.1		Chloro-2-methylaniline, 4-	95-69-2	5.4E+00	c**	2.3E+01	c*	3.6E-02	c	1.6E-01	c	7.0E-01	c**		4.0E-04	c**	
2.7E-01	X							V		1		1.2E+04	Chloroacetaldehyde, 2-	107-20-0	2.6E+00	c	1.2E+01	c					2.9E-01	c		5.8E-05	c	
										1	0.1		Chloroacetic Acid	79-11-8											6.0E+01			1.2E-02
						3.0E-05	I			1	0.1		Chloroacetophenone, 2-	532-27-4	4.3E+03	n	1.8E+04	n	3.1E-03	n	1.3E-02	n						
2.0E-01	P			4.0E-03	I					1	0.1		Chloroaniline, p-	106-47-8	2.7E+00	c**	1.1E+01	c*					3.7E-01	c*		1.6E-04	c*	
				2.0E-02	I	5.0E-02	P	V		1		7.6E+02	Chlorobenzene	108-90-7	2.8E+01	n	1.3E+02	n	5.2E+00	n	2.2E+01	n	7.8E+00	n	1.0E+02	5.3E-03	n	6.8E-02
1.1E-01	C	3.1E-05	C	2.0E-02	I					1	0.1		Chlorobenzilate	510-15-6	4.9E+00	c*	2.1E+01	c*	9.1E-02	c	4.0E-01	c	3.1E-01	c*		1.0E-03	c*	
				3.0E-02	X					1	0.1		Chlorobenzoic Acid, p-	74-11-3	1.9E+02	n	2.5E+03	n					5.1E+01	n		1.3E-02	n	
				3.0E-03	P	3.0E-01	P	V		1		2.9E+02	Chlorobenzotrifluoride, 4-	98-56-6	2.1E+01	n	2.5E+02	n	3.1E+01	n	1.3E+02	n	3.5E+00	n		1.2E-02	n	
				4.0E-02	P			V		1		7.3E+02	Chlorobutane, 1-	109-69-3	3.1E+02	n	4.7E+03	ns					6.4E+01	n		2.6E-02	n	
						5.0E+01	I	V		1		1.7E+03	Chlorodifluoromethane	75-45-6	4.9E+03	ns	2.1E+04	ns	5.2E+03	n	2.2E+04	n	1.0E+04	n		4.3E+00	n	
				2.0E-02	P			V		1		1.1E+05	Chloroethanol, 2-	107-07-3	1.6E+02	n	2.3E+03	n					4.0E+01	n		8.1E-03	n	
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V		1		2.5E+03	Chloroform	67-66-3	3.2E-01	c*	1.4E+00	c*	1.2E-01	c*	5.3E-01	c*	2.2E-01	c*	8.0E+01(F)	6.1E-05	c*	2.2E-02
						9.0E-02	I	V		1		1.3E+03	Chloromethane	74-87-3	1.1E+01	n	4.6E+01	n	9.4E+00	n	3.9E+01	n	1.9E+01	n		4.9E-03	n	
2.4E+00	C	6.9E-04	C					V		1		9.3E+03	Chloromethyl Methyl Ether	107-30-2	2.0E-02	c	8.9E-02	c	4.1E-03	c	1.8E-02	c	6.5E-03	c		1.4E-06	c	
3.0E-01	P			3.0E-03	P	1.0E-05	X			1	0.1		Chloronitrobenzene, o-	88-73-3	1.8E+00	c*	7.7E+00	c*	1.0E-03	n	4.4E-03	n	2.4E-01	c*		2.2E-04	c*	
6.0E-02	P			7.0E-04	P	2.0E-03	P			1	0.1		Chloronitrobenzene, p-	100-00-5	4.4E+00	n	3.8E+01	c**	2.1E-01	n	8.8E-01	n	1.2E+00	c**		1.1E-03	c**	
				5.0E-03	I			V		1		2.7E+04	Chlorophenol, 2-	95-57-8	3.9E+01	n	5.8E+02	n					9.1E+00	n		8.9E-03	n	
						4.0E-04	C	V		1		6.2E+02	Chloropicrin	76-06-2	2.0E-01	n	8.2E-01	n	4.2E-02	n	1.8E-01	n	8.3E-02	n		2.5E-05	n	
3.1E-03	C	8.9E-07	C	1.5E-02	I					1	0.1		Chlorothalonil	1897-45-6	9.5E+01	n	7.4E+02	c**	3.2E+00	c	1.4E+01	c	2.2E+01	c**		5.0E-02	c**	
				2.0E-02	I			V		1		9.1E+02	Chlorotoluene, o-	95-49-8	1.6E+02	n	2.3E+03	ns					2.4E+01	n		2.3E-02	n	
				2.0E-02	X			V		1		2.5E+02	Chlorotoluene, p-	106-43-4	1.6E+02	n	2.3E+03	ns					2.5E+01	n		2.4E-02	n	
2.4E+02	C	6.9E-02	C							1	0.1		Chlorozotocin	54749-90-5	2.3E-03	c	9.6E-03	c	4.1E-05	c	1.8E-04	c	3.2E-04	c		7.1E-08	c	
				2.0E-01	I					1	0.1		Chlorpropham	101-21-3	1.3E+03	n	1.6E+04	n					2.8E+02	n		2.6E-01	n	
				1.0E-03	A					1	0.1		Chlorpyrifos	2921-88-2	6.3E+00	n	8.2E+01	n					8.4E-01	n		1.2E-02	n	
				1.0E-02	H					1	0.1		Chlorpyrifos Methyl	5598-13-0	6.3E+01	n	8.2E+02	n					1.2E+01	n		5.4E-02	n	
				5.0E-02	I					1	0.1		Chlorsulfuron	64902-72-3	3.2E+02	n	4.1E+03	n					9.9E+01	n		8.3E-02	n	
				1.0E-02	I					1	0.1		Chlorthal-dimethyl	1861-32-1	6.3E+01	n	8.2E+02	n					1.2E+01	n		1.5E-02	n	
				8.0E-04	H					1	0.1		Chlorthiophos	60238-56-4	5.1E+00	n	6.6E+01	n					2.8E-01	n		7.3E-03	n	
				1.5E+00	I					0.013			Chromium(III), Insoluble Salts	16065-83-1	1.2E+04	n	1.8E+05	nm					2.2E+03	n		4.0E+06	n	

TR=1E-0
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

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Toxicity and Chemical-specific Information												Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
5.0E-01	J	8.4E-02	S	3.0E-03	I	1.0E-04	I		M	0.025			Chromium(VI)	18540-29-9	3.0E-01	c*	6.3E+00	c*	1.2E-05	c	1.5E-04	c	3.5E-02	c		6.7E-04	c	
										0.013			Chromium, Total	7440-47-3											1.0E+02			1.8E+05
				1.3E-02	I					1	0.1		Clofentezine	74115-24-5	8.2E+01	n	1.1E+03	n					2.3E+01	n		1.4E+00	n	
		9.0E-03	P	3.0E-04	P	6.0E-06	P			1			Cobalt	7440-48-4	2.3E+00	n	3.5E+01	n	3.1E-04	c**	1.4E-03	c**	6.0E-01	n		2.7E-02	n	
		6.2E-04	I					V	M	1			Coke Oven Emissions	8007-45-2					1.6E-03	c	2.0E-02	c						
				4.0E-02	H					1			Copper	7440-50-8	3.1E+02	n	4.7E+03	n					8.0E+01	n	1.3E+03	2.8E+00	n	4.6E+01
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, m-	108-39-4	3.2E+02	n	4.1E+03	n	6.3E+01	n	2.6E+02	n	9.3E+01	n		7.4E-02	n	
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, o-	95-48-7	3.2E+02	n	4.1E+03	n	6.3E+01	n	2.6E+02	n	9.3E+01	n		7.5E-02	n	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresol, p-	106-44-5	6.3E+02	n	8.2E+03	n	6.3E+01	n	2.6E+02	n	1.9E+02	n		1.5E-01	n	
				1.0E-01	A					1	0.1		Cresol, p-chloro-m-	59-50-7	6.3E+02	n	8.2E+03	n					1.4E+02	n		1.7E-01	n	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresols	1319-77-3	6.3E+02	n	8.2E+03	n	6.3E+01	n	2.6E+02	n	1.5E+02	n		1.3E-01	n	
1.9E+00	H			1.0E-03	P			V		1		1.7E+04	Crotonaldehyde, trans-	123-73-9	3.7E-01	c*	1.7E+00	c*					4.0E-02	c*		8.2E-06	c*	
				1.0E-01	I	4.0E-01	I	V		1		2.7E+02	Cumene	98-82-8	1.9E+02	n	9.9E+02	ns	4.2E+01	n	1.8E+02	n	4.5E+01	n		7.4E-02	n	
2.2E-01	C	6.3E-05	C							1	0.1		Cupferron	135-20-6	2.5E+00	c	1.0E+01	c	4.5E-02	c	1.9E-01	c	3.5E-01	c		6.1E-04	c	
8.4E-01	H			2.0E-03	H					1	0.1		Cyanazine	21725-46-2	6.5E-01	c*	2.7E+00	c*					8.8E-02	c*		4.1E-05	c*	
													Cyanides															
				1.0E-03	I					1			~Calcium Cyanide	592-01-8	7.8E+00	n	1.2E+02	n					2.0E+00	n			n	
				5.0E-03	I					1			~Copper Cyanide	544-92-3	3.9E+01	n	5.8E+02	n					1.0E+01	n			n	
				6.0E-04	I	8.0E-04	S	V		1		9.5E+05	~Cyanide (CN-)	57-12-5	2.3E+00	n	1.5E+01	n	8.3E-02	n	3.5E-01	n	1.5E-01	n	2.0E+02	1.5E-03	n	2.0E+00
				1.0E-03	I			V		1			~Cyanogen	460-19-5	7.8E+00	n	1.2E+02	n					2.0E+00	n			n	
				9.0E-02	I			V		1			~Cyanogen Bromide	506-68-3	7.0E+02	n	1.1E+04	n					1.8E+02	n			n	
				5.0E-02	I			V		1			~Cyanogen Chloride	506-77-4	3.9E+02	n	5.8E+03	n					1.0E+02	n			n	
				6.0E-04	I	8.0E-04	I	V		1		1.0E+07	~Hydrogen Cyanide	74-90-8	2.3E+00	n	1.5E+01	n	8.3E-02	n	3.5E-01	n	1.5E-01	n		1.5E-03	n	
				2.0E-03	I					1			~Potassium Cyanide	151-50-8	1.6E+01	n	2.3E+02	n					4.0E+00	n			n	
				5.0E-03	I					0.04			~Potassium Silver Cyanide	506-61-6	3.9E+01	n	5.8E+02	n					8.2E+00	n			n	
				1.0E-01	I					0.04			~Silver Cyanide	506-64-9	7.8E+02	n	1.2E+04	n					1.8E+02	n			n	
				1.0E-03	I					1			~Sodium Cyanide	143-33-9	7.8E+00	n	1.2E+02	n					2.0E+00	n	2.0E+02		n	
				2.0E-04	P					1			~Thiocyanates	NA	1.6E+00	n	2.3E+01	n					4.0E-01	n			n	
				2.0E-04	X			V		1			~Thiocyanic Acid	463-56-9	1.6E+00	n	2.3E+01	n					4.0E-01	n			n	
				5.0E-02	I					1			~Zinc Cyanide	557-21-1	3.9E+02	n	5.8E+03	n					1.0E+02	n			n	
						6.0E+00	I	V		1		1.2E+02	Cyclohexane	110-82-7	6.5E+02	ns	2.7E+03	ns	6.3E+02	n	2.6E+03	n	1.3E+03	n		1.3E+00	n	
2.3E-02	H									1	0.1		Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3	2.4E+01	c	1.0E+02	c					2.4E+00	c		1.4E-02	c	
				5.0E+00	I	7.0E-01	P	V		1		5.1E+03	Cyclohexanone	108-94-1	2.8E+03	n	1.3E+04	ns	7.3E+01	n	3.1E+02	n	1.4E+02	n		3.4E-02	n	
				5.0E-03	P	1.0E+00	X	V		1		2.8E+02	Cyclohexene	110-83-8	3.1E+01	n	3.1E+02	ns	1.0E+02	n	4.4E+02	n	7.0E+00	n		4.6E-03	n	
				2.0E-01	I			V		1		2.9E+05	Cyclohexylamine	108-91-8	1.6E+03	n	2.3E+04	n					3.8E+02	n		1.0E-01	n	
				2.5E-02	I					1	0.1		Cyfluthrin	68359-37-5	1.6E+02	n	2.1E+03	n					1.2E+01	n		3.1E+00	n	
				5.0E-03	I					1	0.1		Cyhalothrin	68085-85-8	3.2E+01	n	4.1E+02	n					1.0E+01	n		6.8E+00	n	
				1.0E-02	I					1	0.1		Cypermethrin	52315-07-8	6.3E+01	n	8.2E+02	n					2.0E+01	n		3.2E+00	n	
				7.5E-03	I					1	0.1		Cyromazine	66215-27-8	4.7E+01	n	6.2E+02	n					1.5E+01	n		3.8E-03	n	
2.4E-01	I	6.9E-05	C							1	0.1		DDD	72-54-8	2.3E+00	c	9.6E+00	c	4.1E-02	c	1.8E-01	c	3.2E-02	c		7.5E-03	c	
3.4E-01	I	9.7E-05	C					V		1			DDE, p,p'-	72-55-9	2.0E+00	c	9.3E+00	c	2.9E-02	c	1.3E-01	c	4.6E-02	c		1.1E-02	c	
3.4E-01	I	9.7E-05	I	5.0E-04	I					1	0.03		DDT	50-29-3	1.9E+00	c**	8.5E+00	c**	2.9E-02	c	1.3E-01	c	2.3E-01	c**		7.7E-02	c**	
				3.0E-02	I					1	0.1		Dalapon	75-99-0	1.9E+02	n	2.5E+03	n					6.0E+01	n	2.0E+02	1.2E-02	n	4.1E-02
1.8E-02	C	5.1E-06	C	1.5E-01	I					1	0.1		Daminozide	1596-84-5	3.0E+01	c*	1.3E+02	c*	5.5E-01	c	2.4E+00	c	4.3E+00	c*		9.5E-04	c*	
7.0E-04	I			7.0E-03	I					1	0.1		Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5	4.4E+01	n	5.7E+02	n					1.4E+01	n		7.8E+00	n	
				4.0E-05	I					1	0.1		Demeton	8065-48-3	2.5E-01	n	3.3E+00	n					4.2E-02	n			n	
1.2E-03	I			6.0E-01	I					1	0.1		Di(2-ethylhexyl)adipate	103-23-1	4.5E+02	c**	1.9E+03	c*					6.5E+01	c*	4.0E+02	4.7E+00	c*	2.9E+01
6.1E-02	H									1	0.1		Diallate	2303-16-4	8.9E+00	c	3.8E+01	c					5.4E-01	c		8.0E-04	c	
				7.0E-04	A					1	0.1		Diazinon	333-41-5	4.4E+00	n	5.7E+01	n					1.0E+00	n		6.5E-03	n	
				1.0E-02	X			V		1			Dibenzothiophene	132-65-0	7.8E+01	n	1.2E+03	n					6.5E+00	n		1.2E-01	n	
8.0E-01	P	6.0E-03	P	2.0E-04	P	2.0E-04	I	V	M	1		9.8E+02	Dibromo-3-chloropropane, 1,2-	96-12-8	5.3E-03	c*	6.4E-02	c*	1.7E-04	c	2.0E-03	c*	3.3E-04	c	2.0E-01	1.4E-07	c	8.6E-05
				4.0E-04	X			V		1		1.6E+02	Dibromobenzene, 1,3-	108-36-1	3.1E+00	n	4.7E+01	n					5.3E-01	n		5.1E-04	n	
				1.0E-02	I			V		1			Dibromobenzene, 1,4-	106-37-6	7.8E+01	n	1.2E+03	n					1.3E+01	n		1.2E-02	n	
8.4E-02	I			2.0E-02	I			V		1		8.0E+02	Dibromochloromethane	124-48-1	8.3E+00	c*	3.9E+01	c*					8.7E-01	c*	8.0E+01(F)	2.3E-04	c*	2.1E-02
2.0E+00	I	6.0E-04	I	9.0E-03	I	9.0E-03	I	V		1		1.3E+03	Dibromoethane, 1,2-	106-93-4	3.6E-02	c	1.6E-01	c	4.7E-03	c	2.0E-02	c	7.5E-03	c	5.0E-02	2.1E-06	c	1.4E-05
						4.0E-03	X	V		1		2.8E+03	Dibromomethane (Methylene Bromide)	74-95-3	2.4E+00	n	9.9E+00	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		2.1E-04	n	
				3.0E-04	P					1	0.1		Dibutyltin Compounds	NA	1.9E+00	n	2.5E+01	n					6.0E-01	n			n	
				3.0E-02	I					1	0.1		Dicamba	1918-00-9	1.9E+02	n	2.5E+03	n					5.7E+01	n		1.5E-02	n	
		4.2E-03	P					V		1		5.5E+02	Dichloro-2-butene, 1,4-	764-41-0	2.1E-03	c	9.4E-03	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.6E-07	c	
		4.2E-03	P					V		1		5.2E+02	Dichloro-2-butene, cis-1,4-	1476-11-5	7.4E-03	c	3.2E-02	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.2E-07	c	
		4.2E-03	P					V		1		7.6E+02	Dichloro-2-butene, trans-1,4-	110-57-6	7.4E-03	c	3.2E-02	c	6.7E-04	c	2.9E-03	c	1.3E-03	c		6.2E-07	c	
5.0E-02	I			4.0E-03	I					1	0.1		Dichloroacetic Acid	79-43-6	1.1E+01	c**	4.6E+01	c**					1.5E+00	c**	6.0E+01	3.1E-04	c**	1.2E-02
				9.0E-02	I	2.0E-01	H	V		1		3.8E+02	Dichlorobenzene, 1,2-	95-50-1	1.8E+02	n	9.3E+02	ns	2.1E+01	n	8.8E+01	n	3.0E+01	n	6.0E+02	3.0E-02	n	5.8E-01
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V		1			Dichlorobenzene, 1,4-	106-46-7	2.6E+00	c	1.1E+01	c	2.6E-01	c	1.1E+00	c	4.8E-01	c	7.5E+01	4.6E-04	c	7.2E-02
4.5E-01	I	3.4E-04	C							1	0.1		Dichlorobenzidine, 3,3'-	91-94-1	1.2E+00	c	5.1E+00	c	8.3E-03	c	3.6E-02	c	1.3E-01	c		8.2E-04	c	
				9.0E-03	X					1	0.1		Dichlorobenzophenone, 4,4'-	90-98-2	5.7E+01	n	7.4E+02	n					7.8E+00	n		4.7E-02	n	
				2.0E-01	I	1.0E-01	X	V		1		8.5E+02	Dichlorodifluoromethane	75-71-8	8.7E+00	n	3.7E+01	n	1.0E+01	n	4.4E+01	n	2.0E+01	n		3.0E-02	n	
5.7E-03	C	1.6E-06	C	2.0E-01	P			V		1		1.7E+03	Dichloroethane, 1,1-	75-34-3	3.6E+00	c	1.6E+01	c	1.8E+00	c	7.7E+00	c	2.8E+00	c		7.8E-04	c	
9.1E-02	I	2.6E-05	I	6.0E-03	X	7.0E-03	P	V		1		3.0E+03	Dichloroethane, 1,2-	107-06-2	4.6E-01	c**	2.0E+00	c**	1.1E-01	c**	4.7E-01	c**	1.7E-01	c**	5.0E+00	4.8E-05	c**	1.4E-03
				5.0E-02	I	2.0E-01	I	V		1		1.2E+03	Dichloroethylene, 1,1-	75-35-4	2.3E+01	n	1.0E+02	n	2.1E+01	n	8.8E+01	n	2.8E+01	n	7.0E+00	1.0E-02	n	2.5E-03
				2.0E-03	I			V		1		2.4E+03	Dichloroethylene, 1,2-cis-	156-59-2	1.6E+01	n	2.3E+02	n					3.6E+00	n	7.0E+01	1.1E-03	n	2.1E-02
				2.0E-02	I			V		1		1.9E+03	Dichloroethylene, 1,2-trans-	156-60-5	1.6E+02	n	2.3E+03	ns					3.6E+01	n	1.0E+02	1.1E-02	n	3.1E-02
				3.0E-03	I					1	0.1		Dichlorophenol, 2,4-	120-83-2	1.9E+01	n	2.5E+02	n					4.6E+00	n		2.3E-03	n	
				1.0E-02	I					1	0.05		Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	7.0E+01	n	9.6E+02	n					1.7E+01	n	7.0E+01	4.5E-03	n	1.8E-02
				8.0E-03	I					1	0.1		Dichlorophenoxy)butyric Acid, 4-(2,4-	94-82-6	5.1E+01	n	6.6E+02	n					1.2E+01	n		1.1E-02	n	

TR=1E-0
THQ=0.1

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Toxicity and Chemical-specific Information														Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
3.6E-02	C	1.0E-05	C	9.0E-02	A	4.0E-03	I	V		1		1.4E+03	Dichloropropane, 1,2-	78-87-5	1.0E+00	c**	4.4E+00	c**	2.8E-01	c**	1.2E+00	c**	4.4E-01	c**	5.0E+00	1.5E-04	c**	1.7E-03
				2.0E-02	P			V		1		1.5E+03	Dichloropropane, 1,3-	142-28-9	1.6E+02	n	2.3E+03	ns					3.7E+01	n		1.3E-02	n	
				3.0E-03	I					1	0.1		Dichloropropanol, 2,3-	616-23-9	1.9E+01	n	2.5E+02	n					5.9E+00	n		1.3E-03	n	
1.0E-01	I	4.0E-06	I	3.0E-02	I	2.0E-02	I	V		1		1.6E+03	Dichloropropene, 1,3-	542-75-6	1.8E+00	c**	8.2E+00	c**	7.0E-01	c**	3.1E+00	c**	4.7E-01	c**		1.7E-04	c**	
2.9E-01	I	8.3E-05	C	5.0E-04	I	5.0E-04	I			1	0.1		Dichlorvos	62-73-7	1.9E+00	c**	7.9E+00	c**	3.4E-02	c**	1.5E-01	c**	2.6E-01	c**		8.1E-05	c**	
				1.0E-04	I					1	0.1		Dicrotophos	141-66-2	6.3E-01	n	8.2E+00	n					2.0E-01	n		4.7E-05	n	
				8.0E-02	P	3.0E-04	X	V		1		2.6E+02	Dicyclopentadiene	77-73-6	1.3E-01	n	5.4E-01	n	3.1E-02	n	1.3E-01	n	6.3E-02	n		2.2E-04	n	
1.6E+01	I	4.6E-03	I	5.0E-05	I					1	0.1		Dieldrin	60-57-1	3.4E-02	c**	1.4E-01	c*	6.1E-04	c	2.7E-03	c	1.8E-03	c*		7.1E-05	c*	
		3.0E-04	C			5.0E-03	I			1	0.1		Diesel Engine Exhaust	NA					9.4E-03	c*	4.1E-02	c*						
				2.0E-03	P	2.0E-04	P			1	0.1		Diethanolamine	111-42-2	1.3E+01	n	1.6E+02	n	2.1E-02	n	8.8E-02	n	4.0E+00	n		8.1E-04	n	
				3.0E-02	P	1.0E-04	P			1	0.1		Diethylene Glycol Monobutyl Ether	112-34-5	1.9E+02	n	2.4E+03	n	1.0E-02	n	4.4E-02	n	6.0E+01	n		1.3E-02	n	
				6.0E-02	P	3.0E-04	P			1	0.1		Diethylene Glycol Monoethyl Ether	111-90-0	3.8E+02	n	4.8E+03	n	3.1E-02	n	1.3E-01	n	1.2E+02	n		2.4E-02	n	
				1.0E-03	P			V		1		1.1E+05	Diethylformamide	617-84-5	7.8E+00	n	1.2E+02	n					2.0E+00	n		4.1E-04	n	
3.5E+02	C	1.0E-01	C							1	0.1		Diethylstilbestrol	56-53-1	1.6E-03	c	6.6E-03	c	2.8E-05	c	1.2E-04	c	5.1E-05	c		2.8E-05	c	
				8.0E-02	I					1	0.1		Difenzoquat	43222-48-6	5.1E+02	n	6.6E+03	n					1.6E+02	n		2.5E+01	n	
				2.0E-02	I					1	0.1		Diflubenzuron	35367-38-5	1.3E+02	n	1.6E+03	n					2.9E+01	n		3.3E-02	n	
						4.0E+01	I	V		1		1.4E+03	Difluoroethane, 1,1-	75-37-6	4.8E+03	ns	2.0E+04	ns	4.2E+03	n	1.8E+04	n	8.3E+03	n		2.8E+00	n	
4.4E-02	C	1.3E-05	C					V		1			Dihydrosafrole	94-58-6	9.9E+00	c	4.5E+01	c	2.2E-01	c	9.4E-01	c	3.0E-01	c		1.9E-04	c	
						7.0E-01	P	V		1		2.3E+03	Diisopropyl Ether	108-20-3	2.2E+02	n	9.4E+02	n	7.3E+01	n	3.1E+02	n	1.5E+02	n		3.7E-02	n	
				8.0E-02	I			V		1		5.3E+02	Diisopropyl Methylphosphonate	1445-75-6	6.3E+02	ns	9.3E+03	ns					1.6E+02	n		4.5E-02	n	
				2.0E-02	I					1	0.1		Dimethipin	55290-64-7	1.3E+02	n	1.6E+03	n					4.0E+01	n		8.8E-03	n	
				2.0E-04	I					1	0.1		Dimethoate	60-51-5	1.3E+00	n	1.6E+01	n					4.0E-01	n		9.0E-05	n	
1.6E+00	P									1	0.1		Dimethoxybenzidine, 3,3'-	119-90-4	3.4E-01	c	1.4E+00	c					4.7E-02	c		5.8E-05	c	
1.7E-03	P			6.0E-02	P					1	0.1		Dimethyl methylphosphonate	756-79-6	3.2E+02	c**	1.4E+03	c**					4.6E+01	c**		9.6E-03	c**	
4.6E+00	C	1.3E-03	C							1	0.1		Dimethylamino azobenzene [p-]	60-11-7	1.2E-01	c	5.0E-01	c	2.2E-03	c	9.4E-03	c	5.0E-03	c		2.1E-05	c	
5.8E-01	H									1	0.1		Dimethylaniline HCl, 2,4-	21436-96-4	9.4E-01	c	4.0E+00	c					1.3E-01	c		1.2E-04	c	
2.0E-01	P			2.0E-03	X					1	0.1		Dimethylaniline, 2,4-	95-68-1	2.7E+00	c**	1.1E+01	c*					3.7E-01	c*		2.1E-04	c*	
				2.0E-03	I			V		1		8.3E+02	Dimethylaniline, N,N-	121-69-7	1.6E+01	n	2.3E+02	n					3.5E+00	n		1.3E-03	n	
1.1E+01	P									1	0.1		Dimethylbenzidine, 3,3'-	119-93-7	4.9E-02	c	2.1E-01	c					6.5E-03	c		4.3E-05	c	
				1.0E-01	P	3.0E-02	I	V		1		1.1E+05	Dimethylformamide	68-12-2	2.6E+02	n	1.5E+03	n	3.1E+00	n	1.3E+01	n	6.1E+00	n		1.2E-03	n	
				1.0E-04	X	2.0E-06	X	V		1		1.7E+05	Dimethylhydrazine, 1,1-	57-14-7	5.7E-03	n	2.4E-02	n	2.1E-04	n	8.8E-04	n	4.2E-04	n		9.3E-08	n	
5.5E+02	C	1.6E-01	C					V		1		1.9E+05	Dimethylhydrazine, 1,2-	540-73-8	8.8E-04	c	4.1E-03	c	1.8E-05	c	7.7E-05	c	2.8E-05	c		6.5E-09	c	
				2.0E-02	I					1	0.1		Dimethylphenol, 2,4-	105-67-9	1.3E+02	n	1.6E+03	n					3.6E+01	n		4.2E-02	n	
				6.0E-04	I					1	0.1		Dimethylphenol, 2,6-	576-26-1	3.8E+00	n	4.9E+01	n					1.1E+00	n		1.3E-03	n	
				1.0E-03	I					1	0.1		Dimethylphenol, 3,4-	95-65-8	6.3E+00	n	8.2E+01	n					1.8E+00	n		2.1E-03	n	
4.5E-02	C	1.3E-05	C					V		1		4.7E+02	Dimethylvinylchloride	513-37-1	1.1E+00	c	4.8E+00	c	2.2E-01	c	9.4E-01	c	3.3E-01	c		1.1E-04	c	
				8.0E-05	X					1	0.1		Dinitro-o-cresol, 4,6-	534-52-1	5.1E-01	n	6.6E+00	n					1.5E-01	n		2.6E-04	n	
				2.0E-03	I					1	0.1		Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5	1.3E+01	n	1.6E+02	n					2.3E+00	n		7.7E-02	n	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,2-	528-29-0	6.3E-01	n	8.2E+00	n					1.9E-01	n		1.8E-04	n	
				1.0E-04	I					1	0.1		Dinitrobenzene, 1,3-	99-65-0	6.3E-01	n	8.2E+00	n					2.0E-01	n		1.8E-04	n	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,4-	100-25-4	6.3E-01	n	8.2E+00	n					2.0E-01	n		1.8E-04	n	
				2.0E-03	I					1	0.1		Dinitrophenol, 2,4-	51-28-5	1.3E+01	n	1.6E+02	n					3.9E+00	n		4.4E-03	n	
6.8E-01	I									1	0.1		Dinitrotoluene Mixture, 2,4/2,6-	NA	8.0E-01	c	3.4E+00	c					1.1E-01	c		1.5E-04	c	
3.1E-01	C	8.9E-05	C	2.0E-03	I					1	0.102		Dinitrotoluene, 2,4-	121-14-2	1.7E+00	c**	7.4E+00	c*	3.2E-02	c	1.4E-01	c	2.4E-01	c*		3.2E-04	c*	
1.5E+00	P			3.0E-04	X					1	0.099		Dinitrotoluene, 2,6-	606-20-2	3.6E-01	c**	1.5E+00	c*					4.9E-02	c*		6.7E-05	c*	
				2.0E-03	S					1	0.006		Dinitrotoluene, 2-Amino-4,6-	35572-78-2	1.5E+01	n	2.3E+02	n					3.9E+00	n		3.0E-03	n	
				2.0E-03	S					1	0.009		Dinitrotoluene, 4-Amino-2,6-	19406-51-0	1.5E+01	n	2.3E+02	n					3.9E+00	n		3.0E-03	n	
4.5E-01	X			9.0E-04	X					1	0.1		Dinitrotoluene, Technical grade	25321-14-6	1.2E+00	c**	5.1E+00	c*					1.0E-01	c*		1.4E-04	c*	
				1.0E-03	I					1	0.1		Dinoseb	88-85-7	6.3E+00	n	8.2E+01	n					1.5E+00	n	7.0E+00	1.3E-02	n	6.2E-02
1.0E-01	I	5.0E-06	I	3.0E-02	I	3.0E-02	I	V		1		1.2E+05	Dioxane, 1,4-	123-91-1	5.3E+00	c*	2.4E+01	c*	5.6E-01	c**	2.5E+00	c**	4.6E-01	c*		9.4E-05	c*	
													Dioxins															
6.2E+03	I	1.3E+00	I							1	0.03		~Hexachlorodibenzo-p-dioxin, Mixture	NA	1.0E-04	c	4.7E-04	c	2.2E-06	c	9.4E-06	c	1.3E-05	c		1.7E-05	c	
1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C	V		1	0.03		~TCDD, 2,3,7,8-	1746-01-6	4.8E-06	c**	2.2E-05	c**	7.4E-08	c*	3.2E-07	c*	1.2E-07	c*	3.0E-05	5.9E-08	c*	1.5E-05
				3.0E-02	I					1	0.1		Diphenamid	957-51-7	1.9E+02	n	2.5E+03	n					5.3E+01	n		5.2E-01	n	
				8.0E-04	X					1	0.1		Diphenyl Sulfone	127-63-9	5.1E+00	n	6.6E+01	n					1.5E+00	n		3.6E-03	n	
				2.5E-02	I					1	0.1		Diphenylamine	122-39-4	1.6E+02	n	2.1E+03	n					3.1E+01	n		5.8E-02	n	
8.0E-01	I	2.2E-04	I							1	0.1		Diphenylhydrazine, 1,2-	122-66-7	6.8E-01	c	2.9E+00	c	1.3E-02	c	5.6E-02	c	7.8E-02	c		2.5E-04	c	
				2.2E-03	I					1	0.1		Diquat	85-00-7	1.4E+01	n	1.8E+02	n					4.4E+00	n	2.0E+01	8.3E-02	n	3.7E-01
7.1E+00	C	1.4E-01	C							1	0.1		Direct Black 38	1937-37-7	7.6E-02	c	3.2E-01	c	2.0E-05	c	8.8E-05	c	1.1E-02	c		5.3E+00	c	
7.4E+00	C	1.4E-01	C							1	0.1		Direct Blue 6	2602-46-2	7.3E-02	c	3.1E-01	c	2.0E-05	c	8.8E-05	c	1.1E-02	c		1.7E+01	c	
6.7E+00	C	1.4E-01	C							1	0.1		Direct Brown 95	16071-86-6	8.1E-02	c	3.4E-01	c	2.0E-05	c	8.8E-05	c	1.2E-02	c		1.6E-01	c	
				4.0E-05	I					1	0.1		Disulfoton	298-04-4	2.5E-01	n	3.3E+00	n					5.0E-02	n		9.4E-05	n	
				1.0E-02	I			V		1			Dithiane, 1,4-	505-29-3	7.8E+01	n	1.2E+03	n					2.0E+01	n		9.7E-03	n	
				2.0E-03	I					1	0.1		Diuron	330-54-1	1.3E+01	n	1.6E+02	n					3.6E+00	n		1.5E-03	n	
				4.0E-03	I					1	0.1		Dodine	2439-10-3	2.5E+01	n	3.3E+02	n					8.0E+00	n		4.1E-02	n	
				2.5E-02	I			V		1			EPTC	759-94-4	2.0E+02	n	2.9E+03	n					3.8E+01	n		2.0E-02	n	
				6.0E-03	I			V		1			Endosulfan	115-29-7	4.7E+01	n	7.0E+02	n					1.0E+01	n		1.4E-01	n	
				2.0E-02	I					1	0.1		Endothall	145-73-3	1.3E+02	n	1.6E+03	n					3.8E+01	n	1.0E+02	9.1E-03	n	2.4E-02
				3.0E-04	I					1	0.1		Endrin	72-20-8	1.9E+00	n	2.5E+01	n					2.3E-01	n	2.0E+00	9.2E-03	n	8.1E-02
9.9E-03	I	1.2E-06	I	6.0E-03	P	1.0E-03	I	V		1		1.1E+04	Epichlorohydrin	106-89-8	1.9E+00	n	8.2E+00	n	1.0E-01	n	4.4E-01	n	2.0E-01	n		4.5E-05	n	
						2.0E-02	I	V		1		1.5E+04	Epoxybutane, 1,2-	106-88-7	1.6E+01	n	6.7E+01	n	2.1E+00	n	8.8E+00	n	4.2E+00	n		9.2E-04	n	
				4.0E-02	P					1	0.1		Ethanol, 2-(2-methoxyethoxy)-	111-77-3	2.5E+02	n	3.3E+03	n					8.0E+01	n		1.6E-02	n	
				5.0E-03	I					1	0.1		Ethephon	16672-87-0	3.2E+01	n	4.1E+02	n					1.0E+01	n		2.1E-03	n	
				5.0E-04	I					1	0.1		Ethion	563-12-2	3.2E+00	n	4.1E+01	n					4.3E-01	n		8.5E-04	n	
				1.0E-01	P	6.0E-02	P	V		1		2.4E+04	Ethoxyethanol Acetate, 2-	111-15-9	2.6E+02	n	1.4E+03	n	6.3E+00	n	2.6E+01	n	1.2E+01	n		2.5E-03	n	

TR=1E-0
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				9.0E-02	P	2.0E-01	I	V		1		1.1E+05	Ethoxyethanol, 2-	110-80-5	5.2E+02	n	4.7E+03	n	2.1E+01	n	8.8E+01	n	3.4E+01	n		6.8E-03	n	
				9.0E-01	I	7.0E-02	P	V		1		1.1E+04	Ethyl Acetate	141-78-6	6.2E+01	n	2.6E+02	n	7.3E+00	n	3.1E+01	n	1.4E+01	n		3.1E-03	n	
				5.0E-03	P	8.0E-03	P	V		1		2.5E+03	Ethyl Acrylate	140-88-5	4.7E+00	n	2.1E+01	n	8.3E-01	n	3.5E+00	n	1.4E+00	n		3.2E-04	n	
						1.0E+01	I	V		1		2.1E+03	Ethyl Chloride (Chloroethane)	75-00-3	1.4E+03	n	5.7E+03	ns	1.0E+03	n	4.4E+03	n	2.1E+03	n		5.9E-01	n	
				2.0E-01	I			V		1		1.0E+04	Ethyl Ether	60-29-7	1.6E+03	n	2.3E+04	ns					3.9E+02	n		8.8E-02	n	
						3.0E-01	P	V		1		1.1E+03	Ethyl Methacrylate	97-63-2	1.8E+02	n	7.6E+02	n	3.1E+01	n	1.3E+02	n	6.3E+01	n		1.5E-02	n	
				1.0E-05	I					1	0.1		Ethyl-p-nitrophenyl Phosphonate	2104-64-5	6.3E-02	n	8.2E-01	n					8.9E-03	n		2.8E-04	n	
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V		1		4.8E+02	Ethylbenzene	100-41-4	5.8E+00	c*	2.5E+01	c*	1.1E+00	c*	4.9E+00	c*	1.5E+00	c*	7.0E+02	1.7E-03	c*	7.8E-01
				7.0E-02	P					1	0.1		Ethylene Cyanohydrin	109-78-4	4.4E+02	n	5.7E+03	n					1.4E+02	n		2.8E-02	n	
				9.0E-02	P			V		1		1.9E+05	Ethylene Diamine	107-15-3	7.0E+02	n	1.1E+04	n					1.8E+02	n		4.1E-02	n	
				2.0E+00	I	4.0E-01	C			1	0.1		Ethylene Glycol	107-21-1	1.3E+04	n	1.6E+05	nm	4.2E+01	n	1.8E+02	n	4.0E+03	n		8.1E-01	n	
				1.0E-01	I	1.6E+00	I			1	0.1		Ethylene Glycol Monobutyl Ether	111-76-2	6.3E+02	n	8.2E+03	n	1.7E+02	n	7.0E+02	n	2.0E+02	n		4.1E-02	n	
3.1E-01	C	8.8E-05	C			3.0E-02	C	V		1		1.2E+05	Ethylene Oxide	75-21-8	1.8E-01	c	7.9E-01	c	3.2E-02	c*	1.4E-01	c*	5.1E-02	c		1.1E-05	c	
4.5E-02	C	1.3E-05	C	8.0E-05	I					1	0.1		Ethylene Thiourea	96-45-7	5.1E-01	n	6.6E+00	n	2.2E-01	c	9.4E-01	c	1.6E-01	n		3.6E-05	n	
6.5E+01	C	1.9E-02	C					V		1		1.5E+05	Ethyleneimine	151-56-4	2.7E-03	c	1.2E-02	c	1.5E-04	c	6.5E-04	c	2.4E-04	c		5.2E-08	c	
				3.0E+00	I					1	0.1		Ethylphthalyl Ethyl Glycolate	84-72-0	1.9E+04	n	2.5E+05	nm					5.8E+03	n		1.3E+01	n	
				2.5E-04	I					1	0.1		Fenamiphos	22224-92-6	1.6E+00	n	2.1E+01	n					4.4E-01	n		4.3E-04	n	
				2.5E-02	I					1	0.1		Fenpropathrin	39515-41-8	1.6E+02	n	2.1E+03	n					6.4E+00	n		2.9E-01	n	
				2.5E-02	I					1	0.1		Fenvalerate	51630-58-1	1.6E+02	n	2.1E+03	n					5.0E+01	n		3.2E+01	n	
				1.3E-02	I					1	0.1		Fluometuron	2164-17-2	8.2E+01	n	1.1E+03	n					2.4E+01	n		1.9E-02	n	
				4.0E-02	C	1.3E-02	C			1			Fluoride	16984-48-8	3.1E+02	n	4.7E+03	n	1.4E+00	n	5.7E+00	n	8.0E+01	n		1.2E+01	n	
				6.0E-02	I	1.3E-02	C			1			Fluorine (Soluble Fluoride)	7782-41-4	4.7E+02	n	7.0E+03	n	1.4E+00	n	5.7E+00	n	1.2E+02	n	4.0E+03	1.8E+01	n	6.0E+02
				8.0E-02	I					1	0.1		Fluridone	59756-60-4	5.1E+02	n	6.6E+03	n					1.4E+02	n		1.6E+01	n	
				2.0E-02	I					1	0.1		Flurprimidol	56425-91-3	1.3E+02	n	1.6E+03	n					3.4E+01	n		1.6E-01	n	
				7.0E-04	I					1	0.1		Flusilazole	85509-19-9	4.4E+00	n	5.7E+01	n					1.1E+00	n		1.8E-01	n	
				6.0E-02	I					1	0.1		Flutolanil	66332-96-5	3.8E+02	n	4.9E+03	n					9.5E+01	n		5.0E-01	n	
				1.0E-02	I					1	0.1		Fluvalinate	69409-94-5	6.3E+01	n	8.2E+02	n					2.0E+01	n		2.9E+01	n	
3.5E-03	I			1.0E-01	I					1	0.1		Folpet	133-07-3	1.6E+02	c**	6.6E+02	c*					2.0E+01	c**		4.7E-03	c**	
1.9E-01	I									1	0.1		Fomesafen	72178-02-0	2.9E+00	c	1.2E+01	c					3.9E-01	c		1.3E-03	c	
				2.0E-03	I					1	0.1		Fonofos	944-22-9	1.3E+01	n	1.6E+02	n					2.4E+00	n		4.7E-03	n	
		1.3E-05	I	2.0E-01	I	9.8E-03	A	V		1		4.2E+04	Formaldehyde	50-00-0	1.7E+01	c**	7.3E+01	c**	2.2E-01	c**	9.4E-01	c**	4.3E-01	c**		8.7E-05	c**	
				9.0E-01	P	3.0E-04	X	V		1		1.1E+05	Formic Acid	64-18-6	2.9E+00	n	1.2E+01	n	3.1E-02	n	1.3E-01	n	6.3E-02	n		1.3E-05	n	
				3.0E+00	I					1	0.1		Fosetyl-AL	39148-24-8	1.9E+04	n	2.5E+05	nm					6.0E+03	n		7.9E+01	n	
													Furans															
				1.0E-03	X			V		1	0.03		~Dibenzofuran	132-64-9	7.3E+00	n	1.0E+02	n					7.9E-01	n		1.5E-02	n	
				1.0E-03	I			V		1	0.03	6.2E+03	~Furan	110-00-9	7.3E+00	n	1.0E+02	n					1.9E+00	n		7.3E-04	n	
				9.0E-01	I	2.0E+00	I	V		1	0.03	1.7E+05	~Tetrahydrofuran	109-99-9	1.8E+03	n	9.4E+03	n	2.1E+02	n	8.8E+02	n	3.4E+02	n		7.5E-02	n	
3.8E+00	H									1	0.1		Furazolidone	67-45-8	1.4E-01	c	6.0E-01	c					2.0E-02	c		3.9E-05	c	
				3.0E-03	I	5.0E-02	H	V		1		1.0E+04	Furfural	98-01-1	2.1E+01	n	2.6E+02	n	5.2E+00	n	2.2E+01	n	3.8E+00	n		8.1E-04	n	
1.5E+00	C	4.3E-04	C							1	0.1		Furium	531-82-8	3.6E-01	c	1.5E+00	c	6.5E-03	c	2.9E-02	c	5.1E-02	c		6.8E-05	c	
3.0E-02	I	8.6E-06	C							1	0.1		Furmecyclox	60568-05-0	1.8E+01	c	7.7E+01	c	3.3E-01	c	1.4E+00	c	1.1E+00	c		1.2E-03	c	
				4.0E-04	I					1	0.1		Glufosinate, Ammonium	77182-82-2	2.5E+00	n	3.3E+01	n					8.0E-01	n		1.8E-04	n	
						8.0E-05	C			1	0.1		Glutaraldehyde	111-30-8	1.1E+04	n	4.8E+04	n	8.3E-03	n	3.5E-02	n						
				4.0E-04	I	1.0E-03	H	V		1		1.1E+05	Glycidyl	765-34-4	2.3E+00	n	2.1E+01	n	1.0E-01	n	4.4E-01	n	1.7E-01	n		3.3E-05	n	
				1.0E-01	I					1	0.1		Glyphosate	1071-83-6	6.3E+02	n	8.2E+03	n					2.0E+02	n	7.0E+02	8.8E-01	n	3.1E+00
				1.0E-02	X			V		1			Guanidine	113-00-8	7.8E+01	n	1.2E+03	n					2.0E+01	n		4.5E-03	n	
				2.0E-02	P					1	0.1		Guanidine Chloride	50-01-1	1.3E+02	n	1.6E+03	n					4.0E+01	n			n	
				5.0E-05	I					1	0.1		Haloxyfop, Methyl	69806-40-2	3.2E-01	n	4.1E+00	n					7.6E-02	n		8.4E-04	n	
4.5E+00	I	1.3E-03	I	5.0E-04	I			V		1			Heptachlor	76-44-8	1.3E-01	c*	6.3E-01	c*	2.2E-03	c	9.4E-03	c	1.4E-03	c*	4.0E-01	1.2E-04	c*	3.3E-02
9.1E+00	I	2.6E-03	I	1.3E-05	I			V		1			Heptachlor Epoxide	1024-57-3	7.0E-02	c**	3.3E-01	c**	1.1E-03	c	4.7E-03	c	1.4E-03	c**	2.0E-01	2.8E-05	c**	4.1E-03
				2.0E-03	I			V		1			Hexabromobenzene	87-82-1	1.6E+01	n	2.3E+02	n					4.0E+00	n		2.3E-02	n	
				2.0E-04	I					1	0.1		Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2	1.3E+00	n	1.6E+01	n					4.0E-01	n			n	
1.6E+00	I	4.6E-04	I	8.0E-04	I			V		1			Hexachlorobenzene	118-74-1	2.1E-01	c*	9.6E-01	c*	6.1E-03	c	2.7E-02	c	9.8E-03	c	1.0E+00	1.2E-04	c	1.3E-02
7.8E-02	I	2.2E-05	I	1.0E-03	P			V		1		1.7E+01	Hexachlorobutadiene	87-68-3	1.2E+00	c**	5.3E+00	c*	1.3E-01	c	5.6E-01	c	1.4E-01	c**		2.7E-04	c**	
6.3E+00	I	1.8E-03	I	8.0E-03	A					1	0.1		Hexachlorocyclohexane, Alpha-	319-84-6	8.6E-02	c	3.6E-01	c	1.6E-03	c	6.8E-03	c	7.2E-03	c		4.2E-05	c	
1.8E+00	I	5.3E-04	I							1	0.1		Hexachlorocyclohexane, Beta-	319-85-7	3.0E-01	c	1.3E+00	c	5.3E-03	c	2.3E-02	c	2.5E-02	c		1.5E-04	c	
1.1E+00	C	3.1E-04	C	3.0E-04	I					1	0.04		Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.7E-01	c**	2.5E+00	c*	9.1E-03	c	4.0E-02	c	4.2E-02	c**	2.0E-01	2.4E-04	c**	1.2E-03
1.8E+00	I	5.1E-04	I							1	0.1		Hexachlorocyclohexane, Technical	608-73-1	3.0E-01	c	1.3E+00	c	5.5E-03	c	2.4E-02	c	2.5E-02	c		1.5E-04	c	
				6.0E-03	I	2.0E-04	I	V		1		1.6E+01	Hexachlorocyclopentadiene	77-47-4	1.8E-01	n	7.5E-01	n	2.1E-02	n	8.8E-02	n	4.1E-02	n	5.0E+01	1.3E-04	n	1.6E-01
4.0E-02	I	1.1E-05	C	7.0E-04	I	3.0E-02	I	V		1			Hexachloroethane	67-72-1	1.8E+00	c**	8.0E+00	c**	2.6E-01	c*	1.1E+00	c*	3.3E-01	c**		2.0E-04	c**	
				3.0E-04	I					1	0.1		Hexachlorophene	70-30-4	1.9E+00	n	2.5E+01	n					6.0E-01	n		8.0E-01	n	
1.1E-01	I			3.0E-03	I					1	0.015		Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	6.1E+00	c**	2.8E+01	c*					7.0E-01	c**		2.7E-04	c**	
						1.0E-05	I	V		1		3.4E+03	Hexamethylene Diisocyanate, 1,6-	822-06-0	3.1E-01	n	1.3E+00	n	1.0E-03	n	4.4E-03	n	2.1E-03	n		2.1E-05	n	
				4.0E-04	P					1	0.1		Hexamethylphosphoramide	680-31-9	2.5E+00	n	3.3E+01	n					8.0E-01	n		1.8E-04	n	
						7.0E-01	I	V		1		1.4E+02	Hexane, N-	110-54-3	6.1E+01	n	2.5E+02	ns	7.3E+01	n	3.1E+02	n	1.5E+02	n		1.0E+00	n	
				2.0E+00	P					1	0.1		Hexanedioic Acid	124-04-9	1.3E+04	n	1.6E+05	nm					4.0E+03	n		9.9E-01	n	
				5.0E-03	I	3.0E-02	I	V		1		3.3E+03	Hexanone, 2-	591-78-6	2.0E+01	n	1.3E+02	n	3.1E+00	n	1.3E+01	n	3.8E+00	n		8.8E-04	n	
				3.3E-02	I					1	0.1		Hexazinone	51235-04-2	2.1E+02	n	2.7E+03	n					6.4E+01	n		3.0E-02	n	
				2.5E-02	I					1	0.1		Hexythiazox	78587-05-0	1.6E+02	n	2.1E+03	n					1.1E+01	n		5.0E-02	n	
				3.0E-04	I					1	0.1		Hydramethylnon	67485-29-4	1.9E+00	n	2.5E+01	n					5.9E-01	n		2.1E+02	n	
3.0E+00	I	4.9E-03	I			3.0E-05	P	V		1			Hydrazine	302-01-2	2.3E-01	c	1.1E+00	c	5.7E-04	c**	2.5E-03	c**	1.1E-03	c**			c**	
3.0E+00	I	4.9E-03	I							1			Hydrazine Sulfate	10034-93-2	2.3E-01	c	1.1E+00	c	5.7E-04	c	2.5E-03	c	2.6E-02	c			c	
						2.0E-02	I	V		1			Hydrogen Chloride	7647-01-0	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n	4.2E+00	n			n	
				4.0E-02	C	1.4E-02	C	V		1			Hydrogen Fluoride	7664-39-3	3.1E+02	n	4.7E+03	n	1.5E+00	n	6.1E+00	n	2.8E+00	n			n	
						2.0E-03	I	V		1			Hydrogen Sulfide	7783-06-4	2.8E+05	nm	1.2E+06	nm	2.1E-01	n	8.8E-01	n	4.2E-01	n			n	

TR=1E-06
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
6.0E-02	P			4.0E-02	P					1	0.1		Hydroquinone	123-31-9	9.0E+00	c*	3.8E+01	c*					1.3E+00	c*		8.7E-04	c*	
				1.3E-02	I					1	0.1		Imazalil	35554-44-0	8.2E+01	n	1.1E+03	n					1.9E+01	n		3.2E-01	n	
				2.5E-01	I					1	0.1		Imazaquin	81335-37-7	1.6E+03	n	2.1E+04	n					4.9E+02	n		2.4E+00	n	
				2.5E-01	I					1	0.1		Imazethapyr	81335-77-5	1.6E+03	n	2.1E+04	n					4.7E+02	n		4.1E-01	n	
				1.0E-02	A					1			Iodine	7553-56-2	7.8E+01	n	1.2E+03	n					2.0E+01	n		1.2E+00	n	
				4.0E-02	I					1	0.1		Iprodione	36734-19-7	2.5E+02	n	3.3E+03	n					7.4E+01	n		2.2E-02	n	
				7.0E-01	P					1			Iron	7439-89-6	5.5E+03	n	8.2E+04	n					1.4E+03	n		3.5E+01	n	
				3.0E-01	I			V		1		1.0E+04	Isobutyl Alcohol	78-83-1	2.3E+03	n	3.5E+04	ns					5.9E+02	n		1.2E-01	n	
9.5E-04	I			2.0E-01	I	2.0E+00	C			1	0.1		Isophorone	78-59-1	5.7E+02	c**	2.4E+03	c**	2.1E+02	n	8.8E+02	n	7.8E+01	c**		2.6E-02	c**	
				1.5E-02	I			V		1			Isopropalin	33820-53-0	1.2E+02	n	1.8E+03	n					4.0E+00	n		9.2E-02	n	
				2.0E+00	P	2.0E-01	P	V		1		1.1E+05	Isopropanol	67-63-0	5.6E+02	n	2.4E+03	n	2.1E+01	n	8.8E+01	n	4.1E+01	n		8.4E-03	n	
				1.0E-01	I					1	0.1		Isopropyl Methyl Phosphonic Acid	1832-54-8	6.3E+02	n	8.2E+03	n					2.0E+02	n		4.3E-02	n	
				5.0E-02	I					1	0.1		Isoxaben	82558-50-7	3.2E+02	n	4.1E+03	n					7.3E+01	n		2.0E-01	n	
						3.0E-01	A	V		1			JP-7	NA	4.3E+07	nm	1.8E+08	nm	3.1E+01	n	1.3E+02	n	6.3E+01	n			n	
				2.0E-03	I					1	0.1		Lactofen	77501-63-4	1.3E+01	n	1.6E+02	n					2.5E+00	n		1.2E-01	n	
													Lead Compounds															
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			~Lead Chromate	7758-97-6	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
8.5E-03	C	1.2E-05	C							1			~Lead Phosphate	7446-27-7	8.2E+01	c	3.8E+02	c	2.3E-01	c	1.0E+00	c	9.1E+00	c			c	
8.5E-03	C	1.2E-05	C							1	0.1		~Lead acetate	301-04-2	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		1.8E-03	c	
										1			~Lead and Compounds	7439-92-1	4.0E+02	L	8.0E+02	L	1.5E-01	L			1.5E+01	L	1.5E+01		L	1.4E+01
8.5E-03	C	1.2E-05	C							1	0.1		~Lead subacetate	1335-32-6	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		2.0E-03	c	
				1.0E-07	I			V		1		2.4E+00	~Tetraethyl Lead	78-00-2	7.8E-04	n	1.2E-02	n					1.3E-04	n		4.7E-07	n	
				5.0E-06	P			V		1		3.8E+02	Lewisite	541-25-3	3.9E-02	n	5.8E-01	n					9.0E-03	n		3.8E-06	n	
				2.0E-03	I					1	0.1		Linuron	330-55-2	1.3E+01	n	1.6E+02	n					3.3E+00	n		2.9E-03	n	
				2.0E-03	P					1			Lithium	7439-93-2	1.6E+01	n	2.3E+02	n					4.0E+00	n		1.2E+00	n	
				5.0E-04	I					1	0.1		MCPA	94-74-6	3.2E+00	n	4.1E+01	n					7.5E-01	n		2.0E-04	n	
				1.0E-02	I					1	0.1		MCPB	94-81-5	6.3E+01	n	8.2E+02	n					1.5E+01	n		5.8E-03	n	
				1.0E-03	I					1	0.1		MCPP	93-65-2	6.3E+00	n	8.2E+01	n					1.6E+00	n		4.7E-04	n	
				2.0E-02	I					1	0.1		Malathion	121-75-5	1.3E+02	n	1.6E+03	n					3.9E+01	n		1.0E-02	n	
				1.0E-01	I	7.0E-04	C			1	0.1		Maleic Anhydride	108-31-6	6.3E+02	n	8.0E+03	n	7.3E-02	n	3.1E-01	n	1.9E+02	n		3.8E-02	n	
				5.0E-01	I					1	0.1		Maleic Hydrazide	123-33-1	3.2E+03	n	4.1E+04	n					1.0E+03	n		2.1E-01	n	
				1.0E-04	P					1	0.1		Malononitrile	109-77-3	6.3E-01	n	8.2E+00	n					2.0E-01	n		4.1E-05	n	
				3.0E-02	H					1	0.1		Mancozeb	8018-01-7	1.9E+02	n	2.5E+03	n					5.4E+01	n		7.6E-02	n	
				5.0E-03	I					1	0.1		Maneb	12427-38-2	3.2E+01	n	4.1E+02	n					9.8E+00	n		1.4E-02	n	
				1.4E-01	I	5.0E-05	I			1			Manganese (Diet)	7439-96-5														
				2.4E-02	S	5.0E-05	I			0.04			Manganese (Non-diet)	7439-96-5	1.8E+02	n	2.6E+03	n	5.2E-03	n	2.2E-02	n	4.3E+01	n		2.8E+00	n	
				9.0E-05	H					1	0.1		Mephosfolan	950-10-7	5.7E-01	n	7.4E+00	n					1.8E-01	n		2.6E-04	n	
				3.0E-02	I					1	0.1		Mepiquat Chloride	24307-26-4	1.9E+02	n	2.5E+03	n					6.0E+01	n		2.0E-02	n	
													Mercury Compounds															
				3.0E-04	I	3.0E-04	S			0.07			~Mercuric Chloride (and other Mercury salts)	7487-94-7	2.3E+00	n	3.5E+01	n	3.1E-02	n	1.3E-01	n	5.7E-01	n	2.0E+00		n	
						3.0E-04	I	V		1		3.1E+00	~Mercury (elemental)	7439-97-6	1.1E+00	n	4.6E+00	ns	3.1E-02	n	1.3E-01	n	6.3E-02	n	2.0E+00	3.3E-03	n	1.0E-01
				1.0E-04	I					1			~Methyl Mercury	22967-92-6	7.8E-01	n	1.2E+01	n					2.0E-01	n			n	
				8.0E-05	I					1	0.1		~Phenylmercuric Acetate	62-38-4	5.1E-01	n	6.6E+00	n					1.6E-01	n		5.0E-05	n	
				3.0E-05	I			V		1			Merphos	150-50-5	2.3E-01	n	3.5E+00	n					6.0E-02	n		5.9E-03	n	
				3.0E-05	I					1	0.1		Merphos Oxide	78-48-8	1.9E-01	n	2.5E+00	n					8.5E-03	n		4.2E-05	n	
				6.0E-02	I					1	0.1		Metalaxyl	57837-19-1	3.8E+02	n	4.9E+03	n					1.2E+02	n		3.3E-02	n	
				1.0E-04	I	3.0E-02	P	V		1		4.6E+03	Methacrylonitrile	126-98-7	7.5E-01	n	1.0E+01	n	3.1E+00	n	1.3E+01	n	1.9E-01	n		4.3E-05	n	
				5.0E-05	I					1	0.1		Methamidophos	10265-92-6	3.2E-01	n	4.1E+00	n					1.0E-01	n		2.1E-05	n	
				2.0E+00	I	2.0E+01	I	V		1		1.1E+05	Methanol	67-56-1	1.2E+04	n	1.2E+05	nms	2.1E+03	n	8.8E+03	n	2.0E+03	n		4.1E-01	n	
				1.0E-03	I					1	0.1		Methidathion	950-37-8	6.3E+00	n	8.2E+01	n					1.9E+00	n		4.7E-04	n	
				2.5E-02	I					1	0.1		Methomyl	16752-77-5	1.6E+02	n	2.1E+03	n					5.0E+01	n		1.1E-02	n	
4.9E-02	C	1.4E-05	C							1	0.1		Methoxy-5-nitroaniline, 2-	99-59-2	1.1E+01	c	4.7E+01	c	2.0E-01	c	8.8E-01	c	1.5E+00	c		5.3E-04	c	
				5.0E-03	I					1	0.1		Methoxychlor	72-43-5	3.2E+01	n	4.1E+02	n					3.7E+00	n	4.0E+01	2.0E-01	n	2.2E+00
				8.0E-03	P	1.0E-03	P	V		1		1.2E+05	Methoxyethanol Acetate, 2-	110-49-6	1.1E+01	n	5.1E+01	n	1.0E-01	n	4.4E-01	n	2.1E-01	n		4.2E-05	n	
				5.0E-03	P	2.0E-02	I	V		1		1.1E+05	Methoxyethanol, 2-	109-86-4	3.3E+01	n	3.5E+02	n	2.1E+00	n	8.8E+00	n	2.9E+00	n		5.9E-04	n	
				1.0E+00	X			V		1		2.9E+04	Methyl Acetate	79-20-9	7.8E+03	n	1.2E+05	nms					2.0E+03	n		4.1E-01	n	
						2.0E-02	P	V		1		6.8E+03	Methyl Acrylate	96-33-3	1.5E+01	n	6.1E+01	n	2.1E+00	n	8.8E+00	n	4.2E+00	n		8.9E-04	n	
				6.0E-01	I	5.0E+00	I	V		1		2.8E+04	Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.7E+03	n	1.9E+04	n	5.2E+02	n	2.2E+03	n	5.6E+02	n		1.2E-01	n	
		1.0E-03	X	1.0E-03	P	2.0E-05	X	V		1		1.8E+05	Methyl Hydrazine	60-34-4	1.0E-01	n	4.4E-01	n	2.1E-03	n	8.8E-03	n	4.2E-03	n		9.4E-07	n	
						3.0E+00	I	V		1		3.4E+03	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	3.3E+03	n	1.4E+04	ns	3.1E+02	n	1.3E+03	n	6.3E+02	n		1.4E-01	n	
						1.0E-03	C	V		1		1.0E+04	Methyl Isocyanate	624-83-9	4.6E-01	n	1.9E+00	n	1.0E-01	n	4.4E-01	n	2.1E-01	n		5.9E-05	n	
				1.4E+00	I	7.0E-01	I	V		1		2.4E+03	Methyl Methacrylate	80-62-6	4.4E+02	n	1.9E+03	n	7.3E+01	n	3.1E+02	n	1.4E+02	n		3.0E-02	n	
				2.5E-04	I					1	0.1		Methyl Parathion	298-00-0	1.6E+00	n	2.1E+01	n					4.5E-01	n		7.4E-04	n	
				6.0E-02	X					1	0.1		Methyl Phosphonic Acid	993-13-5	3.8E+02	n	4.9E+03	n					1.2E+02	n		2.4E-02	n	
				6.0E-03	H	4.0E-02	H	V		1		3.9E+02	Methyl Styrene (Mixed Isomers)	25013-15-4	3.2E+01	n	2.6E+02	n	4.2E+00	n	1.8E+01	n	2.3E+00	n		3.8E-03	n	
9.9E-02	C	2.8E-05	C							1	0.1		Methyl methanesulfonate	66-27-3	5.5E+00	c	2.3E+01	c	1.0E-01	c	4.4E-01	c	7.9E-01	c		1.6E-04	c	
1.8E-03	C	2.6E-07	C			3.0E+00	I	V		1		8.9E+03	Methyl tert-Butyl Ether (MTBE)	1634-04-4	4.7E+01	c*	2.1E+02	c*	1.1E+01	c*	4.7E+01	c*	1.4E+01	c*		3.2E-03	c*	
				3.0E-04	X					1	0.1		Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2	1.9E+00	n	2.5E+01	n					6.0E-01	n		3.6E-04	n	
9.0E-03	P			2.0E-02	X					1	0.1		Methyl-5-Nitroaniline, 2-	99-55-8	6.0E+01	c**	2.6E+02	c**					8.2E+00	c**		4.6E-03	c**	
8.3E+00	C	2.4E-03	C							1	0.1		Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	6.5E-02	c	2.8E-01	c	1.2E-03	c	5.1E-03	c	9.4E-03	c		3.2E-06	c	
1.3E-01	C	3.7E-05	C							1	0.1		Methylaniline Hydrochloride, 2-	636-21-5	4.2E+00	c	1.8E+01	c	7.6E-02	c	3.3E-01	c	6.0E-01	c		2.6E-04	c	
				1.0E-02	A					1	0.1		Methylarsonic acid	124-58-3	6.3E+01	n	8.2E+02	n					2.0E+01	n		5.8E-03	n	
				2.0E-04	X					1	0.1		Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7	1.3E+00	n	1.6E+01	n					4.0E-01	n			n	
1.0E-01	X			3.0E-04	X					1	0.1		Methylbenzene-1,4-diamine sulfate, 2-	615-50-9	1.9E+00	n	2.3E+01	c**					6.0E-01	n			n	
2.2E+01	C	6.3E-03	C						M	1	0.1		Methylcholanthrene, 3-	56-49-5	5.5E-03	c	1.0E-01	c	1.6E-04	c	1.9E-03	c	1.1E-03	c		2.2E-03	c	

TR=1E-06
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information														Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	V	M	1		3.3E+03	Methylene Chloride	75-09-2	3.5E+01	n	3.2E+02	n	6.3E+01	n	2.6E+02	n	1.1E+01	n	5.0E+00	2.7E-03	n	1.3E-03
1.0E-01	P	4.3E-04	C	2.0E-03	P				M	1	0.1		Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.2E+00	c*	2.3E+01	c**	2.4E-03	c	2.9E-02	c	1.6E-01	c*		1.8E-03	c*	
4.6E-02	I	1.3E-05	C							1	0.1		Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	1.2E+01	c	5.0E+01	c	2.2E-01	c	9.4E-01	c	4.8E-01	c		2.6E-03	c	
1.6E+00	C	4.6E-04	C			2.0E-02	C			1	0.1		Methylenebisbenzenamine, 4,4'-	101-77-9	3.4E-01	c	1.4E+00	c	6.1E-03	c	2.7E-02	c	4.7E-02	c		2.1E-04	c	
						6.0E-04	I			1	0.1		Methylenediphenyl Diisocyanate	101-68-8	8.5E+04	n	3.6E+05	nm	6.3E-02	n	2.6E-01	n						
				7.0E-02	H			V		1		5.0E+02	Methylstyrene, Alpha-	98-83-9	5.5E+02	ns	8.2E+03	ns					7.8E+01	n		1.2E-01	n	
				1.5E-01	I					1	0.1		Metolachlor	51218-45-2	9.5E+02	n	1.2E+04	n					2.7E+02	n		3.2E-01	n	
				2.5E-02	I					1	0.1		Metribuzin	21087-64-9	1.6E+02	n	2.1E+03	n					4.9E+01	n		1.5E-02	n	
				2.5E-01	I					1	0.1		Metsulfuron-methyl	74223-64-6	1.6E+03	n	2.1E+04	n					4.9E+02	n		1.9E-01	n	
				3.0E+00	P			V		1		3.4E-01	Mineral oils	8012-95-1	2.3E+04	ns	3.5E+05	nms					6.0E+03	n		2.4E+02	n	
1.8E+01	C	5.1E-03	C	2.0E-04	I			V		1			Mirex	2385-85-5	3.6E-02	c*	1.7E-01	c	5.5E-04	c	2.4E-03	c	8.8E-04	c		6.3E-04	c	
				2.0E-03	I					1	0.1		Molinate	2212-67-1	1.3E+01	n	1.6E+02	n					3.0E+00	n		1.7E-03	n	
				5.0E-03	I					1			Molybdenum	7439-98-7	3.9E+01	n	5.8E+02	n					1.0E+01	n		2.0E-01	n	
				1.0E-01	I					1			Monochloramine	10599-90-3	7.8E+02	n	1.2E+04	n					2.0E+02	n	4.0E+03		n	
				2.0E-03	P					1	0.1		Monomethylaniline	100-61-8	1.3E+01	n	1.6E+02	n					3.8E+00	n		1.4E-03	n	
				2.5E-02	I					1	0.1		Myclobutanil	88671-89-0	1.6E+02	n	2.1E+03	n					4.5E+01	n		5.6E-01	n	
				3.0E-04	X					1	0.1		N,N'-Diphenyl-1,4-benzenediamine	74-31-7	1.9E+00	n	2.5E+01	n					3.6E-01	n		3.7E-02	n	
				2.0E-03	I			V		1			Naled	300-76-5	1.6E+01	n	2.3E+02	n					4.0E+00	n		1.8E-03	n	
				3.0E-02	X	1.0E-01	P	V		1			Naphtha, High Flash Aromatic (HFAN)	64742-95-6	2.3E+02	n	3.5E+03	n	1.0E+01	n	4.4E+01	n	1.5E+01	n			n	
1.8E+00	C	0.0E+00	C							1	0.1		Naphthylamine, 2-	91-59-8	3.0E-01	c	1.3E+00	c					3.9E-02	c		2.0E-04	c	
				1.0E-01	I					1	0.1		Napropamide	15299-99-7	6.3E+02	n	8.2E+03	n					1.6E+02	n		1.1E+00	n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickel Acetate	373-02-4	6.7E+01	n	8.1E+02	n	1.5E-03	n	6.1E-03	n	2.2E+01	n		4.5E-03	n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickel Carbonate	3333-67-3	6.7E+01	n	8.1E+02	n	1.5E-03	n	6.1E-03	n	2.2E+01	n			n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C	V		1			Nickel Carbonyl	13463-39-3	8.2E+01	n	1.1E+03	n	1.5E-03	n	6.1E-03	n	2.9E-03	n			n	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			0.04			Nickel Hydroxide	12054-48-7	8.2E+01	n	1.1E+03	n	1.5E-03	n	6.1E-03	n	2.0E+01	n			n	
		2.6E-04	C	1.1E-02	C	2.0E-05	C			0.04			Nickel Oxide	1313-99-1	8.4E+01	n	1.2E+03	n	2.1E-03	n	8.8E-03	n	2.0E+01	n			n	
		2.4E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Refinery Dust	NA	8.2E+01	n	1.1E+03	n	1.5E-03	n	6.1E-03	n	2.2E+01	n		3.2E+00	n	
		2.6E-04	C	2.0E-02	I	9.0E-05	A			0.04			Nickel Soluble Salts	7440-02-0	1.5E+02	n	2.2E+03	n	9.4E-03	n	3.9E-02	n	3.9E+01	n		2.6E+00	n	
1.7E+00	C	4.8E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Subsulfide	12035-72-2	4.1E-01	c	1.9E+00	c	1.5E-03	n	6.1E-03	n	4.5E-02	c			c	
		2.6E-04	C	1.1E-02	C	1.4E-05	C			1	0.1		Nickelocene	1271-28-9	6.7E+01	n	8.1E+02	n	1.5E-03	n	6.1E-03	n	2.2E+01	n			n	
				1.6E+00	I					1			Nitrate	14797-55-8	1.3E+04	n	1.9E+05	nm					3.2E+03	n	1.0E+04		n	
										1			Nitrate + Nitrite (as N)	NA											1.0E+04			
				1.0E-01	I					1			Nitrite	14797-65-0	7.8E+02	n	1.2E+04	n					2.0E+02	n	1.0E+03		n	
				1.0E-02	X	5.0E-05	X			1	0.1		Nitroaniline, 2-	88-74-4	6.3E+01	n	8.0E+02	n	5.2E-03	n	2.2E-02	n	1.9E+01	n		8.0E-03	n	
2.0E-02	P			4.0E-03	P	6.0E-03	P			1	0.1		Nitroaniline, 4-	100-01-6	2.5E+01	n	1.1E+02	c**	6.3E-01	n	2.6E+00	n	3.8E+00	c**		1.6E-03	c**	
		4.0E-05	I	2.0E-03	I	9.0E-03	I	V		1		3.1E+03	Nitrobenzene	98-95-3	5.1E+00	c**	2.2E+01	c**	7.0E-02	c*	3.1E-01	c*	1.4E-01	c**		9.2E-05	c**	
				3.0E+03	P					1	0.1		Nitrocellulose	9004-70-0	1.9E+07	nm	2.5E+08	nm					6.0E+06	n		1.3E+03	n	
				7.0E-02	H					1	0.1		Nitrofurantoin	67-20-9	4.4E+02	n	5.7E+03	n					1.4E+02	n		6.1E-02	n	
1.3E+00	C	3.7E-04	C							1	0.1		Nitrofurazone	59-87-0	4.2E-01	c	1.8E+00	c	7.6E-03	c	3.3E-02	c	6.0E-02	c		5.4E-05	c	
1.7E-02	P			1.0E-04	P					1	0.1		Nitroglycerin	55-63-0	6.3E-01	n	8.2E+00	n					2.0E-01	n		8.5E-05	n	
				1.0E-01	I					1	0.1		Nitroguanidine	556-88-7	6.3E+02	n	8.2E+03	n					2.0E+02	n		4.8E-02	n	
		8.8E-06	P			5.0E-03	P	V		1		1.8E+04	Nitromethane	75-52-5	5.4E+00	c**	2.4E+01	c**	3.2E-01	c**	1.4E+00	c**	6.4E-01	c**		1.4E-04	c**	
		2.7E-03	H			2.0E-02	I	V		1		4.9E+03	Nitropropane, 2-	79-46-9	1.4E-02	c	6.0E-02	c	1.0E-03	c	4.5E-03	c	2.1E-03	c		5.4E-07	c	
2.7E+01	C	7.7E-03	C						M	1	0.1		Nitroso-N-ethylurea, N-	759-73-9	4.5E-03	c	8.5E-02	c	1.3E-04	c	1.6E-03	c	9.2E-04	c		2.2E-07	c	
1.2E+02	C	3.4E-02	C						M	1	0.1		Nitroso-N-methylurea, N-	684-93-5	1.0E-03	c	1.9E-02	c	3.0E-05	c	3.6E-04	c	2.1E-04	c		4.6E-08	c	
5.4E+00	I	1.6E-03	I					V		1			Nitroso-di-N-butylamine, N-	924-16-3	9.9E-02	c	4.6E-01	c	1.8E-03	c	7.7E-03	c	2.7E-03	c		5.5E-06	c	
7.0E+00	I	2.0E-03	C							1	0.1		Nitroso-di-N-propylamine, N-	621-64-7	7.8E-02	c	3.3E-01	c	1.4E-03	c	6.1E-03	c	1.1E-02	c		8.1E-06	c	
2.8E+00	I	8.0E-04	C							1	0.1		Nitrosodiethanolamine, N-	1116-54-7	1.9E-01	c	8.2E-01	c	3.5E-03	c	1.5E-02	c	2.8E-02	c		5.6E-06	c	
1.5E+02	I	4.3E-02	I						M	1	0.1		Nitrosodiethylamine, N-	55-18-5	8.1E-04	c	1.5E-02	c	2.4E-05	c	2.9E-04	c	1.7E-04	c		6.1E-08	c	
5.1E+01	I	1.4E-02	I	8.0E-06	P	4.0E-05	X	V	M	1		2.4E+05	Nitrosodimethylamine, N-	62-75-9	2.0E-03	c*	3.4E-02	c*	7.2E-05	c*	8.8E-04	c*	1.1E-04	c*		2.7E-08	c*	
4.9E-03	I	2.6E-06	C							1	0.1		Nitrosodiphenylamine, N-	86-30-6	1.1E+02	c	4.7E+02	c	1.1E+00	c	4.7E+00	c	1.2E+01	c		6.7E-02	c	
2.2E+01	I	6.3E-03	C					V		1		1.1E+05	Nitrosomethylethylamine, N-	10595-95-6	2.0E-02	c	9.1E-02	c	4.5E-04	c	1.9E-03	c	7.1E-04	c		2.0E-07	c	
6.7E+00	C	1.9E-03	C							1	0.1		Nitrosomorpholine [N-]	59-89-2	8.1E-02	c	3.4E-01	c	1.5E-03	c	6.5E-03	c	1.2E-02	c		2.8E-06	c	
9.4E+00	C	2.7E-03	C							1	0.1		Nitrosopiperidine [N-]	100-75-4	5.8E-02	c	2.4E-01	c	1.0E-03	c	4.5E-03	c	8.2E-03	c		4.4E-06	c	
2.1E+00	I	6.1E-04	I							1	0.1		Nitrosopyrrolidine, N-	930-55-2	2.6E-01	c	1.1E+00	c	4.6E-03	c	2.0E-02	c	3.7E-02	c		1.4E-05	c	
				1.0E-04	X					1	0.1		Nitrotoluene, m-	99-08-1	6.3E-01	n	8.2E+00	n					1.7E-01	n		1.6E-04	n	
2.2E-01	P			9.0E-04	P			V		1		1.5E+03	Nitrotoluene, o-	88-72-2	3.2E+00	c**	1.5E+01	c**					3.1E-01	c**		3.0E-04	c**	
1.6E-02	P			4.0E-03	P					1	0.1		Nitrotoluene, p-	99-99-0	2.5E+01	n	1.4E+02	c**					4.3E+00	c**		4.0E-03	c**	
				3.0E-04	X	2.0E-02	P	V		1		6.9E+00	Nonane, n-	111-84-2	1.1E+00	n	7.2E+00	ns	2.1E+00	n	8.8E+00	n	5.3E-01	n		7.5E-03	n	
				4.0E-02	I					1	0.1		Norflurazon	27314-13-2	2.5E+02	n	3.3E+03	n					7.7E+01	n		5.0E-01	n	
				3.0E-03	I					1	0.1		Octabromodiphenyl Ether	32536-52-0	1.9E+01	n	2.5E+02	n					6.0E+00	n		1.2E+00	n	
				5.0E-02	I					1	0.006		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	3.9E+02	n	5.7E+03	n					1.0E+02	n		1.3E-01	n	
				2.0E-03	H					1	0.1		Octamethylpyrophosphoramide	152-16-9	1.3E+01	n	1.6E+02	n					4.0E+00	n		9.6E-04	n	
				5.0E-02	I					1	0.1		Oryzalin	19044-88-3	3.2E+02	n	4.1E+03	n					8.1E+01	n		1.5E-01	n	
				5.0E-03	I					1	0.1		Oxadiazon	19666-30-9	3.2E+01	n	4.1E+02	n					4.7E+00	n		4.8E-02	n	
				2.5E-02	I					1	0.1		Oxamyl	23135-22-0	1.6E+02	n	2.1E+03	n					5.0E+01	n	2.0E+02	1.1E-02	n	4.4E-02
				3.0E-03	I					1	0.1		Oxyfluorfen	42874-03-3	1.9E+01	n	2.5E+02	n					3.2E+00	n		2.5E-01	n	
				1.3E-02	I					1	0.1		Paclobutrazol	76738-62-0	8.2E+01	n	1.1E+03	n					2.3E+01	n		4.6E-02	n	
				4.5E-03	I					1	0.1		Paraquat Dichloride	1910-42-5	2.8E+01	n	3.7E+02	n					9.0E+00	n		1.2E-01	n	
				6.0E-03	H					1	0.1		Parathion	56-38-2	3.8E+01	n	4.9E+02	n					8.6E+00	n		4.3E-02	n	
				5.0E-02	H			V		1			Pebulate	1114-71-2	3.9E+02	n	5.8E+03	n					5.6E+01	n		4.5E-02	n	
				4.0E-02	I					1	0.1		Pendimethalin	40487-42-1	2.5E+02	n	3.3E+03	n					1.8E+01	n		2.1E-01	n	
				2.0E-03	I			V		1		3.1E-01	Pentabromodiphenyl Ether	32534-81-9	1.6E+01	ns	2.3E+02	ns					4.0E+00	n		1.7E-01	n	
				1.0E-04	I					1	0.1		Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9	6.3E-01	n	8.2E+00	n					2.0E-01	n		8.7E-03	n	
				8.0E-04	I			V		1			Pentachlorobenzene	608-93-5	6.3E+00	n	9.3E+01	n					3.2E-01	n		2.4E-03	n	

TR=1E-0
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	mutagen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
9.0E-02	P							V		1		4.6E+02	Pentachloroethane	76-01-7	7.7E+00	c	3.6E+01	c					6.5E-01	c		3.1E-04	c	
2.6E-01	H			3.0E-03	I			V		1			Pentachloronitrobenzene	82-68-8	2.7E+00	c**	1.3E+01	c*					1.2E-01	c*		1.5E-03	c*	
4.0E-01	I	5.1E-06	C	5.0E-03	I					1	0.25		Pentachlorophenol	87-86-5	1.0E+00	c*	4.0E+00	c*	5.5E-01	c	2.4E+00	c	4.1E-02	c*	1.0E+00	5.7E-05	c*	1.4E-03
4.0E-03	X			2.0E-03	P					1	0.1		Pentaerythritol tetranitrate (PETN)	78-11-5	1.3E+01	n	1.6E+02	n					3.9E+00	n		5.8E-03	n	
						1.0E+00	P	V		1		3.9E+02	Pentane, n-	109-66-0	8.1E+01	n	3.4E+02	n	1.0E+02	n	4.4E+02	n	2.1E+02	n		1.0E+00	n	
													Perchlorates															
				7.0E-04	I					1			~Ammonium Perchlorate	7790-98-9	5.5E+00	n	8.2E+01	n					1.4E+00	n			n	
				7.0E-04	I					1			~Lithium Perchlorate	7791-03-9	5.5E+00	n	8.2E+01	n					1.4E+00	n			n	
				7.0E-04	I					1			~Perchlorate and Perchlorate Salts	14797-73-0	5.5E+00	n	8.2E+01	n					1.4E+00	n	1.5E+01(F)		n	
				7.0E-04	I					1			~Potassium Perchlorate	7778-74-7	5.5E+00	n	8.2E+01	n					1.4E+00	n			n	
				7.0E-04	I					1			~Sodium Perchlorate	7601-89-0	5.5E+00	n	8.2E+01	n					1.4E+00	n			n	
				2.0E-02	P			V		1			Perfluorobutane Sulfonate	375-73-5	1.6E+02	n	2.3E+03	n					3.8E+01	n		2.1E-02	n	
				5.0E-02	I					1	0.1		Permethrin	52645-53-1	3.2E+02	n	4.1E+03	n					1.0E+02	n		2.4E+01	n	
2.2E-03	C	6.3E-07	C							1	0.1		Phenacetin	62-44-2	2.5E+02	c	1.0E+03	c	4.5E+00	c	1.9E+01	c	3.4E+01	c		9.7E-03	c	
				2.5E-01	I					1	0.1		Phenmedipham	13684-63-4	1.6E+03	n	2.1E+04	n					4.0E+02	n		2.1E+00	n	
				3.0E-01	I	2.0E-01	C			1	0.1		Phenol	108-95-2	1.9E+03	n	2.5E+04	n	2.1E+01	n	8.8E+01	n	5.8E+02	n		3.3E-01	n	
				4.0E-03	I					1	0.1		Phenol, 2-(1-methylethoxy)-, methylcarbamate	114-26-1	2.5E+01	n	3.3E+02	n					7.8E+00	n		2.5E-03	n	
				5.0E-04	X					1	0.1		Phenothiazine	92-84-2	3.2E+00	n	4.1E+01	n					4.3E-01	n		1.4E-03	n	
				6.0E-03	I					1	0.1		Phenylenediamine, m-	108-45-2	3.8E+01	n	4.9E+02	n					1.2E+01	n		3.2E-03	n	
4.7E-02	H									1	0.1		Phenylenediamine, o-	95-54-5	1.2E+01	c	4.9E+01	c					1.6E+00	c		4.4E-04	c	
				1.9E-01	H					1	0.1		Phenylenediamine, p-	106-50-3	1.2E+03	n	1.6E+04	n					3.8E+02	n		1.0E-01	n	
1.9E-03	H									1	0.1		Phenylphenol, 2-	90-43-7	2.8E+02	c	1.2E+03	c					3.0E+01	c		4.1E-01	c	
				2.0E-04	H					1	0.1		Phorate	298-02-2	1.3E+00	n	1.6E+01	n					3.0E-01	n		3.4E-04	n	
						3.0E-04	I	V		1		1.6E+03	Phosgene	75-44-5	3.1E-02	n	1.3E-01	n	3.1E-02	n	1.3E-01	n						
				2.0E-02	I					1	0.1		Phosmet	732-11-6	1.3E+02	n	1.6E+03	n					3.7E+01	n		8.2E-03	n	
													Phosphates, Inorganic															
				4.9E+01	P					1			~Aluminum metaphosphate	13776-88-0	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Ammonium polyphosphate	68333-79-9	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Calcium pyrophosphate	7790-76-3	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Diammonium phosphate	7783-28-0	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Dicalcium phosphate	7757-93-9	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Dimagnesium phosphate	7782-75-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Dipotassium phosphate	7758-11-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Disodium phosphate	7558-79-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monoaluminum phosphate	13530-50-2	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monoammonium phosphate	7722-76-1	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monocalcium phosphate	7758-23-8	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monomagnesium phosphate	7757-86-0	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monopotassium phosphate	7778-77-0	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Monosodium phosphate	7558-80-7	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Polyphosphoric acid	8017-16-1	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Potassium tripolyphosphate	13845-36-8	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium acid pyrophosphate	7758-16-9	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (acidic)	7785-88-8	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (anhydrous)	10279-59-1	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium aluminum phosphate (tetrahydrate)	10305-76-7	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium hexametaphosphate	10124-56-8	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium polyphosphate	68915-31-1	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium trimetaphosphate	7785-84-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Sodium tripolyphosphate	7758-29-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Tetrapotassium phosphate	7320-34-5	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Tetrasodium pyrophosphate	7722-88-5	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	15136-87-5	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Tricalcium phosphate	7758-87-4	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Trimagnesium phosphate	7757-87-1	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Tripotassium phosphate	7778-53-2	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				4.9E+01	P					1			~Trisodium phosphate	7601-54-9	3.8E+05	nm	5.7E+06	nm					9.7E+04	n			n	
				3.0E-04	I	3.0E-04	I	V		1			Phosphine	7803-51-2	2.3E+00	n	3.5E+01	n	3.1E-02	n	1.3E-01	n	5.7E-02	n			n	
				4.9E+01	P	1.0E-02	I			1			Phosphoric Acid	7664-38-2	3.0E+05	nm	2.9E+06	nm	1.0E+00	n	4.4E+00	n	9.7E+04	n			n	
				2.0E-05	I			V		1			Phosphorus, White	7723-14-0	1.6E-01	n	2.3E+00	n					4.0E-02	n		1.5E-04	n	
													Phthalates															
1.4E-02	I	2.4E-06	C	2.0E-02	I					1	0.1		~Bis(2-ethylhexyl)phthalate	117-81-7	3.9E+01	c**	1.6E+02	c*	1.2E+00	c	5.1E+00	c	5.6E+00	c**	6.0E+00	1.3E+00	c**	1.4E+00
1.9E-03	P			2.0E-01	I					1	0.1		~Butyl Benzyl Phthalate	85-68-7	2.9E+02	c**	1.2E+03	c*					1.6E+01	c*		2.4E-01	c*	
				1.0E+00	I					1	0.1		~Butylphthalyl Butylglycolate	85-70-1	6.3E+03	n	8.2E+04	n					1.3E+03	n		3.1E+01	n	
				1.0E-01	I					1	0.1		~Dibutyl Phthalate	84-74-2	6.3E+02	n	8.2E+03	n					9.0E+01	n		2.3E-01	n	
				8.0E-01	I					1	0.1		~Diethyl Phthalate	84-66-2	5.1E+03	n	6.6E+04	n					1.5E+03	n		6.1E-01	n	
				1.0E-01	I			V		1			~Dimethylterephthalate	120-61-6	7.8E+02	n	1.2E+04	n					1.9E+02	n		4.9E-02	n	
				1.0E-02	P					1	0.1		~Octyl Phthalate, di-N-	117-84-0	6.3E+01	n	8.2E+02	n					2.0E+01	n		5.7E+00	n	
				1.0E+00	H					1	0.1		~Phthalic Acid, P-	100-21-0	6.3E+03	n	8.2E+04	n					1.9E+03	n		6.8E-01	n	
				2.0E+00	I	2.0E-02	C			1	0.1		~Phthalic Anhydride	85-44-9	1.3E+04	n	1.6E+05	nm	2.1E+00	n	8.8E+00	n	3.9E+03	n		8.5E-01	n	
				7.0E-02	I					1	0.1		Picloram	1918-02-1	4.4E+02	n	5.7E+03	n					1.4E+02	n	5.0E+02	3.8E-02	n	1.4E-01
				1.0E-04	X					1	0.1		Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3	6.3E-01	n	8.2E+00	n					2.0E-01	n		1.3E-04	n	
				9.0E-04	X					1	0.1		Picric Acid (2,4,6-Trinitrophenol)	88-89-1	5.7E+00	n	7.4E+01	n					1.8E+00	n		8.4E-03	n	
				1.0E-02	I					1	0.1		Pirimiphos, Methyl	29232-93-7	6.3E+01	n	8.2E+02	n					1.2E+01	n		1.2E-02	n	
3.0E+01	C	8.6E-03	C	7.0E-06	H					1	0.1		Polybrominated Biphenyls	59536-65-1	1.8E-02	c**	7.7E-02	c**	3.3E-04	c	1.4E-03	c	2.6E-03	c**			c**	

TR=1E-06
HQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
													Polychlorinated Biphenyls (PCBs)															
7.0E-02	S	2.0E-05	S	7.0E-05	I			V		1	0.14		~Aroclor 1016	12674-11-2	4.1E-01	n	5.1E+00	n	1.4E-01	c	6.1E-01	c	1.4E-01	n		1.3E-02	n	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1221	11104-28-2	2.0E-01	c	8.3E-01	c	4.9E-03	c	2.1E-02	c	4.7E-03	c		8.0E-05	c	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1232	11141-16-5	1.7E-01	c	7.2E-01	c	4.9E-03	c	2.1E-02	c	4.7E-03	c		8.0E-05	c	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1242	53469-21-9	2.3E-01	c	9.5E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		1.2E-03	c	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1248	12672-29-6	2.3E-01	c	9.5E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		1.2E-03	c	
2.0E+00	S	5.7E-04	S	2.0E-05	I			V		1	0.14		~Aroclor 1254	11097-69-1	1.2E-01	n	9.7E-01	c**	4.9E-03	c	2.1E-02	c	7.8E-03	c**		2.0E-03	c**	
2.0E+00	S	5.7E-04	S					V		1	0.14		~Aroclor 1260	11096-82-5	2.4E-01	c	9.9E-01	c	4.9E-03	c	2.1E-02	c	7.8E-03	c		5.5E-03	c	
				6.0E-04	X			V		1	0.14		~Aroclor 5460	11126-42-4	3.5E+00	n	4.4E+01	n					1.2E+00	n		2.0E-01	n	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	1.3E-01	c**	5.2E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		2.8E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	1.2E-01	c**	5.1E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.7E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	69782-90-7	1.2E-01	c**	5.0E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.7E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	38380-08-4	1.2E-01	c**	5.0E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.7E-03	c*	
3.9E+03	E	1.1E+00	E	2.3E-08	E	1.3E-06	E	V		1	0.14		~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	1.2E-04	c**	5.1E-04	c**	2.5E-06	c*	1.1E-05	c*	4.0E-06	c*		1.7E-06	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	1.2E-01	c**	4.9E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.0E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	1.2E-01	c**	4.9E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.0E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	1.2E-01	c**	4.9E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.0E-03	c*	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E	V		1	0.14		~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	1.2E-01	c**	5.0E-01	c**	2.5E-03	c*	1.1E-02	c*	4.0E-03	c*		1.0E-03	c*	
1.3E+04	E	3.8E+00	E	7.0E-09	E	4.0E-07	E	V		1	0.14		~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	3.6E-05	c**	1.5E-04	c**	7.4E-07	c*	3.2E-06	c*	1.2E-06	c*		3.0E-07	c*	
2.0E+00	I	5.7E-04	I					V		1	0.14		~Polychlorinated Biphenyls (high risk)	1336-36-3	2.3E-01	c	9.4E-01	c	4.9E-03	c	2.1E-02	c			5.0E-01			
4.0E-01	I	1.0E-04	I					V		1	0.14		~Polychlorinated Biphenyls (low risk)	1336-36-3					2.8E-02	c	1.2E-01	c	4.4E-02	c	5.0E-01	6.8E-03	c	7.8E-02
7.0E-02	I	2.0E-05	I					V		1	0.14		~Polychlorinated Biphenyls (lowest risk)	1336-36-3					1.4E-01	c	6.1E-01	c			5.0E-01			
1.3E+01	E	3.8E-03	E	7.0E-06	E	4.0E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	3.8E-02	c**	1.6E-01	c**	7.4E-04	c*	3.2E-03	c*	6.0E-03	c**		9.4E-04	c**	
3.9E+01	E	1.1E-02	E	2.3E-06	E	1.3E-04	E	V		1	0.14		~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	1.2E-02	c**	4.8E-02	c**	2.5E-04	c*	1.1E-03	c*	4.0E-04	c*		6.2E-05	c*	
						6.0E-04	I			1	0.1		Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9	8.5E+04	n	3.6E+05	nm	6.3E-02	n	2.6E-01	n						
													Polynuclear Aromatic Hydrocarbons (PAHs)															
				6.0E-02	I			V		1	0.13		~Acenaphthene	83-32-9	3.6E+02	n	4.5E+03	n					5.3E+01	n		5.5E-01	n	
				3.0E-01	I			V		1	0.13		~Anthracene	120-12-7	1.8E+03	n	2.3E+04	n					1.8E+02	n		5.8E+00	n	
7.3E-01	E	1.1E-04	C					V	M	1	0.13		~Benz[a]anthracene	56-55-3	1.6E-01	c	2.9E+00	c	9.2E-03	c	1.1E-01	c	1.2E-02	c		4.2E-03	c	
1.2E+00	C	1.1E-04	C							1	0.13		~Benzo(j)fluoranthene	205-82-3	4.2E-01	c	1.8E+00	c	2.6E-02	c	1.1E-01	c	6.5E-02	c		7.8E-02	c	
7.3E+00	I	1.1E-03	C						M	1	0.13		~Benzo[a]pyrene	50-32-8	1.6E-02	c	2.9E-01	c	9.2E-04	c	1.1E-02	c	3.4E-03	c	2.0E-01	4.0E-03	c	2.4E-01
7.3E-01	E	1.1E-04	C						M	1	0.13		~Benzo[b]fluoranthene	205-99-2	1.6E-01	c	2.9E+00	c	9.2E-03	c	1.1E-01	c	3.4E-02	c		4.1E-02	c	
7.3E-02	E	1.1E-04	C						M	1	0.13		~Benzo[k]fluoranthene	207-08-9	1.6E+00	c	2.9E+01	c	9.2E-03	c	1.1E-01	c	3.4E-01	c		4.0E-01	c	
				8.0E-02	I			V		1	0.13		~Chloronaphthalene, Beta-	91-58-7	4.8E+02	n	6.0E+03	n					7.5E+01	n		3.9E-01	n	
7.3E-03	E	1.1E-05	C						M	1	0.13		~Chrysene	218-01-9	1.6E+01	c	2.9E+02	c	9.2E-02	c	1.1E+00	c	3.4E+00	c		1.2E+00	c	
7.3E+00	E	1.2E-03	C						M	1	0.13		~Dibenz[a,h]anthracene	53-70-3	1.6E-02	c	2.9E-01	c	8.4E-04	c	1.0E-02	c	3.4E-03	c		1.3E-02	c	
1.2E+01	C	1.1E-03	C							1	0.13		~Dibenzo(a,e)pyrene	192-65-4	4.2E-02	c	1.8E-01	c	2.6E-03	c	1.1E-02	c	6.5E-03	c		8.4E-02	c	
2.5E+02	C	7.1E-02	C						M	1	0.13		~Dimethylbenz(a)anthracene, 7,12-	57-97-6	4.6E-04	c	8.4E-03	c	1.4E-05	c	1.7E-04	c	1.0E-04	c		9.9E-05	c	
				4.0E-02	I					1	0.13		~Fluoranthene	206-44-0	2.4E+02	n	3.0E+03	n					8.0E+01	n		8.9E+00	n	
				4.0E-02	I			V		1	0.13		~Fluorene	86-73-7	2.4E+02	n	3.0E+03	n					2.9E+01	n		5.4E-01	n	
7.3E-01	E	1.1E-04	C						M	1	0.13		~Indeno[1,2,3-cd]pyrene	193-39-5	1.6E-01	c	2.9E+00	c	9.2E-03	c	1.1E-01	c	3.4E-02	c		1.3E-01	c	
2.9E-02	P			7.0E-02	A			V		1	0.13	3.9E+02	~Methylnaphthalene, 1-	90-12-0	1.8E+01	c*	7.3E+01	c*					1.1E+00	c*		6.0E-03	c*	
				4.0E-03	I			V		1	0.13		~Methylnaphthalene, 2-	91-57-6	2.4E+01	n	3.0E+02	n					3.6E+00	n		1.9E-02	n	
		3.4E-05	C	2.0E-02	I	3.0E-03	I	V		1	0.13		~Naphthalene	91-20-3	3.8E+00	c**	1.7E+01	c**	8.3E-02	c**	3.6E-01	c**	1.7E-01	c**		5.4E-04	c**	
1.2E+00	C	1.1E-04	C							1	0.13		~Nitropyrene, 4-	57835-92-4	4.2E-01	c	1.8E+00	c	2.6E-02	c	1.1E-01	c	1.9E-02	c		3.3E-03	c	
				3.0E-02	I			V		1	0.13		~Pyrene	129-00-0	1.8E+02	n	2.3E+03	n					1.2E+01	n		1.3E+00	n	
				2.0E-02	P					1	0.1		Potassium Perfluorobutane Sulfonate	29420-49-3	1.3E+02	n	1.6E+03	n					4.0E+01	n		2.2E-02	n	
1.5E-01	I			9.0E-03	I					1	0.1		Prochloraz	67747-09-5	3.6E+00	c*	1.5E+01	c*					3.8E-01	c*		1.9E-03	c*	
				6.0E-03	H			V		1			Profluralin	26399-36-0	4.7E+01	n	7.0E+02	n					2.6E+00	n		1.6E-01	n	
				1.5E-02	I					1	0.1		Prometon	1610-18-0	9.5E+01	n	1.2E+03	n					2.5E+01	n		1.2E-02	n	
				4.0E-03	I					1	0.1		Prometryn	7287-19-6	2.5E+01	n	3.3E+02	n					6.0E+00	n		9.0E-03	n	
				1.3E-02	I					1	0.1		Propachlor	1918-16-7	8.2E+01	n	1.1E+03	n					2.5E+01	n		1.5E-02	n	
				5.0E-03	I					1	0.1		Propanil	709-98-8	3.2E+01	n	4.1E+02	n					8.2E+00	n		4.5E-03	n	
				2.0E-02	I					1	0.1		Propargite	2312-35-8	1.3E+02	n	1.6E+03	n					1.6E+01	n		1.2E+00	n	
				2.0E-03	I			V		1		1.1E+05	Propargyl Alcohol	107-19-7	1.6E+01	n	2.3E+02	n					4.0E+00	n		8.1E-04	n	
				2.0E-02	I					1	0.1		Propazine	139-40-2	1.3E+02	n	1.6E+03	n					3.4E+01	n		3.0E-02	n	
				2.0E-02	I					1	0.1		Propham	122-42-9	1.3E+02	n	1.6E+03	n					3.5E+01	n		2.2E-02	n	
				1.3E-02	I					1	0.1		Propiconazole	60207-90-1	8.2E+01	n	1.1E+03	n					2.1E+01	n		6.9E-02	n	
						8.0E-03	I	V		1		3.3E+04	Propionaldehyde	123-38-6	7.5E+00	n	3.1E+01	n	8.3E-01	n	3.5E+00	n	1.7E+00	n		3.4E-04	n	
				1.0E-01	X	1.0E+00	X	V		1		2.6E+02	Propyl benzene	103-65-1	3.8E+02	ns	2.4E+03	ns	1.0E+02	n	4.4E+02	n	6.6E+01	n		1.2E-01	n	
						3.0E+00	C	V		1		3.5E+02	Propylene	115-07-1	2.2E+02	n	9.3E+02	ns	3.1E+02	n	1.3E+03	n	6.3E+02	n		6.0E-01	n	
				2.0E+01	P					1	0.1		Propylene Glycol	57-55-6	1.3E+05	nm	1.6E+06	nm					4.0E+04	n		8.1E+00	n	
						2.7E-04	A			1	0.1		Propylene Glycol Dinitrate	6423-43-4	3.9E+04	n	1.6E+05	nm	2.8E-02	n	1.2E-01	n						
				7.0E-01	H	2.0E+00	I	V		1		1.1E+05	Propylene Glycol Monomethyl Ether	107-98-2	4.1E+03	n	3.7E+04	n	2.1E+02	n	8.8E+02	n	3.2E+02	n		6.5E-02	n	
2.4E-01	I	3.7E-06	I			3.0E-02	I	V		1		7.8E+04	Propylene Oxide	75-56-9	2.1E+00	c*	9.7E+00	c*	7.6E-01	c**	3.3E+00	c**	2.7E-01	c*		5.6E-05	c*	
				7.5E-02	I					1	0.1		Propyzamide	23950-58-5	4.7E+02	n	6.2E+03	n					1.2E+02	n		1.2E-01	n	
				1.0E-03	I			V		1		5.3E+05	Pyridine	110-86-1	7.8E+00	n	1.2E+02	n					2.0E+00	n		6.8E-04	n	
				5.0E-04	I					1	0.1		Quinalphos	13593-03-8	3.2E+00	n	4.1E+01	n					5.1E-01	n		4.3E-03	n	
3.0E+00	I									1	0.1		Quinoline	91-22-5	1.8E-01	c	7.7E-01	c					2.4E-02	c		7.8E-05	c	
				9.0E-03	I					1	0.1		Quizalofop-ethyl	76578-14-8	5.7E+01	n	7.4E+02	n					1.2E+01	n		1.9E-01	n	
						3.0E-02	A			1			Refractory Ceramic Fibers	NA	4.3E+06	nm	1.8E+07	nm	3.1E+00	n	1.3E+01	n						
				3.0E-02	I					1	0.1		Resmethrin	10453-86-8	1.9E+02	n	2.5E+03	n					6.7E+00	n		4.2E+00	n	
				5.0E-02	H			V		1			Ronnel	299-84-3	3.9E+02	n	5.8E+03	n					4.1E+01	n		3.7E-01	n	
				4.0E-03	I					1	0.1		Rotenone	83-79-4	2.5E+01	n	3.3E+02	n					6.1E+00	n		3.2E+00	n	
2.2E-01	C	6.3E-05	C						M	1	0.1		Safrole	94-59-7	5.5E-01	c	1.0E+01	c	1.6E-02	c	1.9E-01	c	9.6E-02	c		5.9E-05	c	

TR=1E-0
THQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information												Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volatile	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				5.0E-03	I					1			Selenious Acid	7783-00-8	3.9E+01	n	5.8E+02	n					1.0E+01	n			n	
				5.0E-03	I	2.0E-02	C			1			Selenium	7782-49-2	3.9E+01	n	5.8E+02	n	2.1E+00	n	8.8E+00	n	1.0E+01	n	5.0E+01	5.2E-02	n	2.6E-01
				5.0E-03	C	2.0E-02	C			1			Selenium Sulfide	7446-34-6	3.9E+01	n	5.8E+02	n	2.1E+00	n	8.8E+00	n	1.0E+01	n			n	
				9.0E-02	I					1	0.1		Sethoxydim	74051-80-2	5.7E+02	n	7.4E+03	n					1.0E+02	n		9.3E-01	n	
						3.0E-03	C			1			Silica (crystalline, respirable)	7631-86-9	4.3E+05	nm	1.8E+06	nm	3.1E-01	n	1.3E+00	n						
				5.0E-03	I					0.04			Silver	7440-22-4	3.9E+01	n	5.8E+02	n					9.4E+00	n		8.0E-02	n	
1.2E-01	H			5.0E-03	I					1	0.1		Simazine	122-34-9	4.5E+00	c**	1.9E+01	c*					6.1E-01	c*	4.0E+00	3.0E-04	c*	2.0E-03
				1.3E-02	I					1	0.1		Sodium Acifluorfen	62476-59-9	8.2E+01	n	1.1E+03	n					2.6E+01	n		2.1E-01	n	
				4.0E-03	I					1			Sodium Azide	26628-22-8	3.1E+01	n	4.7E+02	n					8.0E+00	n			n	
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Sodium Dichromate	10588-01-9	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
2.7E-01	H			3.0E-02	I					1	0.1		Sodium Diethyldithiocarbamate	148-18-5	2.0E+00	c*	8.5E+00	c					2.9E-01	c		1.8E-04	c	
				5.0E-02	A	1.3E-02	C			1			Sodium Fluoride	7681-49-4	3.9E+02	n	5.8E+03	n	1.4E+00	n	5.7E+00	n	1.0E+02	n			n	
				2.0E-05	I					1	0.1		Sodium Fluoroacetate	62-74-8	1.3E-01	n	1.6E+00	n					4.0E-02	n		8.1E-06	n	
				1.0E-03	H					1			Sodium Metavanadate	13718-26-8	7.8E+00	n	1.2E+02	n					2.0E+00	n			n	
				8.0E-04	P					1			Sodium Tungstate	13472-45-2	6.3E+00	n	9.3E+01	n					1.6E+00	n			n	
				8.0E-04	P					1			Sodium Tungstate Dihydrate	10213-10-2	6.3E+00	n	9.3E+01	n					1.6E+00	n			n	
2.4E-02	H			3.0E-02	I					1	0.1		Stirofos (Tetrachlorovinphos)	961-11-5	2.3E+01	c**	9.6E+01	c*					2.8E+00	c*		8.2E-03	c*	
5.0E-01	C	1.5E-01	C	2.0E-02	C	2.0E-04	C		M	0.025			Strontium Chromate	7789-06-2	3.0E-01	c	6.2E+00	c	6.8E-06	c	8.2E-05	c	4.1E-02	c			c	
				6.0E-01	I					1			Strontium, Stable	7440-24-6	4.7E+03	n	7.0E+04	n					1.2E+03	n		4.2E+01	n	
				3.0E-04	I					1	0.1		Strychnine	57-24-9	1.9E+00	n	2.5E+01	n					5.9E-01	n		6.5E-03	n	
				2.0E-01	I	1.0E+00	I	V		1		8.7E+02	Styrene	100-42-5	6.0E+02	n	3.5E+03	ns	1.0E+02	n	4.4E+02	n	1.2E+02	n	1.0E+02	1.3E-01	n	1.1E-01
				3.0E-03	P					1	0.1		Styrene-Acrylonitrile (SAN) Trimer	NA	1.9E+01	n	2.5E+02	n					4.8E+00	n			n	
				1.0E-03	P	2.0E-03	X			1	0.1		Sulfolane	126-33-0	6.3E+00	n	8.2E+01	n	2.1E-01	n	8.8E-01	n	2.0E+00	n		4.4E-04	n	
				8.0E-04	P					1	0.1		Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9	5.1E+00	n	6.6E+01	n					1.1E+00	n		6.5E-03	n	
						1.0E-03	C	V		1			Sulfur Trioxide	7446-11-9	1.4E+05	nm	6.0E+05	nm	1.0E-01	n	4.4E-01	n	2.1E-01	n			n	
						1.0E-03	C			1			Sulfuric Acid	7664-93-9	1.4E+05	nm	6.0E+05	nm	1.0E-01	n	4.4E-01	n						
2.5E-02	I	7.1E-06	I	5.0E-02	H					1	0.1		Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester	140-57-8	2.2E+01	c*	9.2E+01	c*	4.0E-01	c	1.7E+00	c	1.3E+00	c*		1.5E-02	c*	
				3.0E-02	H					1	0.1		TCMTB	21564-17-0	1.9E+02	n	2.5E+03	n					4.8E+01	n		3.3E-01	n	
				7.0E-02	I					1	0.1		Tebuthiuron	34014-18-1	4.4E+02	n	5.7E+03	n					1.4E+02	n		3.9E-02	n	
				2.0E-02	H					1	0.1		Temephos	3383-96-8	1.3E+02	n	1.6E+03	n					4.0E+01	n		7.6E+00	n	
				1.3E-02	I					1	0.1		Terbacil	5902-51-2	8.2E+01	n	1.1E+03	n					2.5E+01	n		7.5E-03	n	
				2.5E-05	H			V		1		3.1E+01	Terbufos	13071-79-9	2.0E-01	n	2.9E+00	n					2.4E-02	n		5.2E-05	n	
				1.0E-03	I					1	0.1		Terbutryn	886-50-0	6.3E+00	n	8.2E+01	n					1.3E+00	n		1.9E-03	n	
				1.0E-04	I					1	0.1		Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1	6.3E-01	n	8.2E+00	n					2.0E-01	n		5.3E-03	n	
				3.0E-04	I			V		1			Tetrachlorobenzene, 1,2,4,5-	95-94-3	2.3E+00	n	3.5E+01	n					1.7E-01	n		7.9E-04	n	
2.6E-02	I	7.4E-06	I	3.0E-02	I			V		1		6.8E+02	Tetrachloroethane, 1,1,1,2-	630-20-6	2.0E+00	c	8.8E+00	c	3.8E-01	c	1.7E+00	c	5.7E-01	c*		2.2E-04	c*	
2.0E-01	I	5.8E-05	C	2.0E-02	I			V		1		1.9E+03	Tetrachloroethane, 1,1,2,2-	79-34-5	6.0E-01	c	2.7E+00	c	4.8E-02	c	2.1E-01	c	7.6E-02	c		3.0E-05	c	
2.1E-03	I	2.6E-07	I	6.0E-03	I	4.0E-02	I	V		1		1.7E+02	Tetrachloroethylene	127-18-4	8.1E+00	n	3.9E+01	n	4.2E+00	n	1.8E+01	n	4.1E+00	n	5.0E+00	1.8E-03	n	2.3E-03
				3.0E-02	I					1	0.1		Tetrachlorophenol, 2,3,4,6-	58-90-2	1.9E+02	n	2.5E+03	n					2.4E+01	n		1.8E-02	n	
2.0E+01	H							V		1			Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1	3.5E-02	c	1.6E-01	c					1.3E-03	c		4.5E-06	c	
				5.0E-04	I					1	0.1		Tetraethyl Dithiopyrophosphate	3689-24-5	3.2E+00	n	4.1E+01	n					7.1E-01	n		5.2E-04	n	
						8.0E+01	I	V		1		2.1E+03	Tetrafluoroethane, 1,1,1,2-	811-97-2	1.0E+04	ns	4.3E+04	ns	8.3E+03	n	3.5E+04	n	1.7E+04	n		9.3E+00	n	
				2.0E-03	P					1	7E-04		Tetryl (Trinitrophenylmethylnitramine)	479-45-8	1.6E+01	n	2.3E+02	n					3.9E+00	n		3.7E-02	n	
				2.0E-05	S					1			Thallic Oxide	1314-32-5	1.6E-01	n	2.3E+00	n					4.0E-02	n			n	
				1.0E-05	X					1			Thallium (I) Nitrate	10102-45-1	7.8E-02	n	1.2E+00	n					2.0E-02	n			n	
				1.0E-05	X					1			Thallium (Soluble Salts)	7440-28-0	7.8E-02	n	1.2E+00	n					2.0E-02	n	2.0E+00	1.4E-03	n	1.4E-01
				1.0E-05	X			V		1			Thallium Acetate	563-68-8	7.8E-02	n	1.2E+00	n					2.0E-02	n		4.1E-06	n	
				2.0E-05	X			V		1			Thallium Carbonate	6533-73-9	1.6E-01	n	2.3E+00	n					4.0E-02	n		8.3E-06	n	
				1.0E-05	X					1			Thallium Chloride	7791-12-0	7.8E-02	n	1.2E+00	n					2.0E-02	n			n	
				1.0E-05	S					1			Thallium Selenite	12039-52-0	7.8E-02	n	1.2E+00	n					2.0E-02	n			n	
				2.0E-05	X					1			Thallium Sulfate	7446-18-6	1.6E-01	n	2.3E+00	n					4.0E-02	n			n	
				1.3E-02	I					1	0.1		Thifensulfuron-methyl	79277-27-3	8.2E+01	n	1.1E+03	n					2.6E+01	n		7.8E-03	n	
				1.0E-02	I					1	0.1		Thiobencarb	28249-77-6	6.3E+01	n	8.2E+02	n					1.6E+01	n		5.5E-02	n	
				7.0E-02	X					1	0.008		Thiodiglycol	111-48-8	5.4E+02	n	7.9E+03	n					1.4E+02	n		2.8E-02	n	
				3.0E-04	H					1	0.1		Thiofanox	39196-18-4	1.9E+00	n	2.5E+01	n					5.3E-01	n		1.8E-04	n	
				8.0E-02	I					1	0.1		Thiophanate, Methyl	23564-05-8	5.1E+02	n	6.6E+03	n					1.6E+02	n		1.4E-01	n	
				5.0E-03	I					1	0.1		Thiram	137-26-8	3.2E+01	n	4.1E+02	n					9.8E+00	n		1.4E-02	n	
				6.0E-01	H					1			Tin	7440-31-5	4.7E+03	n	7.0E+04	n					1.2E+03	n		3.0E+02	n	
						1.0E-04	A	V		1			Titanium Tetrachloride	7550-45-0	1.4E+04	n	6.0E+04	n	1.0E-02	n	4.4E-02	n	2.1E-02	n			n	
				8.0E-02	I	5.0E+00	I	V		1		8.2E+02	Toluene	108-88-3	4.9E+02	n	4.7E+03	ns	5.2E+02	n	2.2E+03	n	1.1E+02	n	1.0E+03	7.6E-02	n	6.9E-01
		1.1E-05	C			8.0E-06	C	V		1			Toluene-2,4-diisocyante	584-84-9	6.4E-01	n	2.7E+00	n	8.3E-04	n	3.5E-03	n	1.7E-03	n		2.5E-05	n	
1.8E-01	X			2.0E-04	X					1	0.1		Toluene-2,5-diamine	95-70-5	1.3E+00	n	1.3E+01	c**					4.0E-01	n		1.2E-04	n	
		1.1E-05	C			8.0E-06	C	V		1		1.7E+03	Toluene-2,6-diisocyante	91-08-7	5.3E-01	n	2.2E+00	n	8.3E-04	n	3.5E-03	n	1.7E-03	n		2.6E-05	n	
1.6E-02	P	5.1E-05	C							1	0.1		Toluidine, o- (Methylaniline, 2-)	95-53-4	3.4E+01	c	1.4E+02	c	5.5E-02	c	2.4E-01	c	4.7E+00	c		2.0E-03	c	
3.0E-02	P			4.0E-03	X					1	0.1		Toluidine, p-	106-49-0	1.8E+01	c**	7.7E+01	c**					2.5E+00	c**		1.1E-03	c**	
				3.0E+00	P			V		1		3.4E-01	Total Petroleum Hydrocarbons (Aliphatic High)	NA	2.3E+04	ns	3.5E+05	nms					6.0E+03	n		2.4E+02	n	
						6.0E-01	P	V		1		1.4E+02	Total Petroleum Hydrocarbons (Aliphatic Low)	NA	5.2E+01	n	2.2E+02	ns	6.3E+01	n	2.6E+02	n	1.3E+02	n		8.8E-01	n	
				1.0E-02	X	1.0E-01	P	V		1		6.9E+00	Total Petroleum Hydrocarbons (Aliphatic Medium)	NA	9.6E+00	ns	4.4E+01	ns	1.0E+01	n	4.4E+01	n	1.0E+01	n		1.5E-01	n	
				4.0E-02	P					1	0.1		Total Petroleum Hydrocarbons (Aromatic High)	NA	2.5E+02	n	3.3E+03	n					8.0E+01	n		8.9E+00	n	
				4.0E-03	P	3.0E-02	P	V		1		1.8E+03	Total Petroleum Hydrocarbons (Aromatic Low)	NA	8.2E+00	n	4.2E+01	n	3.1E+00	n	1.3E+01	n	3.3E+00	n		1.7E-03	n	
				4.0E-03	P	3.0E-03	P	V		1			Total Petroleum Hydrocarbons (Aromatic Medium)	NA	1.1E+01	n	6.0E+01	n	3.1E-01	n	1.3E+00	n	5.5E-01	n		2.3E-03	n	
1.1E+00	I	3.2E-04	I							1	0.1		Toxaphene	8001-35-2	4.9E-01	c	2.1E+00	c	8.8E-03	c	3.8E-02	c	7.1E-02	c	3.0E+00	1.1E-02	c	4.6E-01
				7.5E-03	I					1	0.1		Tralomethrin	66841-25-6	4.7E+01	n	6.2E+02	n					1.5E+01	n		5.8E+00	n	
				3.0E-04	A			V		1			Tri-n-butyltin	688-73-3	2.3E+00	n	3.5E+01	n					3.7E-01	n		8.2E-03	n	
				8.0E+01	X					1	0.1		Triacetin	102-76-1	5.1E+05	nm	6.6E+06	nm					1.6E+05	n		4.5E+01	n	

TR=1E-06
HQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = APPENDIX PPRTV SCREEN (See FAQ #27); H = HEAST; F = See FAQ; J = New Jersey; O = EPA Office of Water; E = see user guide Section 2.3.5; L = see user guide on lead; M = mutagen; S = see user guide Section 5; V = volatile; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide)

Toxicity and Chemical-specific Information													Contaminant		Screening Levels										Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				3.0E-02	I					1	0.1		Triadimefon	43121-43-3	1.9E+02	n	2.5E+03	n					5.5E+01	n		4.4E-02	n	
				1.3E-02	I			V		1			Triallate	2303-17-5	1.0E+02	n	1.5E+03	n					1.2E+01	n		2.6E-02	n	
				1.0E-02	I					1	0.1		Triasulfuron	82097-50-5	6.3E+01	n	8.2E+02	n					2.0E+01	n		2.1E-02	n	
				8.0E-03	I					1	0.1		Tribenuron-methyl	101200-48-0	5.1E+01	n	6.6E+02	n					1.6E+01	n		6.1E-03	n	
				5.0E-03	I			V		1			Tribromobenzene, 1,2,4-	615-54-3	3.9E+01	n	5.8E+02	n					4.5E+00	n		6.4E-03	n	
9.0E-03	P			1.0E-02	P					1	0.1		Tributyl Phosphate	126-73-8	6.0E+01	c**	2.6E+02	c**					5.2E+00	c**		2.5E-02	c**	
				3.0E-04	P					1	0.1		Tributyltin Compounds	NA	1.9E+00	n	2.5E+01	n					6.0E-01	n			n	
				3.0E-04	I					1	0.1		Tributyltin Oxide	56-35-9	1.9E+00	n	2.5E+01	n					5.7E-01	n		2.9E+01	n	
				3.0E+01	I	3.0E+01	H	V		1		9.1E+02	Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	4.0E+03	ns	1.7E+04	ns	3.1E+03	n	1.3E+04	n	5.5E+03	n		1.4E+01	n	
7.0E-02	I			2.0E-02	I					1	0.1		Trichloroacetic Acid	76-03-9	7.8E+00	c*	3.3E+01	c*					1.1E+00	c*	6.0E+01	2.2E-04	c*	1.2E-02
2.9E-02	H									1	0.1		Trichloroaniline HCl, 2,4,6-	33663-50-2	1.9E+01	c	7.9E+01	c					2.7E+00	c		7.4E-03	c	
7.0E-03	X			3.0E-05	X					1	0.1		Trichloroaniline, 2,4,6-	634-93-5	1.9E-01	n	2.5E+00	n					4.0E-02	n		3.6E-04	n	
				8.0E-04	X			V		1			Trichlorobenzene, 1,2,3-	87-61-6	6.3E+00	n	9.3E+01	n					7.0E-01	n		2.1E-03	n	
2.9E-02	P			1.0E-02	I	2.0E-03	P	V		1		4.0E+02	Trichlorobenzene, 1,2,4-	120-82-1	5.8E+00	n	2.6E+01	n	2.1E-01	n	8.8E-01	n	4.0E-01	n	7.0E+01	1.2E-03	n	2.0E-01
				2.0E+00	I	5.0E+00	I	V		1		6.4E+02	Trichloroethane, 1,1,1-	71-55-6	8.1E+02	ns	3.6E+03	ns	5.2E+02	n	2.2E+03	n	8.0E+02	n	2.0E+02	2.8E-01	n	7.0E-02
5.7E-02	I	1.6E-05	I	4.0E-03	I	2.0E-04	X	V		1		2.2E+03	Trichloroethane, 1,1,2-	79-00-5	1.5E-01	n	6.3E-01	n	2.1E-02	n	8.8E-02	n	4.1E-02	n	5.0E+00	1.3E-05	n	1.6E-03
4.6E-02	I	4.1E-06	I	5.0E-04	I	2.0E-03	I	V	M	1		6.9E+02	Trichloroethylene	79-01-6	4.1E-01	n	1.9E+00	n	2.1E-01	n	8.8E-01	n	2.8E-01	n	5.0E+00	1.0E-04	n	1.8E-03
				3.0E-01	I			V		1		1.2E+03	Trichlorofluoromethane	75-69-4	2.3E+03	ns	3.5E+04	ns					5.2E+02	n		3.3E-01	n	
				1.0E-01	I					1	0.1		Trichlorophenol, 2,4,5-	95-95-4	6.3E+02	n	8.2E+03	n					1.2E+02	n		4.0E-01	n	
1.1E-02	I	3.1E-06	I	1.0E-03	P					1	0.1		Trichlorophenol, 2,4,6-	88-06-2	6.3E+00	n	8.2E+01	n	9.1E-01	c	4.0E+00	c	1.2E+00	n		1.2E-03	n	
				1.0E-02	I					1	0.1		Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	6.3E+01	n	8.2E+02	n					1.6E+01	n		6.8E-03	n	
				8.0E-03	I					1	0.1		Trichlorophenoxypropionic acid, -2,4,5	93-72-1	5.1E+01	n	6.6E+02	n					1.1E+01	n	5.0E+01	6.1E-03	n	2.8E-02
				5.0E-03	I			V		1		1.3E+03	Trichloropropane, 1,1,2-	598-77-6	3.9E+01	n	5.8E+02	n					8.8E+00	n		3.5E-03	n	
3.0E+01	I			4.0E-03	I	3.0E-04	I	V	M	1		1.4E+03	Trichloropropane, 1,2,3-	96-18-4	5.1E-03	c*	1.1E-01	c*	3.1E-02	n	1.3E-01	n	7.5E-04	c*		3.2E-07	c*	
				3.0E-03	X	3.0E-04	P	V		1		3.1E+02	Trichloropropene, 1,2,3-	96-19-5	7.3E-02	n	3.1E-01	n	3.1E-02	n	1.3E-01	n	6.2E-02	n		3.1E-05	n	
				2.0E-02	A					1	0.1		Tricresyl Phosphate (TCP)	1330-78-5	1.3E+02	n	1.6E+03	n					1.6E+01	n		1.5E+00	n	
				3.0E-03	I					1	0.1		Tridiphane	58138-08-2	1.9E+01	n	2.5E+02	n					1.8E+00	n		1.3E-02	n	
						7.0E-03	I	V		1		2.8E+04	Triethylamine	121-44-8	1.2E+01	n	4.8E+01	n	7.3E-01	n	3.1E+00	n	1.5E+00	n		4.4E-04	n	
				2.0E+00	P					1	0.1		Triethylene Glycol	112-27-6	1.3E+04	n	1.6E+05	nm					4.0E+03	n		8.8E-01	n	
						2.0E+01	P	V		1		4.8E+03	Trifluoroethane, 1,1,1-	420-46-2	1.5E+03	n	6.2E+03	ns	2.1E+03	n	8.8E+03	n	4.2E+03	n		1.3E+01	n	
7.7E-03	I			7.5E-03	I			V		1			Trifluralin	1582-09-8	5.9E+01	n	4.2E+02	c**					2.6E+00	c**		8.4E-02	c**	
2.0E-02	P			1.0E-02	P					1	0.1		Trimethyl Phosphate	512-56-1	2.7E+01	c**	1.1E+02	c**					3.9E+00	c**		8.6E-04	c**	
						5.0E-03	P	V		1		2.9E+02	Trimethylbenzene, 1,2,3-	526-73-8	4.9E+00	n	2.1E+01	n	5.2E-01	n	2.2E+00	n	1.0E+00	n		1.5E-03	n	
						7.0E-03	P	V		1		2.2E+02	Trimethylbenzene, 1,2,4-	95-63-6	5.8E+00	n	2.4E+01	n	7.3E-01	n	3.1E+00	n	1.5E+00	n		2.1E-03	n	
				1.0E-02	X			V		1		1.8E+02	Trimethylbenzene, 1,3,5-	108-67-8	7.8E+01	n	1.2E+03	ns					1.2E+01	n		1.7E-02	n	
				1.0E-02	X			V		1		3.0E+01	Trimethylpentene, 2,4,4-	25167-70-8	7.8E+01	ns	1.2E+03	ns					6.5E+00	n		2.2E-02	n	
				3.0E-02	I					1	0.019		Trinitrobenzene, 1,3,5-	99-35-4	2.2E+02	n	3.2E+03	n					5.9E+01	n		2.1E-01	n	
3.0E-02	I			5.0E-04	I					1	0.032		Trinitrotoluene, 2,4,6-	118-96-7	3.6E+00	n	5.1E+01	n					9.8E-01	n		5.7E-03	n	
				2.0E-02	P					1	0.1		Triphenylphosphine Oxide	791-28-6	1.3E+02	n	1.6E+03	n					3.6E+01	n		1.5E-01	n	
				2.0E-02	A					1	0.1		Tris(1,3-Dichloro-2-propyl) Phosphate	13674-87-8	1.3E+02	n	1.6E+03	n					3.6E+01	n		8.0E-01	n	
				1.0E-02	X					1	0.1		Tris(1-chloro-2-propyl)phosphate	13674-84-5	6.3E+01	n	8.2E+02	n					1.9E+01	n		6.5E-02	n	
2.3E+00	C	6.6E-04	C					V		1		4.7E+02	Tris(2,3-dibromopropyl)phosphate	126-72-7	2.8E-01	c	1.3E+00	c	4.3E-03	c	1.9E-02	c	6.8E-03	c		1.3E-04	c	
2.0E-02	P			7.0E-03	P					1	0.1		Tris(2-chloroethyl)phosphate	115-96-8	2.7E+01	c**	1.1E+02	c**					3.8E+00	c**		3.8E-03	c**	
3.2E-03	P			1.0E-01	P					1	0.1		Tris(2-ethylhexyl)phosphate	78-42-2	1.7E+02	c**	7.2E+02	c*					2.4E+01	c**		1.2E+02	c**	
				8.0E-04	P					1			Tungsten	7440-33-7	6.3E+00	n	9.3E+01	n					1.6E+00	n		2.4E-01	n	
				3.0E-03	I	4.0E-05	A			1			Uranium (Soluble Salts)	NA	2.3E+01	n	3.5E+02	n	4.2E-03	n	1.8E-02	n	6.0E+00	n	3.0E+01	2.7E+00	n	1.4E+01
1.0E+00	C	2.9E-04	C						M	1	0.1		Urethane	51-79-6	1.2E-01	c	2.3E+00	c	3.5E-03	c	4.2E-02	c	2.5E-02	c		5.6E-06	c	
		8.3E-03	P	9.0E-03	I	7.0E-06	P			0.026			Vanadium Pentoxide	1314-62-1	6.6E+01	n	8.4E+02	n	3.4E-04	c**	1.5E-03	c**	1.5E+01	n			n	
				5.0E-03	S	1.0E-04	A			0.026			Vanadium and Compounds	7440-62-2	3.9E+01	n	5.8E+02	n	1.0E-02	n	4.4E-02	n	8.6E+00	n		8.6E+00	n	
				1.0E-03	I			V		1			Vernolate	1929-77-7	7.8E+00	n	1.2E+02	n					1.1E+00	n		8.9E-04	n	
				2.5E-02	I					1	0.1		Vinclozolin	50471-44-8	1.6E+02	n	2.1E+03	n					4.4E+01	n		3.4E-02	n	
				1.0E+00	H	2.0E-01	I	V		1		2.8E+03	Vinyl Acetate	108-05-4	9.1E+01	n	3.8E+02	n	2.1E+01	n	8.8E+01	n	4.1E+01	n		8.7E-03	n	
		3.2E-05	H			3.0E-03	I	V		1		2.5E+03	Vinyl Bromide	593-60-2	1.2E-01	c**	5.2E-01	c**	8.8E-02	c**	3.8E-01	c**	1.8E-01	c**		5.1E-05	c**	
7.2E-01	I	4.4E-06	I	3.0E-03	I	1.0E-01	I	V	M	1		3.9E+03	Vinyl Chloride	75-01-4	5.9E-02	c	1.7E+00	c*	1.7E-01	c*	2.8E+00	c*	1.9E-02	c	2.0E+00	6.5E-06	c	6.9E-04
				3.0E-04	I					1	0.1		Warfarin	81-81-2	1.9E+00	n	2.5E+01	n					5.6E-01	n		5.9E-04	n	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, P-	106-42-3	5.6E+01	n	2.4E+02	n	1.0E+01	n	4.4E+01	n	1.9E+01	n		1.9E-02	n	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, m-	108-38-3	5.5E+01	n	2.4E+02	n	1.0E+01	n	4.4E+01	n	1.9E+01	n		1.9E-02	n	
				2.0E-01	S	1.0E-01	S	V		1		4.3E+02	Xylene, o-	95-47-6	6.5E+01	n	2.8E+02	n	1.0E+01	n	4.4E+01	n	1.9E+01	n		1.9E-02	n	
				2.0E-01	I	1.0E-01	I	V		1		2.6E+02	Xylenes	1330-20-7	5.8E+01	n	2.5E+02	n	1.0E+01	n	4.4E+01	n	1.9E+01	n	1.0E+04	1.9E-02	n	9.9E+00
				3.0E-04	I					1			Zinc Phosphide	1314-84-7	2.3E+00	n	3.5E+01	n					6.0E-01	n			n	
				3.0E-01	I					1			Zinc and Compounds	7440-66-6	2.3E+03	n	3.5E+04	n					6.0E+02	n		3.7E+01	n	
				5.0E-02	I					1	0.1		Zineb	12122-67-7	3.2E+02	n	4.1E+03	n					9.9E+01	n		2.9E-01	n	
				8.0E-05	X					1			Zirconium	7440-67-7	6.3E-01	n	9.3E+00	n					1.6E-01	n		4.8E-01	n	

TR=1E-06
HQ=0.1

U.S. Environmental Protection Agency. 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

Appendix A-2

EPA Region 4 Ecological Screening Levels

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Inorganic Compounds							
Metals							
Aluminum (pH 6.5 -9.0)	7429-90-5	87	750	a	1,900	3,288	c
Antimony	7440-36-0	190	900	b	30	180	c
Arsenic (unfiltered) ^	7440-38-2	150	340	a	36	69	a
Arsenic III (unfiltered) ^	22541-54-4	148	340	b	36	69	f
Barium	7440-39-3	220	2,000	b			
Beryllium	7440-41-7	11	93	b	0.66	35	c
Boron	7440-42-8	7,200	34,000	b	1,000		l
Cadmium (unfiltered) ^ *	7740-43-9	0.25	2	a	8.8	40	a
Calcium	7440-70-2	116,000	-	c	116,000		c
Chromium III (unfiltered) ^ *	16065-83-1	74	570	a	20		e
Chromium VI (unfiltered) ^	18540-29-9	11	16	a	50	1,100	a
Cobalt	7440-48-4	19	120	b	23	1,500	c
Copper (unfiltered) ^ *	7740-50-8	9	13	a	3.1	4.8	a
Iron	7439-89-6	1,000		a			
Lead (unfiltered) ^ *	7439-92-1	2.5	65	a	8.1	210	a
Lithium	7439-93-2	440	910	b	14	260	c
Magnesium	7439-95-4	82,000		c	82,000		c
Manganese	7439-96-5	93	1,680	b	120	2,300	d, c
Mercury (unfiltered) ^ (aquatic)	7439-97-6	0.77	1.4	a	0.94	1.8	a
Mercury (wildlife based)	7439-97-6	0.0013	0.012	b, a	0.00053	0.025	a
Methylmercury (aquatic life)	22967-92-6	0.0028	0.099	c	0.0028	0.099	c
Molybdenum	7439-98-7	800	7,200	b	370	16,000	c
Nickel (unfiltered) ^ *	7440-02-0	52	470	a	8.2	74	a
Phosphorus (elemental)	7723-14-0	1,000		m	100		d
Potassium	7440-09-7	53,000		c	53,000		c
Selenium (unfiltered) ^ (aquatic)	7782-49-2	5	20	a	71	290	a
Silver (unfiltered) ^ *	7740-22-4	0.06	3.2	b	0.1	1.9	e, a
Sodium	7440-23-5	680,000		c	680,000		c
Strontium	7440-24-6	5,300	48,000	b	1,500	15,000	c
Thallium	7740-28-0	6	54	b	12	110	c
Tin	7440-31-5	180	1,600	b	73	2,700	c
Uranium	7440-61-1	2.6	46	c	2.6	46	c
Vanadium	7440-62-2	27	79	b	20	280	c
Zinc (unfiltered) ^ *	7740-66-6	120	120	a	81	90	a
Zirconium	7440-67-7	17	310	c	17	310	c
Other Inorganics							
Chloride	16887-00-6	230,000	860,000	a			
Chlorine	7782-50-5	11	19	a	7.5	13	a
Cyanide (free)	57-12-5	5.2	22	a	1	1	a
Fluorides	16984-48-8	2,700	9,800	b	5,000		d
Hydrogen sulfide (S^{2-}, HS^{-})	7783-06-4	2	3.2	a	2		a
Sulfite	14265-45-3	200		b			
Volatile Organic Compounds (VOCs)							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	85	770	b	10.8		d
1,1,2,2-Tetrachloroethane	79-34-5	200	910	b	610	2,100	c
1,1,1-Trichloroethane	71-55-6	76	690	b	11	200	c
1,1,2-Trichloroethane	79-00-5	730	3,200	b	1,200	5,200	c
1,1-Dichloroethane	75-34-3	410	3,700	b	47	830	c
1,2-Dichloroethane	107-06-2	2,000	8,200	b	910	8,800	c
1,2-Dichloropropane	78-87-5	520	3,300	b		3,400	g
Dichloromethane (Methylene chloride)	75-09-2	1,500	8,500	b	2,200	26,000	c
Trichloromethane (Chloroform)	67-66-3	140	1,300	b	28	490	c
Tetrachloromethane (Carbon tetrachloride)	56-23-5	77	690	b	9.8	180	c

U.S. Environmental Protection Agency. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. Scientific Support Section Superfund Division EPA Region 6. August.

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	130	1,200	b	25	450	c
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	970	8,800	b	590	1,100	c
1,2-cis-Dichloroethyene	156-59-2	620	5,500	b			
1,2-trans-Dichloroethylene	156-60-5	558	10,046	b			
1,3-Dichloropropene (cis and trans)	542-75-6	1.7	15	b	0.06	0.99	c
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	53	430	b	98	830	c
1,1,2-Trichloroethylene (TCE)	79-01-6	200	2,000	b	47	440	c
Chloroethene (Vill chloride)	75-01-4	930	8,400	b			
Chlorobenzenes							
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
1,2-Dichlorobenzene	95-50-1	23	130	b	14	260	c
1,3-Dichlorobenzene	541-73-1	22	79	b	71	630	c
1,4-Dichlorobenzene	106-46-7	9.4	57	b	15	180	c
1,2,3-Trichlorobenzene	87-61-6	5	195	l, i	5		l
1,2,4-Trichlorobenzene	120-82-1	130	420	b	110	700	c
1,3,5-Trichlorobenzene	108-70-3	5	195	l, i	5		l
Trichlorobenzene (mixed isomers)	12002-48-1	5	555	b, i	5		l
Monoaromatic hydrocarbons							
1,2,4-Trimethylbenzene	95-63-6	15	140	b			
1,3,5-Trimethylbenzene	108-67-8	26	230	b			
Benzene	71-43-2	160	700	b	71.3		d
Cymene, p- (4-Isopropyltoluene)	99-87-6	16	150	b			
Ethylbenzene	100-41-4	61	550	b	7.3	130	c
Isopropylbenzene (Cumene)	98-82-8	4.8	43	b			
Styrene (vinyl benzene)	100-42-5	32	290	b			
Toluene	108-88-3	62	560	b	9.8	120	c
Xylenes (total)	1330-20-7	27	240	b	13	230	c
Energetic VOAs							
Acetonitrile	75-05-8	12,000	100,000	b			
Acrylonitrile	107-13-1	78	650	b			
1,2-Diphenylhydrazine	122-66-7	1.1	9.6	b			
Hydrazine	302-01-2	2	16	b			
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	22,000	200,000	b	14,000	240,000	c
2-Hexanone (methyl butyl ketone)	591-78-6	99	1,800	c	99	1,800	c
2-Octanone (methyl hexyl ketone)	111-13-7	8.3	150	c	8.3	150	c
4-Methyl-2-pentanone (MIBK)	108-10-1	170	2,200	c	170	2,200	c
Acetone	67-64-1	1,700	15,000	b	1,500	28,000	c
Other VOCs							
1-Pentanol	71-41-0	110	2,000	c	110	2,000	c
2-Propanol	67-63-0	7.5	130	c	7.5	130	c
Acetaldehyde	75-07-0	130	1,200	b	1.4		e
Acrolein	107-02-8	3	3	a			
Bromoform (tribromomethane)	75-25-2	230	1,100	b	320	2,300	c
Bromomethane (methyl bromide)	74-83-9	16	38	b			
Carbon disulfide	75-15-0	15	130	b	0.92	17	c
Cyclohexane	110-82-7	230		e	120		e
Dibromochloromethane	124-48-1	320	2,900	b	34		d
Dichlorobromomethane	75-27-4	340	3,100	b			
Ethylene glycol	107-21-1	140,000	1,300,000	b			
Hexane	110-54-3	0.58	10	c	0.58	10	c
Hexachloroethane	67-72-1	12	210	c	12	210	c
Methanol	67-56-1	330	3,000	b			
Methylamine	74-89-5	860	7,700	b			

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Other VOCs							
Methyl tert-butyl ether (MTBE)	1634-04-4	730	6,500	b	18,000	53,000	m
Propylene glycol	57-55-6	71	640	b			
Tetrahydrofuran	109-99-9	11,000	74,000	b			
Vinyl acetate	108-05-4	16	280	c	16	280	c
Semivolatile Organic Compounds							
Chloroanilines							
4-Chloroaniline	106-47-8	19	459	j			
2,4-Dichloroaniline	554-00-7	15	575	j			
Pentachloroaniline	527-20-8	5	429	j			
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	3.4	18	n			
1,2,4,5-Tetrachlorobenzene	95-94-3	8.3	75	b			
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
Hexachlorobenzene (wildlife based)	118-74-1	0.0003		n			
Pentachlorobenzene (aquatic only)	608-93-5	3.1	16	b	0.47	8.4	c
Pentachlorobenzene (wildlife based)	608-93-5	0.019		n			
Chlorophenols							
2-Chlorophenol	95-57-8	32	290	b	400		d
2,4-Dichlorophenol	120-83-2	11	110	b	790		d
2,4,5-Trichlorophenol	95-95-4	1.9	17	b	12	259	o
2,4,6-Trichlorophenol	88-06-2	4.9	39	b	6.5		d
2,3,4,6-Tetrachlorophenol	58-90-2	1.2	11	n			
3-Methyl-4-Chlorophenol	59-50-7	7.4	67	n			
Other Phenols							
2-Methylphenol (Cresol, o-)	95-48-7	67	600	b	13	230	c
3-Methylphenol (Cresol, m-)	108-39-4	62	560	b			
4-Methylphenol (Cresol, p-)	106-44-5	53	480	b			
2,3-Dimethylphenol	526-75-0	120	1,100	n			
2,4-Dimethylphenol	105-67-9	15	140	b			
2-Nitrophenol	88-75-5	73	650	b			
4-Nitrophenol	100-02-7	58	530	b	300	1,200	c
2,4-Dinitrophenol	51-28-5	71	379	b	14.3		d
2,4,6-Tribromophenol	118-79-6	5.6	50	b			
Nonylphenol	84852-15-3	6.6	28	o	1.7	7	o
Pentachlorophenol # (aquatic)	87-86-5	15	19	a	7.9	13	a
Phenol	108-95-2	160	4,700	b	58	300	p
Semivolatile Organic Compounds							
Energetic SVOAs							
2-Amino-4,6-dinitrotoluene	35572-78-2	18	160	b	20	180	k
4-Amino-2,6-dinitrotoluene	19406-51-0	11	98	b			
1,3-Dinitrobenzene (DNB)	99-65-0	22	100	b	20	110	k
2,3-Dinitrotoluene	602-01-7	2.3	21	b			
2,4-Dinitrotoluene	121-14-2	44	390	b	9.1	200	d, g
2,5-Dinitrotoluene	619-15-8	5.6	50	b			
2,6-Dinitrotoluene	606-20-2	81	730	b		200	g
3,5-Dinitrotoluene	618-85-9	95	860	b			
3,5-Dinitroanaline (DNA)	618-87-1	60	230	k	60	230	k
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	220	1,200	b	330	1,880	k
Nitroglycerine	55-63-0	18	160	b			
2-Nitrotoluene	88-72-2	71	640	b			
3-Nitrotoluene	99-08-1	42	380	b			
4-Nitrotoluene	99-99-0	46	410	b			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	79	520	b	190	700	k
1,3,5-Trinitrobenzene (TNB)	99-35-4	11	27	b	10	30	k
2,4,6-Trinitrotoluene (TNT)	118-96-7	13	120	b	90	570	k

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Semivolatile Organic Compounds							
Phthalates							
bis(2-Ethylhexyl) Phthalate	117-81-7	3	27	c	3	27	c
Butylbenzyl Phthalate	85-68-7	23	130	b	19		c
Diethyl Phthalate	84-66-2	220	980	b	210	1,800	c
Dimethyl Phthalate	131-11-3	1,100	3,200	b	2,900		e
Di-n-Butyl Phthalate	84-74-2	19	34	b	35	190	c
Polycyclic Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	90-12-0	2.1	37	c	2.1	37	c
2-Methylnaphthalene	91-57-6	4.7	42	b	72	86, i	q
Acenaphthene	83-32-9	15	19	b	20	86, i	l
Acenaphthylene	208-96-8	13	120	b	307	582, i	q
Anthracene	120-12-7	0.02	0.18	b	0.73	13	c
Benz(a)anthracene	56-55-3	4.7	42	b	0.027	0.49	c
Benzo(a)pyrene	50-32-8	0.060	0.54	b	0.3	2, i	c
Benzo(b)fluoranthene	205-99-2	2.6	23	b	0.68	2, i	q
Benzo(g,h,i)perylene	191-24-2	0.44	6	q, j	0.44	0.5, i	q
Benzo(k)fluoranthene	207-08-9	0.64	2	q, i	0.64	2, i	q
Chrysene	218-01-9	4.7	42	b	2	6.5, i	q
Dibenz(a,h)anthracene	53-70-3	0.28	6	q, j	0.28	1.2 i	q
Fluoranthene	206-44-0	0.8	3.7	b	7.1	21, i	q
Fluorene	86-73-7	19	110	b	3.9	70	c
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	6	q, j	0.28	0.5, i	q
Naphthalene	91-20-3	21	170	b	12	190	c
Phenanthrene	85-01-8	2.3	31	b	4.6	7.7	o
Pyrene	129-00-0	4.6	42	b	10	21, i	q
Other SVOCs							
1,1-Biphenyl	92-52-4	6.5	26	b	14		c
2,2-Dibromo-3-nitrilopropionamide	10222-01-2	20	50	b			
3,3'-Dichlorobenzidine	91-94-1	4.5	41	n			
4-Bromophenyl Phenyl Ether	101-55-3	1.5	0	c	1.5		c
Aniline	62-53-3	4.1	30	b			
Benzaldehyde	100-52-7	57	547	j			
Benzidine	92-87-5	1.5	14	b	3.9	70	c
Benzoic Acid	65-85-0	42	740	c	42	740	c
Benzyl alcohol	100-51-6	8.6	150	c	8.6	150	c
Decane	124-18-5	49	880	c	49	880	c
Dibenzofuran	132-64-9	4	36	b	3.7	66	c
Hexachlorobutadiene (Aquatic Life)	87-68-3	1	10	b	0.3	3	l
Hexachlorobutadiene (Wildlife Based)	87-68-3	0.053		n			
Hexachlorocyclopentadiene	77-47-4	0.45	4.5	b	0.07	0.7	l
Hydroquinone	123-31-9	2.2	4.4	b			
Isodecyl diphenyl phosphate	29761-21-5	1.73	22	b			
Isophorone	78-59-1	920	7,500	b		4,300	g
N-Nitrosodiphenylamine	86-30-6	25	220	b	210	3,800	c
Nitrobenzene	98-95-3	380	2,000	b		2,000	g
Propylene glycol	57-55-6	71	640	b			
Quinoline	91-22-5	3.4		h			
Triphenyl phosphate	115-86-6	4	40	b			
Pesticides, Herbicides, Fungicides							
2,4-D	94-75-7	79.2	130	r	70		d
4,4'-DDT (Aquatic Life Only)	50-29-3	0.0032	1.1	a	0.001	0.13	a
4,4'-DDE	72-55-9	0.41	7	j			
4,4'-DDD	72-54-8	0.011	0.19	c	0.011	0.19	c
Acephate	30560-19-1	150	550	r			
Aldrin	309-00-2	0.035	3.0	b	0.00014	1.3	d
Atrazine	1912-24-9	12	330	b			
Azinphos-methyl (Guthion)	86-50-0	0.01	0.08	a, r	0.01		a

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Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Pesticides, Herbicides, Fungicides							
BHC (beta)	319-84-6	0.046		d	0.046		d
BHC-gamma (Lindane) (Aquatic Life)	58-89-9	0.11	0.95	b, a	0.063	0.16	d, a
BHC-gamma (Lindane) (Wildlife Based)	58-89-9	0.026		n			
Carbaryl	63-25-2	0.5	0.85	r		1.6	a
Carbofuran	1563-66-2	0.75	1.12	r			
Captan	133-06-2		13.1	r			
Chlordane	57-74-9	0.0043	2.4	a	0.00059	0.004	d
Chlorothalonil	1897-45-6	0.6	1.8	r			
Chloropyrifos	2921-88-2	0.041	0.05	a, r	0.0056	0.011	a
Cyanazine	21725-46-2	270	2420	b			
Demeton	8065-48-3	0.1	-	b, a	0.1		a
Diazinon	333-41-5	0.17	0.17	a	0.82	0.82	a
Dicamba	1918-00-9	3,898	216	b			
Dieldrin	60-57-1	0.056	0.24	a	0.0019	0.71	a
Dimethoate	60-51-5	0.5	21.5	r			
Dinoseb	88-85-7	0.48	9.5	n			
Diquat	2764-72-9	6	54	b			
Endosulfan-alpha	959-98-8	0.01	0.11	r	0.0087	0.034	a
Endosulfan-beta	33213-65-9	0.01	0.11	r	0.0087	0.034	a
Endosulfan Sulfate	1031-07-8	0.056	0.22	p	0.0087	0.034	p
Endrin	72-20-8	0.036	0.086	a	0.0023	0.037	a
Heptachlor	76-44-8	0.0038	0.52	a	0.0036	0.053	a
Heptachlor Epoxide	1024-57-3	0.0038	0.52	a	0.0036	0.053	a
Malathion	121-75-5	0.035	0.295	r	0.1		a
MCPA (2-methyl-4-chlorophenoxyacetic acid)	94-74-6	2.6		h	4.2		h
Pesticides, Herbicides, Fungicides							
Methoxychlor	72-43-5	0.03	0.7	a	0.019		c
Metolachlor	51218-45-2	15	110	n			
Mirex (Aquatic Life)	2385-85-5	0.001	0.001	a	0.001	0.001	a
Mirex (Wildlife Based)	2385-85-5	0.000016	-	n			
Parathion	56-38-2	0.013	0.065	a	0.04		d
Silvex (2,4,5-TP)	93-72-1	30	270	n	50		f
Simazine	122-34-9	9	80	b			
Toxaphene	8001-35-2	0.0002	0.73	a	0.0002	0.21	a
Trifluralin	1582-09-8	1.14	20.5	r			
Polychlorinated Biphenyls (PCBs) and Dioxin/Furans							
2,3,7,8-TCDD (Dioxin)	1746-01-6	3.10E-09		b			
Dioxins (TEQ)			0.003	g			
Total PCBs (Wildlife Based)	1336-36-3	0.000074	0.014	b	0.000072	0.03	m
Other							
Alkalinity	-	20,000		a			
Ammonia ^^	7664-41-7	Varies	Varies	a	0.024	0.094	m
Formaldehyde	50-00-0	74	660	b			
Nitrite (warm water)	14797-65-0	20	100	b			
pH	-	6.5 - 9.0		a	6.5 - 8.5		a
Selenate	14124-68-6	9.5	12.5	b			
Selenite	14124-67-5	27.6	186	b			
Tributyltin	688-73-3	0.072	0.46	a	0.0074	0.42	a
Urea	57-13-6	17,000	150,000	b			

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Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source

Table 1a Notes:

Red font indicates a bioaccumulative chemical.

- Chemical that should be evaluated with the SUM Toxic Unit Approach as discussed in Text Section 3.1.5.

^ - Screening value is for total metals. A conversion factor (CF) was used to convert the screening value for total metals in surface water to a screening value for dissolved metals in surface water. CMC (dissolved) = CMC (total) × CF. See Table 1b for screening values for dissolved metals.

* - The freshwater screening value is hardness dependent. The screening value shown in Table 1a is for total metals assuming a hardness of 50 mg/L as $CaCO_3$. A correction for site-specific hardness was based on equations listed in Tables 1b and 1c. If hardness data are unavailable hardness may be estimated as: H = 2.497 × Ca (mg/L) + 4.118 × Mg (mg/L).

- Freshwater criteria for pentachlorophenol are pH Dependent. Values displayed are for a pH of 7.8.

^^ - Criteria for ammonia are pH, temperature, and lifestage dependent.

Table 1a Sources:

a - National Recommended Water Quality Criteria http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

b - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013 http://www.epa.gov/gliclearinghouse/

c - Suter, G.W. II, and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 Revision. ES/ER/TM-96/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf

d - Florida State Criteria for Surface Water Quality Classifications http://www.dep.state.fl.us/legal/Rules/shared/62-302/302-Table.pdf

e - North Carolina Department of Natural Resources (NCDNR) Surface Water Standards http://portal.ncdenr.org/web/wq/ps/csu/swstandards

f - Georgia Department of Natural Resources (GADNR) Water Use Classifications and Water Quality Standards http://rules.sos.state.ga.us/docs/391/3/6/03.pdf

g - Hawaii Department of Health (HDOH) Environmental Action Levels, Chronic and Acute Surface Water (Aquatic Habitat) Standards http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/environmental-hazard-evaluation-and-environmental-action-levels

h - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at: http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html

i - Region 4 Surface Water Model - See text Section 6.1.4 Equation 1.

j - ECOSAR program predicted lowest chronic or acute value. See Section 6.1.4 in text.

k - Talmadge et al. (1999)

l - New York Ambient Water Quality Criteria and Guidance Values: http://www.dec.ny.gov/docs/water_pdf/togs111.pdf

m - New Jersey Department of Environmental Protection (NJDEP) Ecological Screening Criteria http://www.nj.gov/dep/srp/guidance/ecoscreening/esc_table.pdf

n - Michican Water Quality Values - Rule 57: http://www.michigan.gov/deq/0,4561,7-135-3313_3686_3728-11383--,00.html

o - Texas Surface Water Quality Standards: https://www.tceq.texas.gov/waterquality/standards/2014standards.html

p - Mississippi Water Quality Standards: http://www.deq.state.ms.us/mdeq.nsf/page/WQSB_Water_Quality_Standards

q - EPA. 2003. Equilibrium Partitioning Sediment Benchmarks for Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. http://www.epa.gov/nheerl/download_files/publications/PAHESB.pdf

r - Office of Pesticide Programs (OPP) Aquatic Life Benchmarks: http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm

Table 1b
Conversion Factors (CF) and Hardness-Dependent Equations

Chemical	Freshwater						Saltwater	
	Chronic Values			Acute values			Conversion Factors	
	m_A	b_A	*CF*	m_A	b_A	*CF*	*CF - Chronic*	*CF - Acute*
Beryllium *	1.609	-5.017		1.609	-2.874			
Cadmium	0.7409	-4.719	1.101672-0.041838(lnH)	1.0166	-3.924	1.136672-0.041838 (lnH)	0.994	0.994
Chromium III	0.819	0.6848	0.86	0.819	3.7256	0.316	NA	NA
Chromium VI			0.962			0.982	0.993	0.993
Copper	0.8545	-1.702	0.96	0.9422	-1.7	0.96	0.83	0.83
Lead	1.273	-4.705	1.46203-0.145712(lnH)	1.273	-1.46	1.46203-0.145712 (lnH)	0.951	0.951
Mercury			0.85			0.85	0.85	0.85
Nickel	0.846	0.0584	0.997	0.846	2.255	0.998	0.99	0.99
Selenium							0.998	0.998
Silver				1.72	-6.59	0.85	NA	0.85
Zinc	0.8473	0.884	0.986	0.8473	0.884	0.978	0.986	0.978

Notes:

* - beryllium hardness-based Great Lakes Tier 2 equation

CF - Conversion Factor

InH - natural log of Hardness

Filtered Chronic Screening Value = $\exp\{m_A[\ln(H)]+b_A\}$ [CF]

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Table 1c
Example Freshwater Screening Values for Varying Degrees of Water Hardness

CHEMICAL	Unfiltered Samples							
	Chronic Values (µg/L)				Acute Values (µg/L)			
	Hardness (mg/kg $CaCO_3$)				Hardness (mg/kg $CaCO_3$)			
	25	50	100	200	25	50	100	200
Beryllium	1.2	3.5	11	33	10	30	93	285
Cadmium	0.10	0.16	0.27	0.45	0.52	1.1	2.1	4.3
Chromium III	23.8	39	86	152	183	1,000	1,800	3,200
Copper	2.74	4.9	8.9	16	3.6	7.3	14	27
Lead	0.54	1.3	3.2	7.69	13.9	34	82	197
Nickel	16.1	29	52	94	145	261	469	843
Silver	--	--	--	--	0.30	1.1	3.8	12
Zinc	36	67	120	216	36	67	120	216

Notes:

$CaCO_3$ - calcium carbonate

µg/L - micrograms per liter

mg/kg- milligrams per kilogram

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Inorganic Compounds mg/kg dry weight								
Metals mg/kg dw								
Aluminum		7429-90-5	25,000	58,000	i			
Antimony		7440-36-0	2	25	a	2	25	a
Arsenic		7440-38-2	9.8	33	b	7.24	41.6	c
Barium		7440-39-3	20	60	b	-	-	-
Cadmium		7440-43-9	1	5	b	0.68	4.21	c
Chromium (Total)		7440-47-3	43.4	111	b	52.3	160	c
Cobalt		7440-48-4	50		g			
Copper		7440-50-8	31.6	149	b	18.7	108	c
Iron		7439-89-6	20,000	40,000	g			
Lead		7439-92-1	35.8	128	b	30.2	112	c
Manganese		7439-96-5	460	1,100	h			
Mercury		7439-97-6	0.18	1.1	b	0.13	0.7	c
Nickel		7440-02-0	22.7	48.6	b	15.9	42.8	c
Selenium		7782-49-2	11	20	h			
Silver		7440-22-4	1	2.2	b	0.73	1.77	c
Uranium		7440-61-1	100	1,000	i			
Zinc		7440-66-6	121	459	b	124	271	c
Other Inorganics mg/kg								
Ammonia		7664-41-7	230	300	h			
Sulfides (Total)		18946-25-8	39	61	h			
Volatile Organic Compounds (VOCs) µg/kg @1% OC								
Acetaldehyde	R	75-07-0	1.6	12	d	342		e
Acrylonitrile	R	107-13-1	6.9	55	d			
1,2-Diphenylhydrazine	R	122-66-7	3.8	31	d			
Methylamine	R	74-89-5	34	298	d			
Vinyl acetate	N3	108-05-4	1.2	16	d	1.2	16	d
Semivolatile Organic Compounds (SVOCs)								
Phenols µg/kg @1% OC unles denoted by shading								
2-Chlorophenol	N2	95-57-8	61		d	764		d
2-Methylphenol (o-cresol)	N2	95-48-7	100		d	19	63	d, h
2,3-Dimethylphenol	N2	526-75-0	349		d			
2,4-Dimethylphenol	N2	105-67-9	35		c	29	29	h
3-Methylphenol (Cresol, m-)	N2	108-39-4	93		d			
4-Methylphenol (p-Cresol)	N2	106-44-5	78	260	d, h	670	670	h
2-Nitrophenol	N2	88-75-5	146		d			
4-Nitrophenol	N2	100-02-7	135		d	699		d
2,4-Dinitrophenol	U	51-28-5	202		d	41		d
2-Methyl-4,6-Dinitrophenol	U	534-52-1	2,477		e			
2,4,5-Trichlorophenol	N2	95-95-4	34		d	213		d
2,4,6-Trichlorophenol	N2	88-06-2	87		d	116		d
3-Methyl-4-Chlorophenol	N2	59-50-7	37		d			
Pentachlorophenol	U	87-86-5	744	1,200	d, h	360	690	h
Phenol	N2	108-95-2	120	120	h	420	1,200	h
Energetic SVOAs µg/kg @ 1% OC								
2-Amino-4,6-dinitrotoluene	U	35572-78-2	41		d			
4-Amino-2,6-dinitrotoluene	U	19406-51-0	25		d			
1,3-Dinitrobenzene	U	99-65-0	34		d	795		e
2,3-Dinitrotoluene	R	602-01-7	8.8		d	1,168		e
2,4-Dinitrotoluene	R	121-14-2	127		d	26		d
2,5-Dinitrotoluene	R	619-15-8	21		d	1,168		e
2,6-Dinitrotoluene	R	606-20-2	271		d	1,084		e
3,5-Dinitrotoluene	R	618-85-9	353		d	1,168		e
HMX (Octahydro-tetranitro-1,3,5…)	C	2691-41-0	42		d			
Nitroglycerine	R	55-63-0	4.9		d			
RDX (Hexahydro-1,3,5-trinitro-1,3,5...)	R	121-82-4	41		d			
1,3,5-Trinitrobenzene	R	99-35-4	12		d	782		e
2,4,6-Trinitrotoluene (TNT)	R	118-96-7	23		d	888		e

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Semivolatile Organic Compounds (SVOCs)								
Other SVOCs µg/kg @ 1% OC								
4-Chloroaniline	N2	106-47-8	316		d			
2,4-Dichloroaniline	N2	554-00-7	328		d			
Pentachloroaniline	U	527-20-8	920		d			
2,2-Dibromo-3-nitrilopropionamide	R	10222-01-2	1.4		d	304		e
3,3'-Dichlorobenzidine	N2	91-94-1	30		d			
Aniline	N2	62-53-3	1.3		d			
Benzaldehyde	R	100-52-7	462		e			
Benzidine	N2	92-87-5	0.9		d	1.6		d
bis(2-Chloroethyl) Ether	R	111-44-4	4,761		e			
Decane	N2	124-18-5	491		e	308		d
Hexachlorobutadiene (aquatic life)	R	87-68-3	8.8		d	2.5		d
Hexachlorobutadiene (wildlife-based)	R	87-68-3	0.7		d			
Hexachlorocyclopentadiene	R	77-47-4	6.6		d	1.0		d
Hydroquinone	R	123-31-9	1.1		d			
Pesticides µg/kg @ 1% OC unless denoted by shading								
2,4-D	H	94-75-7	24		d			
4,4'-DDD	C	72-54-8	1.22	7.81	c	1.22	7.81	c
Total DDD	C	-	4.88	28	b	2	20	a
4,4'-DDE	C	72-55-9	2.07	3.74	c	2.07	3.74	c
Total DDE	C	-	3.16	31.3	b	2	15	a
4,4'-DDT (aquatic life)	C	50-29-3	5.7		d	1.7		d
4,4'-DDT (wildlife-based)	C	50-29-3	0.32		d	0.01		d
4,4'-DDT	C	50-29-3	1.19	4.77	c	1.19	4.77	c
Total DDT	C	-	4.16	62.9	b	3.89	51.7	c
DDT/DDE/DDD (total)	C	-	5.28	572	b			
Acephate	A	30560-19-1	5.7		d	300		d
Acrolein	R	107-02-8	0.33		d			
Aldrin	C	309-00-2	29		d	0.11		d
Atrazine	H	1912-24-9	18		d	1,289		e
BHC (alpha)	C	319-84-6	1.6		d	1.3		d
BHC (beta)	C	319-85-7	6,665		f			
BHC-gamma (Lindane)	C	58-89-9	2.37	4.99	b	0.32	0.99	c
BHC-gamma (Lindane) (aquatic life)	C	58-89-9	3.4		d			
BHC-gamma (Lindane) (wildlife-based)	C	58-89-9	1.0		d			
Carbaryl	A	63-25-2	1.0		d			
Carbofuran	A	1563-66-2	1.0		d			
Captan	F	133-06-2	346		d			
Chlordane	C	57-74-9	3.24	17.6	b	2.26	4.79	c
Chlorothalonil	R	1897-45-6	6.5		d	301		f
Chloropyrifos	A	2921-88-2	3.3		d	0.41		d
Cyanazine	H	21725-46-2	362		d	2,790		e
Demeton	A	126-75-0	0.44		d	300		e
Diazinon	A	333-41-5	4.0		d	18		d
Dicamba	H	1918-00-9	1,060		d			
Dieldrin	C	60-57-1	1.9	9.3	b, h	0.715	4.3	c
Dieldrin (aquatic life)	C	60-57-1	3.2		d	0.1		d
Dieldrin (wildlife-based)	C	60-57-1	0.3		d			
Dimethoate	A	60-51-5	0.36		d			
Dinoseb	H	88-85-7	15		d			
Diquat	H	2764-72-9	23		d			
Endosulfan-alpha	C	959-98-8	0.46		d	0.14		d
Endosulfan-beta	C	33213-65-9	0.46		d	0.14		d
Endosulfan Sulfate	C	1031-07-8	1.0		d	0.11		d
Endrin	C	72-20-8	2.22	207	b	2.67	62	j
Guthion	A	86-50-0	0.31		d	0.005		d
Heptachlor	C	76-44-8	1.9		d	1.5		d
Heptachlor epoxide	C	1024-57-3	2.47	16	b	0.6	2.7	j
Malathion	A	121-75-5	0.31		d	0.03		d

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		*CAS*	*Freshwater Sediment Screening Value*		*Source*	*Marine/Estuarine Sediment Screening Value*		*Source*
			ESV	*RSV*		*ESV*	*RSV*	
Pesticides µg/kg @ 1% OC								
MCPA (2-methyl-4-chlorophenoxyacetic acid)	H	94-74-6	1,000		f	1,000		f
Methoxychlor	C	72-43-5	2.4		d	1.34		d
Metolachlor	H	51218-45-2	37		d	3,840		f
Mirex (aquatic life)	C	2385-85-5	3.9		d	3.6		d
Mirex (wildlife-based)	C	2385-85-5	0.36		d			
Parathion	A	56-38-2	0.5		d	0.6		d
Silvex (2,4,5-TP)	H	93-72-1	53		d	88		d
Simazine	H	122-34-9	7.8		d			
Toxaphene	C	8001-35-2	0.45		d	0.15		d
Trifluralin	H	1582-09-8	187		d			
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans µg/kg @ 1% OC unless denoted by shading								
Total PCBs	E	1336-36-3	59.8	676	b	21.6	12	c, h
Total PCBs (wildlife-based)	E	1336-36-3	0.33		d	0.025		d
Dioxins/Furans	E	1746-01-6	0.0025	0.025	k	0.0025	0.025	k
2,3,7,8-TCDD (Dioxin) (wildlife-based)	E	1746-01-6	0.3		d			
Other mg/kg dw								
Butyl tins mg/kg dw								
Monobutyltin		78763-54 -9	0.54	4.8	h			
Dibutyltin		818-08-6	0.91	130	h			
Tributyltin		688-73-3	0.047	0.32	h			
Tetrabutyltin		1461-25-2	0.097	0.097	h			
Bulk Petroleum Hydrocarbons mg/kg dw								
Total Petroleum Hydrocarbons - Diesel		68334-30-5	340	510	h			
Total Petroleum Hydrocarbons - Residual		68476-53-9	3,600	4,400	h			

Table 2 Notes:
Red font indicates a bioaccumulative chemical.
Shaded gray cells indicate units in µg/kg dry weight.
CAS = chemical abstract service registry number
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
R - Reactive electrophiles/proelectrophiles
N2 - Polar Narcosis
N3 - Diesters
U - Oxidative phosphorylation uncouplers
H - Herbicides
C - Central nervous system seizure agents
A - Acetylcholinesterase inhibitors
F - Fungicide
E - Endocrine disrupters or reproductive and developmental toxicants

Table 2a Sources:
a - Long, Edward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

b - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

c - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.

d - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a. See Equation 3 in text Section 6.2.2.

e - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.

f - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.

g - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario.

h - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

i - Los Alamos National Laboratory ECORISK Database. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

j - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at http://www.ccme.ca/publications/ceqg_rcqe.html

k - USEPA. 1993. Interim Report on Data and Methods for Assessment of 2,3,7,8 - Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. EPA/600/R-93/055. Available from the National Service Center for Environmental Publications (NSCEP) Document Number 600R93055. http://www.epa.gov/nscep/

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action

Chemical	CAS	Freshwater Sediment Screening Value (µg/kg 1% OC)		Source	Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)		Source
		ESV	RSV		ESV	RSV	
Volatile Organic Compounds (VOCs) - µg/kg @ 1% OC							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	73		a	9.6		a
1,1,2,2-Tetrachloroethane	79-34-5	190		a	579		a
1,1,1-Trichloroethane	71-55-6	34		a	5.1		a
1,1,2-Trichloroethane	79-00-5	319		a	524		a
1,1-Dichloroethane	75-34-3	131		a	15		a
1,2-Dichloroethane	107-06-2	385		a	175		a
1,2-Dichloropropane	78-87-5	272		a	1,900		b
Dichloromethane (methylene chloride)	75-09-2	183		a	268		a
Trichloromethane (Chloroform)	67-66-3	45		a	9.2		a
Tetrachloromethane (Carbon tetrachloride)	56-23-5	34		a	4.6		a
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	41		a	8.3		a
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	338		a	234		a
1,2-cis-Dichloroethyene	156-59-2	246		a			-
1,2-trans-Dichloroethylene	156-60-5	221		a			-
1,3-Dichloropropene	542-75-6	1.0		a	0.33		a
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	50		a	93		a
1,1,2-Trichloroethylene (TCE)	79-01-6	134		a	29		a
chloroethene (Vinyl chloride)	75-01-4	202		a			-
Chlorobenzenes							
Chlorobenzene	108-90-7	58		a	150		a
1,2-Dichlorobenzene	95-50-1	88		a	54		a
1,3-Dichlorobenzene	541-73-1	83		a	267		a
1,4-Dichlorobenzene	106-46-7	35		a	57		a
1,2,3-Trichlorobenzene	87-61-6	69		a	70		a
1,2,4-Trichlorobenzene	120-82-1	1,700		c	775		b
1,3,5-Trichlorobenzene	108-70-3	66		a	67		a
Trichlorobenzene (mixed isomers)	12002-48-1	66		a	67		a
Monoaromatic hydrocarbons							
1,2,3-Trimethylbenzene	526-73-8	2,074		c	652		b
1,2,4-Trimethylbenzene	95-63-6	92		a	645		b
1,3,5-Trimethylbenzene	108-67-8	157		a	638		b
Benzene	71-43-2	113		a	4,038		b
Cymene, p- (4-Isopropyltoluene)	99-87-6	179		a	536		b
Ethylbenzene	100-41-4	272		a	33		a
Isopropylbenzene (Cumene)	98-82-8	33		a	984		b
Styrene (Vinyl benzene)	100-42-5	116		a	1,959		b
Toluene	108-88-3	145		a	23		a
Xylenes (total)	1330-20-7	103		a	50		a
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	992		a	631		a
2-Hexanone (methyl butyl ketone)	591-78-6	2,828		b	15		a
2-Octanone (methyl hexyl ketone)	111-13-7	4.1		a	4.4		a
4-Methyl-2-pentanone (MIBK)	108-10-1	2,712		b	22		a
Acetone	67-64-1	40		a	36		a
Other VOCs							
1-Pentanol	71-41-0	7.3		a	7.3		a
2-Propanol	67-63-0	0.42		a	0.42		a
Acetonitrile	75-05-8	561		a	5,144		b
4-Bromophenyl phenyl ether	101-55-3	46		a	46		a
Bromoform (Tribromomethane)	75-25-2	73		a	102		a
Bromomethane (methyl bromide)	74-83-9	2.0		a	3,107		b
Carbon disulfide	75-15-0	3.6		a	0.5		a
Dibromochloromethane	124-48-1	102		a	11.1		a
Dichlorobromomethane	75-27-4	108		a	5,915		b

U.S. Environmental Protection Agency. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. Scientific Support Section Superfund Division EPA Region 6. August.

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action

Chemical	CAS	Freshwater Sediment Screening Value (µg/kg 1% OC)		Source	Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)		Source
		ESV	RSV		ESV	RSV	
Other VOCs							
Ethylene glycol	107-21-1	314		a	1,921		b
Hexachloroethane	67-72-1	24		a	24		a
Methanol	67-56-1	3.6		a	1,941		b
Methyl tert-butyl ether (MTBE)	1634-04-4	84		a	2,911		b
Propylene glycol	57-55-6	0.6		a	2,199		b
Tetrahydrofuran	109-99-9	1,183		a	4,372		b
Semivolatile Organic Compounds (SVOCs) µg/kg @ 1% OC							
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	77		a	436		c
1,2,4,5-Tetrachlorobenzene	95-94-3	185		a	434		c
Hexachlorobenzene	118-74-1	0.32		a	310		c
Pentachlorobenzene	608-93-5	115		a	18		a
Phenols							
2,4-Dichlorophenol	120-83-2	54		a	3,885		b
2,4,6-Tribromophenol	118-79-6	45		a			
2,3,4,6-Tetrachlorophenol	58-90-2	36		a			
Nonylphenol	25154-52-3	1,268		a	327		a
Energetic SVOAs							
2-Nitrotoluene	88-72-2	185		a	8,315		b
3-Nitrotoluene	99-08-1	133		a	10,000		b
4-Nitrotoluene	99-99-0	131		a	9,065		b
Phthalates µg/kg @ 1% OC unless denoted by shading							
Bis(2-ethylhexyl)phthalate	117-81-7	182	2,647	d	182	2,647	d
Butyl benzyl phthalate	85-68-7	592		a	489		a
Diethyl phthalate	84-66-2	231		a	221		a
Dimethyl phthalate	131-11-3	348		a	3,000		b
Di-n-butyl phthalate	84-74-2	220	1,000	a, e	405		a
Di-n-octyl phthalate	117-84-0	513	1,100	e	300		b
PAHs µg/kg dw							
Low molecular weight PAHs (LMW-PAHs)							
1-Methylnaphthalene	90-12-0	*			*		
2-Methylnaphthalene	91-57-6	*			*		
Acenaphthene	83-32-9	*			*		
Acenaphthylene	208-96-8	*			*		
Anthracene	120-12-7	*			*		
Fluorene	86-73-7	*			*		
Naphthalene	91-20-3	*			*		
Phenanthrene	85-01-8	*			*		
Total LMW-PAHs		*			**312**		d
High molecular weight PAHs (HMW-PAHs)							
Benz(a)anthracene	56-55-3	*			*		
Benzo(a)pyrene	50-32-8	*			*		
Benzo(b)fluoranthene	205-99-2	*			*		
Benzo(g,h,i)perylene	191-24-2	*			*		
Benzo(k)fluoranthene	207-08-9	*			*		
Chrysene	218-01-9	*			*		
Dibenz(a,h)anthracene	53-70-3	*			*		
Fluoranthene	206-44-0	*			*		
Indeno(1,2,3-cd)pyrene	193-39-5	*			*		
Phenanthrene	85-01-8	*			*		
Pyrene	129-00-0	*			*		
Total HMW-PAHs		*		d	**655**		d
Total PAHs		**1,610**		f	**1,684**		d

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Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action

Chemical	*CAS*	*Freshwater Sediment Screening Value (µg/kg 1% OC)*		*Source*	*Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)*		*Source*
		ESV	*RSV*		*ESV*	*RSV*	
Other SVOCs µg/kg @ 1% OC unless denoted by shading							
1,1-Biphenyl	92-52-4	197		a	423		a
4-Bromophenyl Phenyl Ether	101-55-3	46		a	46		a
Benzoic Acid	65-85-0	2,900	3,800	e	650	650	e
Benzyl alcohol	100-51-6	1.4		a	57	73	e
Carbazole	86-74-8	900	1,100	e			-
Dibenzofuran	132-64-9	151	680	a, e	139		a
Isodecyl diphenyl phosphate	29761-21-5	89		a	301		b
Isophorone	78-59-1	600		a	2,177		b
N-Nitrosodiphenylamine	86-30-6	35		a	295		a
Nitrobenzene	98-95-3	559		a	21,670		b
Propylene glycol	57-55-6	0.6		a	2,198		b
Quinoline	91-22-5	2,774		c	2,774		c
Triphenyl phosphate	115-86-6	69		a	301		b

Table 2 Notes:
* see Total below.
Red font indicates a bioaccumulative chemical.
Gray shaded cells indicate concentration in µg/kg dry weight
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
CAS = chemical abstract service registry number

Table 2a Sources:
a - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a See Equation 3 in text Section 6.2.2.
b - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.
c - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.
d - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.
e - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm
f - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for ESV.

Table 2c
Region 4 Step 3a Sediment Screening Values
for Polycyclic Aromatic Hydrocarbons (PAHs) at Hazardous Waste Sites

Chemical	*CAS*	*Freshwater Sediment Screening Values (µg/kg OC)*	*Source*	*Marine/Estuarine Sediment Screening Values (µg/kg OC)*	*Source*
		RSV		RSV	
Low Molecular Weight PAHs (LMW-PAHs)					
Acenaphthene	83-32-9	491	a	16	c
Acenaphthylene	208-96-8	452	a	66	c
Anthracene	120-12-7	594	a	220	c
Fluorene	86-73-7	538	a	23	c
C1-Fluorenes	-	611	a	-	-
C2-Fluorenes	-	686	a	-	-
C3-Fluorenes	-	769	a	-	-
1-Methyl naphthalene	90-12-0	446	a	131	b
2-Methyl naphthalene	91-57-6	447	a	116	b
2,6-Dimethyl naphthalene	581-42-0	513	a	44	b
2,3,5-Trimethylnaphthalene	2245-38-7	584	a	13	b
Naphthalene	91-20-3	385	a	99	c
C1-Naphthalenes	-	444	a	-	-
C2-Naphthalenes	-	510	a	-	-
C3-Naphthalenes	-	581	a	-	-
C4-Naphthalenes	-	657	a	-	-
1-Methyl phenanthrene	832-69-9	670	a	50	b
Phenanthrene	85-01-8	596	a	100	c
C1-Phenatherene/anthracenes	-	670	a	-	-
C2-Phenatherene/anthracenes	-	746	a	-	-
C3-Phenatherene/anthracenes	-	829	a	-	-
C4-Phenatherene/anthracenes	-	913	a	-	-
Thiophenes					
Benzothiophene	11095-43-5	569	b	226	b
Dibenzothiophene	132-65-0	1,860	b	156	b
C1-Dibenzothiophenes	-	1,146	b	-	-
C2-Dibenzothiophenes	-	898	b	-	-
C3-Dibenzothiophenes	-	664	b	-	-
C4-Dibenzothiophenes	-	466	b	-	-
Naphthothiophene	233-02-3	1,803	b	151	b
High Molecular Weight PAHs (HMW-PAHs)					
Benzo(a)anthracene	56-55-3	841	a	110	c
C1-Benzanthracene/chrysenes	-	929	a	-	-
C2-Benzanthracene/chrysenes	-	1,008	a	-	-
C3-Benzanthracene/chrysenes	-	1,112	a	-	-
C4-Benzanthracene/chrysenes	-	1,214	a	-	-
Benzo(b)fluoranthene	205-99-2	979	a	38	b
Benzo(k)fluoranthene	-	981	a	38	b
Benzo(g,h,i)perylene	191-24-2	1,095	a	230	c
Benzo(a)pyrene	50-32-8	965	a	31	c
Benzo(e)pyrene	192-97-2	967	a	99	b
Chrysene	218-01-9	844	a	25	c
Dibenz(a,h) anthracene	53-70-3	1,123	a	12	c
Fluoranthene	206-44-0	707	a	160	c
C1-Fluoranthene/pyrenes	-	770	a	-	-
Indeno(1,2,3-cd)pyrene	193-39-5	1,115	a	34	c
Perylene	198-55-0	967	a	17	b
Pyrene	129-00-0	697	a	1,000	c

Notes:

RSV - Refinement Screening Value

a - EPA (2003). Procedures for the Derivation of Equlibrium Partitioning Sediment Benchmarks(ESBs) for the Protection of Benthic Orgamisms: PAH Mixtures. EPA/600/R-02/013. The value listed represents the C_{OC}, PAH_i, FCV_i from the document. See text section 6.2.4.

b - Region 4 Sediment model using ECOSAR.

c - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Inorganic Compounds												
Metals												
Aluminum	7429-90-5	Narrative	a	All			Narrative	a				
Antimony	7440-36-0	0.27	a	All	11	c	78	a	0.27	a		
Arsenic	7440-38-2	18	a	All	18	a	60	b	46	a	43	a
Barium	7440-39-3	330	a	All	110	c	330	a	2,000	a	1,000	c
Beryllium	7440-41-7	10	b	All	10	b	40	a	18	c		
Boron	7440-42-8	7.5	c	All	36	c			56	c	7.5	c
Cadmium	7440-43-9	0.36	a	All	32	a	140	a	0.36	a	0.77	a
Chromium - Total	7440-47-3	28	c	All					45	c	28	c
Chromium III	16065-83-1	18	a	All			18	a	34	a	26	a
Chromium VI	18540-29-9	0.35	c	All	0.35	c	7.8	a	81	a	190	c
Cobalt	7440-48-4	13	a	All	13	a			230	a	120	a
Copper	7440-50-8	28	a	All	70	a	80	a	49	a	28	a
Iron	7439-89-6	Narrative	a	All			Narrative	a				
Lead	7439-92-1	11	a	All	120	a	1,700	a	56	a	11	a
Lithium	7439-93-2	2	b	P, M	2	b			38	c		
Manganese	7439-96-5	220	a	All	220	a	450	a	4,000	a	4,300	a
Mercury (total)	7439-97-6	0.1	b	All	0.3	b	0.1	b	1.7	c	0.013	c
Methylmercury	22967-92-6	0.00051	b	All	0.3	b	0.1	b	0.0031	c	0.00035	c
Molybdenum	7439-98-7	2	b	All	2	b			4.8	b	17	c
Nickel	7440-02-0	38	a	All	38	a	280	a	130	a	210	a
Selenium	7782-49-2	0.52	a	All	0.52	a	4.1	a	0.63	a	1.2	a
Silver	7440-22-4	4.2	a	All	560	a			14	a	4.2	a
Strontium	7440-24-6	96	c	M					96	c		
Thallium	7440-28-0	0.22	c	All	1	b			0.22	c	6.3	c
Tin	7440-31-5	50	b	P	50	b						
Uranium	7440-61-1	25	c	All	25	c			220	c	1,600	c
Vanadium	7440-62-2	7.8	a	All	60	c			280	a	7.8	a
Zinc	7440-66-6	46	a	All	160	a			79	a	46	a
Other Inorganics												
Ammonia	7664-41-7											
Bromine (total)	7726-95-6	10	b	P	10	b						
Cyanide (free)	57-12-5	0.1	c	SI, A			0.9	f			0.1	c
Fluoride	16984-48-8	32	c	M, A					580	c	32	c
Fluorine†	7782-41-4	200	b	P	200	b						
Iodine	7553-56-2	4	b	P	4	b						

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Table 3
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CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Chlorinated Alkanes												
1,1,1,2-Tetrachloroethane	630-20-6	0.07	d	SI			0.07	d				
1,1,2,2-Tetrachloroethane	79-34-5	0.19	d	SI			0.19	d				
1,1,1-Trichloroethane	71-55-6	0.04	d	All			0.04	d	260	c		
1,1,2-Trichloroethane	79-00-5	0.32	d	All			0.32	d				
1,1-Dichloroethane	75-34-3	0.14	d	All			0.14	d	210	c		
1,2-Dichloroethane	107-06-2	0.4	d	All			0.40	d	27	c	1.4	c
1,2-Dichloropropane	78-87-5	0.28	d	All			0.28	d				
Dichloromethane (Methylene chloride)	75-09-2	0.21	d	All	1,600	c	0.21	d	2.6	c		
Trichloromethane (chloroform)	67-66-3	0.05	d	All			0.05	d	8	c		
Tetrachloromethane (Carbon tetrachloride)	56-23-5	0.05	d	All			0.05	d				
Chlorinated Alkenes												
1,1-Dichloroethene/ethylene	75-35-4	0.04	d	All			0.04	d	11	c		
1,2-Dichloroethene (cis and trans)	540-59-0	0.04	d	All			0.04	d	23	c		
1,2-cis-Dichloroethyene	156-59-2	0.04	d	All			0.04	d				
1,2-trans-Dichloroethylene	156-60-5	0.04	d	All			0.04	d				
1,3-Dichloropropene	542-75-6	0.0	d	All			0.001	d				
Tetrachloroethene	127-18-4	0.06	d	All	10	c	0.06	d	0.18	c		
1,1,2-Trichloroethylene (TCE)	79-01-6	0.06	d	All			0.06	d	42	c		
Vinyl chloride	75-01-4	0.03	d	All			0.03	d	0.12	c		
Chlorobenzenes												
Chlorobenzene	108-90-7	2.4	c	All			2.4	c	43	c		
1,2-Dichlorobenzene	95-50-1	0.09	d	All			0.09	d	0.92	c		
1,3-Dichlorobenzene	541-73-1	0.1	d	All			0.08	d	0.73	c		
1,4-Dichlorobenzene	106-46-7	0.88	c	SI, M			1.2	c	0.88	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,4-Trichlorobenzene	120-82-1	0.27	c	All			1.2	c	0.27	c		
1,3,5-Trichlorobenzene	108-70-3	0.07	d	All			0.07	d				
Monoaromatic Hydrocarbons												
1,2,4-Trimethylbenzene	95-63-6	0.09	d	All			0.09	d				
1,3,5-Trimethylbenzene	108-67-8	0.16	d	All			0.16	d				
Benzene	71-43-2	0.12	d	All			0.12	d	24	c		
Cymene, p- (4-Isopropyltoluene)	99-87-6	0.18	d	All			0.18	d				
Ethylbenzene	100-41-4	0.27	d	All			0.27	d				
Isopropylbenzene (Cumene)	98-82-8	0.04	d	All			0.04	d				
Styrene (Vinyl benzene)	100-42-5	1.2	c	All	3.2	c	1.2	c				
Toluene	108-88-3	0.15	d	All	200	c	0.15	d	23	c		
Xylenes (total)	1330-20-7	0.1	d	All	100	c	0.1	d	1.4	c	41	c

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CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Ketones												
2-Butanone (Methyl Ethyl Ketone)	78-93-3	1.0	d	All			1.0	d	360	c		
2-Hexanone	591-78-6	0.36	c	SI, M, A			2.5	d	5.4	c	0.36	c
Acetone	67-64-1	1.2	c	M, A			0.04	d	1.2	c	14	c
Other VOCs												
Tribromomethane (Bromoform)	75-25-2	0.07	d	All			0.07	d				
Bromomethane (methyl bromide)	74-83-9	0.002	d	All			0.002	d				
Carbon Disulfide	75-15-0	0.005	d	All			0.005	d	0.82	c		
Ethylene glycol	107-21-1	0.31	d	All			0.31	d				
Hexachloroethane	67-72-1	0.024	d	All			0.024	d				
Hexane	110-54-3	0.007	d	All			0.007	d				
Tert-butyl methyl ether (MTBE)	1634-04-4	12.5	c	SI			12.5	c				
Semivolatile Organic Compounds (SVOCs)												
Chloroanilines												
3-Chloroaniline	108-42-9	20	b	P, SI	20	b	30	b				
4-Chloroaniline	106-47-8	1.0	c	P, SI	1	c	1.8	c				
3,4-Dichloroaniline	95-76-1	20	b	SI			20	b				
2,4,5-Trichloroaniline	636-30-6	20	b	P, SI	20	b	20	b				
Pentachloroaniline	527-20-8	0.62	d	SI			0.62	d				
Chlorobenzenes												
1,3-Dichlorobenzene	99-65-0	0.08	d	All			0.08	d	0.73	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,3,4-Tetrachlorobenzene	634-66-2	0.08	d	All			0.08	d				
1,2,4,5-Tetrachlorobenzene	95-94-3	0.18	d	All			0.18	d				
Hexachlorobenzene	118-74-1	0.079	c	All	10	c	10	c	0.2	c	0.079	c
Pentachlorobenzene	608-93-5	0.11	d	All			0.11	d				
Dichlorophenols												
Dichlorophenols (2,3-), (2,4-), (2,5-), (2,6-)	120-83-2	0.05	d	All			0.05	d				
3,4-Dichlorophenols (3,4-), (3,5-)	95-77-2	20	b	P, SI	20	b	20	b				
Trichlorophenols												
2,4,5-Trichlorophenol	95-95-4	0.03	d	All	4	b	0.03	d				
2,4,6-Trichlorophenol	88-06-2	0.09	d	All			0.09	d				
Tetrachlorophenols												
2,3,4,5-Tetrachlorophenol	4901-51-3	20	b	SI			20	b				
Tetrachlorophenols (2,3,4,6-), (2,3,5,6-)	58-90-2	0.04	d	All			0.04	d				

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CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Other Phenols												
Chlorophenols (2-), (4-)	95-57-8	0.06	d	All			0.06	d	0.54	c	0.69	c
3-Chlorophenol	108-43-0	7	b	P, SI	7	b	10	b				
2,4-Dimethylphenol	105-67-9	0.04	d	SI			0.04	d				
2,4-Dinitrophenol	51-28-5	0.15	d	All	20	b	0.15	d				
4-Nitrophenol	100-02-7	7	b	SI			7	b				
2-Methylphenol (Cresol, o-)	95-48-7	0.1	d	All	0.67	c	0.1	d	590	c		
3-Methylphenol (Cresol, m-)	108-39-4	0.09	d	All	0.69	c	0.09	d				
4-Methylphenol (Cresol, p-)	106-44-5	0.08	d	All			0.08	d				
Nonylphenol	25154-52-3	1.27	d	SI			1.27	d				
Pentachlorophenol (PCP)	87-86-5	2.1	a	All	5	a	31	a	2.8	a	2.1	a
Phenol	108-95-2	0.79	c	All	0.79	c	1.8	c	38	c		
Energetic SVOCs												
2-Amino-4,6-dinitrotoluene	35572-78-2	14	c	SI, M, P	14	c	43	c	15	c		
4-Amino-2,6-dinitrotoluene	19406-51-0	12	c	SI, M, P	33	c	18	c	12	c		
1,3- Dinitrobenzene	99-65-0	0.073	d	All			0.034	d	0.073	c	0.15	c
2,4-Dinitrotoluene	121-14-2	6	c	SI, M, P	6	c	18	c	13	c		
2,6-Dinitrotoluene	606-20-2	4.1	c	All			30	c	4.1	c	52	c
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	16	c	SI, M, P	2,700	c	16	c	300	c		
Nitroglycerine	55-63-0	13	c	SI, M			13	c	71	c		
2-Nitrotoluene	88-72-2	0.19	d	All			0.19	d	9.9	c		
3-Nitrotoluene	99-08-1	0.13	d	All			0.13	d	12	c		
4-Nitrotoluene	99-99-0	0.14	d	All			0.14	d	22	c		
PETN (Pentaerythrite-tetranitrate)	78-11-5	100	c	M					100	c		
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	2.3	c	All			8.4	c	16	c	2.3	c
Tetryl (Methyl-2,4,6-trinitrophenylnitroamine)	479-45-8	1.5	c	M					1.5	c		
1,3,5-Trinitrobenzene	99-35-4	10	c	SI, M			10	c	120	c		
2,4,6-Trinitrotoluene (TNT)	118-96-7	7.6	c	All	62	c	32	c	96	c	7.6	c
Other SVOCs												
1,1'-Biphenyl	92-52-4	0.2	d	All	60	b	0.2	d				
3,3'- Dichlorobenzidine	91-94-1	0.03	d	All			0.03	d				
Benzoic acid	65-85-0	0.01	d	All			0.01	d	1	c		
Benzyl Alcohol	100-51-6	0.001	d	All			0.001	d	120	c		
Carbazole	86-74-8	0.16	d	All			0.16	d	80	c		
Dibenzofuran	132-64-9	0.15	d	All	6.1	c	0.15	d				
Hexachlorobutadiene	87-68-3	0.1	d	SI			0.1	d				
Hexachlorocyclopentadiene	77-47-4	0.001	d	All	10	b	0.001	d				
N-Nitrosodiphenylamine	86-30-6	0.12	d	All			0.12	d				
Nitrobenzene	98-95-3	2.2	c	SI, M			2.2	c	4.9	c		
Pentachloronitrobenzene	82-68-8	0.7	c	M, A					11	c	0.7	c

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CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Phthalates												
Bis(2-ethylhexyl) phthalate	117-81-7	0.02	c	All			0.23	d	0.59	c	0.02	c
Butylbenzyl phthalate	85-68-7	0.59	d	All			0.59	d	90	c		
Diethylphthalate	84-66-2	0.23	d	All	100	c	0.23	d	3,600	c		
Dimethylphthalate	131-11-3	0.35	d	All			10	c	38	c		
Di-n-butyl phthalate	84-74-2	0.011	c	All	160	c	0.22	d	180	c	0.011	c
Di-n-octyl phthalate	117-84-0	0.21	c	All			0.21	d	0.91	c		
Polycyclic Aromatic Hydrocarbons (PAHs)												
Low Molecular Weight PAHs												
Acenaphthene	83-32-9	See Total			0.25	c			120	c		
Acenaphthylene	208-96-8	See Total							120	c		
Anthracene	120-12-7	See Total			6.8	c			210	c		
Fluorene	86-73-7	See Total					3.7	c	250	c		
1-Methyl naphthalene	90-12-0	See Total										
2-Methylnaphthalene	91-57-6	See Total							16	c		
2,6-Dimethyl naphthalene	581-42-0	See Total										
2,3,5-Trimethylnaphthalene	2245-38-7	See Total										
Naphthalene	91-20-3	See Total			1.0	c			9.7	c	5.7	c
1-Methyl phenanthrene	832-69-9	See Total										
Phenanthrene	85-01-8	See Total					5.5	c	10	c		
Total LMWPAHs	-	**29**	a	All			29	a	100	a		
High Molecular Weight PAHs												
Benzo(a)anthracene	56-55-3	See Total			18	c			3	c	1	c
Benzo(b)fluoranthene	205-99-2	See Total			18	c			38	c		
Benzo(k)fluoranthene	207-08-9	See Total							62	c		
Benzo(ghi)perylene	191-24-2	See Total							24	c		
Benzo(a)pyrene	50-32-8	See Total							53	c		
Benzo(e)pyrene	192-97-2	See Total										
Chrysene	218-01-9	See Total							2.4	c		
Dibenzo(a,h)anthracene	53-70-3	See Total							12	c		
Fluoranthene	206-44-0	See Total					10	c	22	c		
Indeno(1,2,3-cd)pyrene	193-39-5	See Total							62	c		
Perylene	198-55-0	See Total										
Pyrene	129-00-0	See Total					10	c	22	c	34	c
Total HMWPAHs	-	**1.1**	a	M			18	a	1.1	a		

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CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Pesticides/Herbicides												
Acrolein	107-02-8	0.0001	d	All			0.0001	d				
Aldrin	309-00-2	0.037	c	SI, M			0.048	d	0.037	c		
Atrazine	1912-24-9	0.073	d	SI			0.073	d				
BHC - alpha	319-84-6	0.34	d	SI, M			0.34	d	58	c		
BHC - beta	319-85-7	0.27	c	M, A			0.0003	d	0.27	c	14	c
BHC - gamma (Lindane)	58-89-9	0.0094	c	P, M, A	0.1	c	0.0013	d	0.0094	c	0.21	c
Carbaryl	63-25-2	0.0025	d	All			0.0025	d				
Carbofuran	1563-66-2	0.0001	d	All			0.0001	d				
Chlordane - alpha	5103-71-9	0.27	c	P, M, A	2.2	c	0.17	d	0.27	c	0.28	c
Chlordane - gamma	12789-03-6	2.2	c	P, M, A	2.2	c	0.17	d	2.2	c	2.3	c
Chloropyrifos	2921-88-2	0.0035	d	All			0.0035	d				
Dinoseb	88-85-7	0.0054	d	All			0.0054	d				
DDD (sum 4,4- & 2,4-DDD)	50-29-3	0.0063	c	M, A			0.0001	d	4.1	c	0.0063	c
DDE (sum 4,4- & 2,4-DDE)	72-55-9	0.11	c	M, A			0.0038	d	3.7	c	0.11	c
DDT (sum 4,4- & 2,4-DDT)	72-54-8	0.044	c	All	4.1	c	3.37	d	0.044	c	0.36	c
DDT/DDE/DDD (total)	--	0.021	a	All					0.021	a	0.093	a
Diazinon	333-41-5	0.002	d	All			0.002	d				
Dieldrin	60-57-1	0.0049	a	All	10	c	0.1	d	0.0049	a	0.021	a
Endosulfan - alpha	959-98-8	0.64	c	M, A			0.0009	d	0.64	c	22	c
Endosulfan (alpha and beta)	115-29-7	0.0009	d	All			0.0009	d				
Endosulfan sulfate	1031-07-8	0.0065	d	All			0.0065	d				
Endrin	72-20-8	0.0014	c	All	0.0034	c	0.025	d	0.023	c	0.0014	c
Guthion	86-50-0	0.0006	d	All			0.0006	d				
Heptachlor	76-44-8	0.059	c	All	0.4	c	0.29	d	0.059	c	0.3	c
Heptachlor epoxide	1024-57-3	0.0004	d	All			0.0004	d				
Hexachlorocyclopentadiene	77-47-4	0.0008	d	All			0.0008	d				
Kepone (Chlordecone)	143-50-0	0.021	c	All			17	d	0.021	c	1.3	c
Malathion	121-75-5	0.0001	d	All			0.0001	d				
Methoxychlor	72-43-5	5	c	M, A			0.0025	d	5	c	18	c
Mirex	2385-85-5	0.014	d	All			0.014	d				
Parathion	56-38-2	0.0005	d	All			0.0005	d				
2,4,5-TP (Silvex)	93-72-1	12	d	SI			12	d				
Simazine	122-34-9	0.0001	d	All			0.0001	d				
Toxaphene	8001-35-2	4.1	d	M, A			0.38	d	5.9	c	4.1	c
Trifluralin	1582-09-8	0.0002	d	All			0.0002	d				

U.S. Environmental Protection Agency. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft.
Scientific Support Section Superfund Division EPA Region 6. August.

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans												
PCDDs, PCDFs (ΣTEQ)	1746-01-6	0.0088	d	All			0.0088	d				
PCBs (sum) (Wildlife Based)	1336-36-3	0.33	d	All	40	b	0.33	d				
Aroclor-1016	12674-11-2	1	c	All					1	c		
Aroclor-1242	53469-21-9	0.041	c	All					0.38	c	0.041	c
Aroclor-1248	12672-29-6	0.0072	c	All					0.0072	c	0.041	c
Aroclor-1254	11097-69-1	0.014	c	All	160	c			0.44	c	0.041	c
Aroclor-1260	11096-82-5	0.88	c	All					10	c	0.88	c
Other												
2-Nitroaniline	88-74-4	5.4	c	M					5.4	c		
Diphenylamine	122-39-4	10	c	M, A					10	c	73	c
Trichlorofluoromethane	75-69-4	52	c	M					52	c		

Notes:
Sreening values in mg/kg.
All - ESV for protection of all receptors
A - ESV for protection of Avians
M - ESV for protection of Mammals
P - ESV for protection of Plants
SI - ESV for protection of soil invertebrates

LMWPAHs have less than 4 rings
HMWPAHs have 4 or more rings

Table 3 Sources:
a - USEPA (2007): Ecological Soil Screening Levels. http://www.epa.gov/ecotox/ecossl/
b - Oak Ridge National Laboratory:

Efroymson, R.A., M.E. Will, and G.W. Suter. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-126/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf

Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-95/R4. http://www.esd.ornl.gov/programs/ecorisk/documents/tm85r3.pdf

Efroymson, R.A., G.W. Suter, II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals for Ecological Endpoints. Oak Ridge National Laboratory, Oak Ridge, TN. 50 pp. ES/ER/TM-162/R2
c - Los Alamos National Laboratory (LANL). 2012. ECORISK Database Release 3.2. Environmental Programs, Engineering and Technology Division. September 2013. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php
d - ECOSAR & Region 4 soil model. See text Section 6.3.

Appendix A-3

EA Standard Operating Procedures

Standard Operating Procedure No. 001
for
Sample Labels

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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Hunt Valley, Maryland 21031

Revision 0
December 2014

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for the use of sample labels. Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. An example label is provided below. Other formats with similar levels of detail are acceptable.

PROJECT NAME _____ PROJECT NUM. _____
SAMPLE LOCATION/SITE ID _____
DATE: ____/____/____ TIME: _____:_____
ANALYTES: METALS VOC EXPLOSIVES ORGANICS OTHER
FILTERED: [NO] [YES]
PRESERVATIVE: [NONE] [HNO_3] [OTHER _____]
SAMPLER: _____

2. MATERIALS

The following materials may be required: sample label and indelible laboratory marker.

3. PROCEDURE

The following sections describe how to use the sample labeling system.

3.1 LABEL INFORMATION

As each sample is collected/selected, fill out a sample label. Enter the following information on each label:

- Project name
- Project number
- Location/site identification—Enter the media type (i.e., well number, surface water, soil, etc.) sampling number, and other pertinent information concerning where the sample was taken
- Date of sample collection

- Time of sample collection
- Analyses to be performed (NOTE: Due to number of analytes, details of analysis should be arranged with laboratory *prior to start of work)*
- Whether filtered or unfiltered (water samples only)
- Preservatives (water samples only)
- Number of containers for the sample (e.g., 1 of 2, 2 of 2).

3.2 ROUTINE CHECK

Double-check the label information to make sure it is correct. Detach the label, remove the backing, and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

3.3 RECORD INFORMATION

Record the sample number and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated)
- Location of the sample
- Organic vapor meter or photoionization meter readings for the sample (when appropriate)
- Any unusual or pertinent observations (oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, etc.)
- Number of containers required for each sample
- Whether the sample is a quality assurance sample (split, duplicate, or blank).

3.3.1 Logbook Entry

A typical logbook entry might look like this:

- 7:35 a.m. Sample No. MW-3. PID = 35 ppm
- Petroleum odor present. Sample designated MW-3-001.

NOTE: Duplicate samples will be given a unique sample designation rather than the actual sample number with an added prefix or suffix. This will prevent any indication to the laboratory that this is a duplicate sample. This fictitious sample number will be listed in the logbook along with the actual location of the sample.

3.4 SHIPMENT

Place the sample upright in the designated sample cooler. Make sure there is plenty of ice in the cooler at all times.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

5.1 INCIDENTAL ODORS

Note that although incidental odors should be noted in the logbook, it is unwise from a safety and health standpoint to routinely “sniff test” samples for contaminants.

5.2 DUPLICATE SAMPLE

No indication of which samples are duplicates is to be provided to the laboratory.

6. REFERENCES

U.S. Environmental Protection Agency. 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans. QAMS-005/80.

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Standard Operating Procedure No. 002
for
Chain-of-Custody Form

Prepared by

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Hunt Valley, Maryland 21031

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5. PRECAUTIONS 2

6. REFERENCES 2

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for use of the chain-of-custody form. An example is provided as Figure SOP002-1. Other formats with similar levels of detail are acceptable.

2. MATERIALS

The following materials may be required: chain-of-custody form and indelible ink pen.

3. PROCEDURE

- Give the site name and project name/number.
- Enter the sample identification code.
- Indicate the sampling dates for all samples.
- List the sampling times (military format) for all samples.
- Indicate “grab” or “composite” sample with an “X.”
- Specify the sample location.
- Enter the total number of containers per cooler.
- List the analyses/container volume.
- Obtain the signature of sample team leader.
- State the carrier service and airbill number, analytical laboratory, and custody seal numbers.
- Sign, date, and time the “relinquished by” section.
- Upon completion of the form, retain the shipper copy, and affix the other copies to the inside of the sample cooler, in a zip-seal bag to protect from moisture, to be sent to the designated laboratory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

———. 1990. Sampler's Guide to the Contract Laboratory Program. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. User's Guide to the Contract Laboratory Program. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January.

Company Name:				Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis															Chain-of-Custody Record		
Project No. Dept.: Task:				Project Name:																EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000		
Sample Storage Location:				ATO Number:																**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT: _____**		
Page of				**Report #:**																		
Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**															**EA Labs Accession Number**	Remarks	
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Company Name:				Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis															Chain-of-Custody Record EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000			
Project No. Dept.: Task:				Project Name:																			
Sample Storage Location:				ATO Number:																**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT: _____**			
Page of				**Report #:**																			
Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**															**EA Labs Accession Number**		Remarks	
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Samples by: (Signature)				Date/Time	Relinquished by: (Signature)															Date/Time	Received by: (Signature)		Date/Time
Relinquished by: (Signature)				Date/Time	Received by Laboratory: (Signature)															Date/Time	Airbill Number:		Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:
Cooler Temp. _____C pH: ___ Yes ___ No Comments:																				**Custody Seals Intact ___ Yes ___ No**			
NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.																							

Standard Operating Procedure No. 003
for
Subsurface/Utility Clearance

Prepared by

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1. SCOPE AND APPLICATION

1.1 PURPOSE

The purpose of this Standard Operating Procedure is to prevent injury to workers and damage to subsurface structures (including tanks, pipe lines, water lines, gas lines, electrical service, etc.) during ground disturbance activities (including drilling, augering, sampling, use of direct-push technologies, excavation, trenching, concrete coring or removal, fence post installation, grading, or other similar operations).

1.2 LIMITATIONS

The procedures set forth in this document are the suggested procedures but may not be applicable to particular sites based on the site-specific considerations. The Project Manager is responsible for making a site-specific evaluation of each site to determine whether the Subsurface/Clearance Procedures should be utilized or require modification. If safety or other site-specific considerations require a modified or different procedure, the Project Manager should review the modified procedure with the Business Unit Director, Profit Center Manager, or Senior Technical Reviewer.

1.3 SCOPE

This procedure provides minimum guidance for subsurface clearance activities, which must be followed prior to and during ground disturbance activities at EA project sites. Even after completing the subsurface clearance activities required in this procedure, all ground disturbance activities should proceed with due caution.

Deviations from this procedure may be provided on an exception basis for specific situations, such as underground storage tank systems removals, verified aboveground/overhead services/lines, undeveloped land/idle facilities, shallow groundwater conditions, soil stability, or well construction quality assurance/quality control concerns, etc.

EA or its subcontractors are responsible for, and shall ensure that, all ground disturbance activities are completed safely, without incident, and in accordance with applicable federal, state, and local regulations.

This procedure shall not override any site-specific or consultant/contractor procedures that are more stringent or provide a greater degree of safety or protection of health or the environment.

2. PROCEDURES

The EA Project Manager or his designee must complete the Subsurface Clearance Procedure Checklist (Appendix A) in conjunction with the following procedures. The checklist must be completed before initiating any ground disturbance activities. The completed checklist must be submitted to the appropriate team individuals, subcontractors, and/or the client and included in the project files.

2.1 SAFETY

A Health and Safety Plan must be available onsite and followed by all contractors and subcontractors.

All work areas shall be defined and secured with safety cones, safety tape, construction fence, other barriers, or signs as appropriate.

Site work permits must be obtained as required by site procedures. Based on site conditions or classification, the use of intrinsically-safe equipment may be required.

To ensure the safety of all onsite personnel and subsurface structure integrity, consideration should be given to de-energizing and locking out selected site utilities or temporarily shutting down a portion of or the entire facility.

2.2 PREPARATION TASKS

Objective—To gather all relevant information about potential subsurface structures prior to the actual site visit.

2.2.1 Obtain Permits and Site Access

The consultant/contractor is responsible for following all applicable laws, guidance, and approved codes of practice; obtaining all necessary permits and utility clearances; and securing site access permission.

2.2.2 Historic Site Information

Obtain most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) as available.

NOTE: As-built drawings may not accurately depict the locations and depths of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

EA should obtain any other site information such as easements, right-of-ways, historical plot plans, fire insurance plans, tank (dip) charts, previous site investigations, soil surveys, boring logs, and aerial photographs, etc. as relevant to the planned ground disturbance activities.

Where applicable, EA should also contact contract personnel who may have historic site knowledge.

2.2.3 Mark-Outs

Objective—To identify location of subsurface structures on surface.

EA must ensure that a thorough mark-out at the site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and all other subsurface utilities/services.

- Where available, public utility companies must be contacted to identify underground utilities. (This can be accomplished through the One-Call system in most instances.)

- In addition, where available and warranted by site conditions, a private utility/pipeline mark-out company should be contracted to perform an electronic subsurface survey to identify the presence of suspected hazardous or critical underground utilities and subsurface structures. In some cases, this is necessary to confirm public utility mark-outs in the vicinity of planned ground disturbance activities.

EA will review all available site plan subsurface information with the private mark-out company to assist in locating utilities and other subsurface structures.

NOTE: Mark-outs may not accurately depict the exact locations of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

Where possible, EA personnel are encouraged to be onsite at the time of subsurface mark-outs. This is to ensure accuracy and understanding of subsurface structures identified and provides an opportunity to exchange information with mark-out company personnel regarding planned work activities.

Subsurface structures should be marked throughout the entire work area(s) with adequate materials (e.g., site conditions may require paint and tape/flags). Ground disturbance activities must be started within 30 days of mark-out, unless local ordinances specify a shorter time period. If activities are not started within required time period or markings have faded, mark-outs must be redone.

EA personnel will record time and date of mark-out request and list all companies contacted by the service and confirmation number. This should be available for review onsite and checked off after visual confirmation of markings.

2.2.4 Initial Site Visit

Objective—To compare the site plan to actual conditions based on information gathered in Procedures 2 and 3 above, obtain additional site information needed, and prepare a vicinity map.

EA will document all findings and update the site plan with this information. On third party sites, close coordination with the site owner's representatives for mark-outs, review of as-builts, and other information reviews should be conducted prior to work. Project Managers are encouraged to provide updated as-built information to the client.

In some regions, it may be more effective and efficient to conduct the site visit at the same time the contractor and drill rig are mobilized to the site. The inspection should include the following activities and may include others as determined by the consultant/contractor and the Project Manager.

2.2.5 Utilities

EA shall perform a detailed site walk-through for the purpose of identifying all aboveground indicators of subsurface utilities/services that may be leading to or from buildings within the planned work area. The inspection shall include, but not be limited to, the following:

- Utility mark-outs
- Aboveground utilities
- Area lights/signs
- Phones
- Drains
- Junction boxes
- Natural gas meters or connections
- Other utilities including: fire hydrants, on/below grade electrical transformers, splice cages, sewer lines, pipeline markers, cable markers, valve box covers, clean-outs/traps, sprinkler systems, steam lines (including insulated tanks that may indicate steam lines), and cathodic protection on lines/tanks
- Observe paving scars (i.e., fresh asphalt/concrete patches, scored asphalt/concrete).

NOTE: In many cases, the onsite location of low-voltage electrical lines and individual property water and sewer line branches may be approximated by using the following technique:

- Locate the entry/connection location at the facility building
- Attempt to identify utility connections for the mains (water sewer, etc.) by locating clean-outs, valve manways, etc. The location path of the utility is likely with the area between the main connection and facility building connection. Subsurface electrical line locations from the facility building to signs, lamps, etc. can be estimated with the same process.

2.2.6 Other Subsurface Systems

Some other subsurface systems to be cognizant of during subsurface activities include product delivery systems (i.e., at gas stations) and existing remediation systems.

2.2.7 Selection of Ground Disturbance Locations

EA will utilize the information collected to this point in combination with regulatory requirements and project objectives to select ground disturbance locations. Ground disturbance locations should also consider the location of overhead obstructions (e.g., power lines). Work at active gasoline retail locations must consider several special considerations that should be outlined in the site-specific safety and health plan.

2.2.8 Review of Selected Locations with the Client

EA will review the selected ground disturbance locations with the client. EA will not proceed with the subsurface activities until the plan has been discussed with the client. During execution of the project, subsurface activities are required outside of the area previously approved by the client. EA will submit these changes to the client for approval prior to execution.

2.2.9 Ground Disturbance Activity Sequence

EA will plan ground disturbance activities starting at the point farthest from the location of suspected underground improvements. This is done to determine the natural subsurface conditions and to allow EA site personnel to recognize fill conditions.

Experience has shown that the following warning signs may indicate the presence of a subsurface structure:

- Warning tape (typically indicative of underground services).
- Pea gravel/sand/non-indigenous material (typically indicative of tanks or lines).
- Red concrete (typically indicative of electrical duct banks).

- The abrupt absence of soil recovery in a hand auger. This could indicate pea gravel or sand that has spilled out of the auger. This may not be indicative in areas where native soil conditions typically result in poor hand auger recoveries.

- Any unexpected departure from the native soil or backfill conditions as established by prior onsite digging.

If any of these conditions is encountered by EA site personnel, digging should stop and the client should be contacted.

3. SUBSURFACE CLEARANCE METHODS

The method used to delineate the subsurface should be compatible with the inherent associated risk given the type of facility/property, soil stratigraphy, and the location of the ground disturbance activity, such that required delineation is obtained. It should be noted that in areas where there is paving, sufficient paving should be removed to allow clear visibility of the subsurface conditions during clearance activities. The following is a list of potential clearance methods that may be used on a job site:

- Vacuum digging
- Probing
- Hand digging
- Hand augering
- Post-hole digging.

EA personnel will evaluate the potential for electrical shock or fire/explosion for each subsurface disturbance project and will evaluate as necessary the use of non-conductive or non-sparking tools (i.e., fiberglass hand shovels, and thick electrically insulating rubber grips on hand augers or probes). The potential need for the use of non-conductive materials, electrical safety insulated gloves, and footwear will also be evaluated on a case-by-case basis.

3.1 SUBSURFACE CLEARANCE PROCEDURES FOR DRILLING, DIRECT-PUSH TECHNOLGY, AUGERING, FENCE POST INSTALLATION, OR OTHER BOREHOLE INSTALLATION ACTIVITIES

The area to be delineated will exceed the diameter of the largest tool to be advanced and sufficiently allow for visual inspection of any obstructions encountered.

3.2 SUBSURFACE CLEARANCE PROCEDURES FOR TRENCHING/ EXCAVATION ACTIVITIES

Appropriate subsurface clearance methods should be conducted along the length and width of the excavation at a frequency sufficient to ensure adequate precautions have been applied to the entire work area. The frequency and density of investigations will be based on site knowledge, potential hazards, and risks of the work area to surrounding locations (e.g., proximity to a residential area or school).

Whenever subsurface structures are exposed, EA will cease work and mark the area (e.g., flags, stakes, cross bracing) to ensure the integrity of these exposed structures is maintained during subsequent trenching/excavation/backfilling.

Uniform color codes for marking of underground facilities are provided in Appendix B.

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Appendix A

Subsurface Clearance Procedure Checklist

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Subsurface Clearance Procedure Checklist

Site Identification: _____

Project Consultant/Contractor: _____

Section 1: Safety, Preparation Tasks, and Mark-Outs

Activity	Yes	No	N/A	Comments including Justification if Response Is No or Not Applicable
Health and Safety Plan is available and all contractors and subcontractors are familiar with it.				
All applicable local, state, and federal permits have been obtained.				
Site access/permission has been secured.				
Most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) obtained.				
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, rights-of-way, historical plot plans, fire insurance plans, tank dip charts, previous site investigations, soil surveys, boring logs, aerial photographs, etc.).				
Utility mark-outs have been performed by public utility company(s). Mark-outs clear/visible.				
Subsurface structure mark-outs performed by private mark-out company. Mark-outs clear/visible.				
Additional Activities: Were dig locations reviewed with site representative?				

Section 2: Initial Site Visit and Selecting Ground Disturbance Locations

Activity	Yes	No	N/A	Comments including Justification if Response Is No or Not Applicable
Location of all aboveground indicators of subsurface utilities/services that may be leading to or from buildings within the planned work area has been identified.				
Location of utility mark-outs by all utility companies previously contacted has been identified within required time period.				
Location of all subsurface structure mark-outs by private mark-out company has been identified within required time period.				
Location of area lights/signs and associated subsurface lines identified.				
Location of all phones and associated subsurface lines identified.				
Location of all drains and associated interconnecting lines identified.				
Location of all electrical junction boxes and associated interconnecting lines identified				
Location of all natural gas meters or connections and all interconnecting lines identified				

Completed by: _____
Name

Signature: _____ _____
Company Date

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Appendix B

Uniform Color Codes for Excavation

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APWA UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

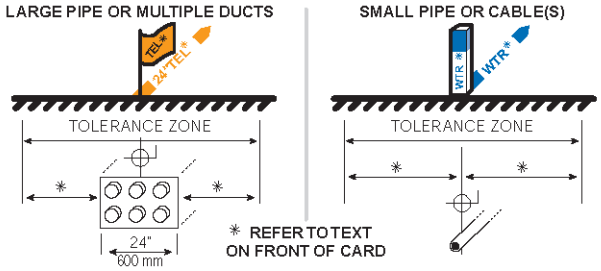
ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewers and Drain Lines

TYPICAL MARKING



Customize with your center's phone and address information

GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

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Standard Operating Procedure No. 004
for
Sample Packing and Shipping

Prepared by

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Revision 0
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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the packing and shipping of samples to the laboratory for analysis.

2. MATERIALS

The following materials may be required:

Clear tape	Plastic garbage bags
Custody seals	Sample documentation
Ice	Waterproof coolers (hard plastic or metal)
Metal cans with friction-seal lids (e.g., paint cans)	Zip-seal plastic bags
Packing material[1]	

3. PROCEDURE

Check cap tightness and verify that clear tape covers label and encircles container. Wrap sample container in bubble wrap or closed cell foam sheets. Enclose each sample in a clear zip-seal plastic bag.

Place several layers of bubble wrap, or at least 1 in. of vermiculite on the bottom of the cooler. Line cooler with open garbage bag, place all the samples upright inside a garbage bag, and tie the bag.

Double bag and seal loose ice to prevent melting ice from soaking the packing material. Place the ice outside the garbage bags containing the samples.

Pack shipping containers with packing material (closed-cell foam, vermiculite, or bubble wrap). Place this packing material around the sample bottles or metal cans to avoid breakage during shipment.

Enclose all sample documentation (i.e., Field Parameter Forms, chain-of-custodies) in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.

Seal the coolers with signed and dated custody seals so that if the cooler were opened, the custody seal would be broken. Place clear tape over the custody seal to prevent damage to the seal.

1. Permissible packing materials are: (a) (non-absorbent) bubble wrap or closed cell foam packing sheets, or (b) (absorbent) vermiculite. Organic materials such as paper, wood shavings (excelsior), and cornstarch packing “peanuts” will not be used.

Refer to SOP Nos. 001, 002, 016, and 039.

Tape the cooler shut with packing tape over the hinges and place tape over the cooler drain. Ship all samples via overnight delivery on the same day they are collected if possible.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Any samples suspected to be of medium/high contaminant concentration or containing dioxin must be enclosed in a metal can with a clipped or sealable lid (e.g., similar to a paint can). Label the outer metal container with the sample number of the sample inside.

6. REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

———. 1990. Sampler's Guide to the Contract Laboratory Program. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. User's Guide to the Contract Laboratory Program. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January.

Standard Operating Procedure No. 005
for
Field Decontamination

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1. SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling, or that enter a hazardous waste site during intrusive sampling, must be thoroughly decontaminated prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. This Standard Operating Procedure describes the normal decontamination of sampling equipment and site personnel.

2. MATERIALS

The following materials may be required:

0.01N HCl	Non-phosphate laboratory detergent (liquinox)
0.10N nitric acid	Plastic garbage bags
Aluminum foil or clean plastic sheeting	Plastic sheeting, buckets, etc. to collect wash water and rinsates
Approved water	Pressure sprayer, rinse bottles, brushes
High performance liquid chromatography (HPLC)-grade water[1]	Reagent grade alcohol[2]

3. PROCEDURE

3.1 SAMPLE BOTTLES

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Ensure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

3.2 PERSONNEL DECONTAMINATION

Review the project Health and Safety Plan for the appropriate decontamination procedures.

1. For the purposes of this Standard Operating Procedure, HPLC-grade water is considered equivalent to "deionized ultra filtered water," "reagent-grade distilled water," and "deionized organic-free water." The end product is water that is pure with no spurious ions or organics to contaminate the sample. The method of generation is left to the individual contractor.
2. For the purposes of this Standard Operating Procedure, the term "reagent grade alcohol" refers to either pesticide grade isopropanol or reagent grade methanol.

3.3 EQUIPMENT DECONTAMINATION

3.3.1 Water Samplers

3.3.1.1 Bailers

After each use, polytetrafluoroethelyne (PTFE) double check valve bailers used for groundwater sampling will be decontaminated as follows:

- Discard all ropes used in sampling in properly marked sealable container, or as directed by the Health and Safety Plan. NOTE: No tubing is to be used in conjunction with a bailer in collecting samples.
- Scrub the bailer to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate detergent.
- Rinse off detergent three times with approved water.
- Rinse bailer with reagent grade alcohol.
- Rinse bailer three times with HPLC-grade water.
- Rinse bailer with 0.10N nitric acid solution.
- Rinse bailer three times with HPLC-grade water.
- Allow bailer to air dry.[3]
- Wrap bailer in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride or PTFE storage container.
- Dispose of used decontamination solutions with drummed purge water.
- Rinse bailer with HPLC-grade water immediately prior to re-use.

3.3.1.2 Pumps

Submersible pumps will be decontaminated as follows:

3. If the bailer has just been used for purging and is being decontaminated prior to sampling, do not air dry. Double rinse with HPLC-grade water and proceed to collect samples.

- Scrub the exterior of the pump to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate detergent. (Steam cleaning may be substituted for detergent scrub.)

- Calculate the volume of pump plus any tubing which is not disposable and not dedicated to a single well. Pump three volumes of non-phosphate laboratory detergent solution to purge and clean the interior of the pump.

- Rinse by pumping no less than nine volumes of approved water to rinse.

- Rinse pump exterior with reagent grade alcohol.

- Rinse pump exterior with HPLC-grade water.

- Allow pump to air dry.

- Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride or PTFE storage container.

- Prior to reusing pump rinse exterior again with HPLC-grade water. (Double rinse in Bullet 5 above may be substituted for this step).

3.3.1.3 Dip Samplers

All dip samplers, whether bucket, long-handled, or short-handled, will be decontaminated in the same manner as provided in Section 3.3.1.1.

3.3.1.4 Labware

Labware, such as beakers, which are used to hold samples for field measurements, water chemistry, etc., will be decontaminated according to the procedures in Section 3.3.1.1.

3.3.1.5 Water Level Indicators

Electric water level indicators, weighted measuring tapes, or piezometers used in the determination of water levels, well depths, and/or non-aqueous phase liquid levels will be decontaminated in accordance with Section 3.3.1.1. Clean laboratory wipes may be substituted for brushes. Tapes, probes, and piezometers should be wiped dry with clean laboratory wipes, and coiled on spools or clean plastic sheeting rather than allowed to air dry.

3.3.2 Solid Materials Samplers

Solid materials samplers include soil and sediment sampling probes, augers, trowels, shovels, sludge samplers, and other sampling equipment (e.g., core tubes, grab samples, core catchers, core liners, scoops, spoons, etc.), which will be decontaminated as follows:

- Scrub the sampler to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent.
- Rinse off detergent with approved water.
- Rinse sampler with reagent grade alcohol.
- Rinse sampler with HPLC-grade water.
- For non-metallic samplers only, rinse sampler with 0.10N nitric acid solution.
- For non-metallic samplers only, rinse sampler with HPLC-grade water.
- Allow sampler to air dry.
- Wrap sampler in aluminum foil clean plastic sheeting, or store in a new zipseal bag (size permitting) or clean, dedicated polyvinyl chloride or PTFE storage container.
- Dispose used decontamination solutions properly according to the site-specific Health and Safety Plan.
- Rinse sampler with HPLC-grade water immediately prior to re-use.

For larger sediment sampling equipment, if sediment can be collected from the interior of a sampling device and away from potentially contaminated surfaces of the sampler, a site water rinse may be sufficient between stations. A site water rinse may also be sufficient for vessel surfaces between sample locations. However, all tools and equipment coming into contact with the sample should be decontaminated in accordance with the procedures above. Wash water from decontamination activities should be collected and disposed of properly. Specific projects and programs may have additional decontamination requirements.

3.3.3 Other Sampling and Measurement Probes

Soil (or sediment) gas sampling probes will be decontaminated as solids sampling devices.

Temperature, pH, conductivity, redox, and dissolved oxygen probes will be decontaminated according to manufacturer's specifications. If no such specifications exist, remove gross contaminant and triple rinse probe with HPLC-grade water. A summary of the decontamination procedures to be used must be included in the instrument-specific standard operating procedure.

Measuring tapes that become contaminated through contact with soil or sediment during field use will be decontaminated as follows:

- Wipe tape with a clean cloth or laboratory wipe that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination. Rinse cloth in the solution and continue wiping until tape is clean.

- Wipe tape with a second clean, wet cloth (or laboratory wipe) to remove soap residues.

- Dry tape with a third cloth (or laboratory wipe) and rewind into case, or re-coil tape.

3.3.4 Drilling Rigs, Sediment Sampling Vessels, and Other Heavy Equipment

All drilling rigs, sediment sampling vessels, and associated equipment such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out) will be decontaminated prior to site entry after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed prior to site entry when there is a likelihood that contamination has accumulated on tires and as spatter or dust enroute from one site to the next.

- Place contaminated equipment in an enclosure designed to contain all decontamination residues (water, sludge, etc.).

- Steam clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) have been removed.

- Water used will be taken from an approved source.

- Containerize in 55-gal drums; sample; characterize; and, based on sample results, dispose of all decontamination residues properly.

Other heavy equipment includes use of backhoes, excavators, skid steers, etc. If heavy equipment is utilized during field activities, i.e., a backhoe for test pitting, the bucket should not come in contact with soil to be sampled. If the bucket contacts the soil to be sampled, then it should be decontaminated between sample locations, following the same procedures as listed above for a drill rig.

3.3.5 High Performance Liquid Chromatography-Grade Water Storage

Dedicated glass storage containers will be used solely for dispensing HPLC-grade water. New HPLC-grade water containers will be decontaminated as follows:

- Clean with tap water from approved source and non-phosphate laboratory detergent while scrubbing the exterior and interior of the container with a stiff-bristled brush.

- Rinse thoroughly with approved water.

- Rinse with 0.01N nitric acid.
- Rinse with approved water.
- Rinse thoroughly with HPLC-grade water.
- Fill clean container with HPLC-grade water. Cap with one layer of PTFE-lined paper and one layer of aluminum foil. Secure cap with rubber band and date the container.

Used HPLC-grade water containers will be decontaminated as follows:

- Clean the exterior with tap water from an approved source, non-phosphate laboratory detergent, and a stiff-bristled brush.
- Rinse the exterior thoroughly with HPLC-grade water.
- Rinse the interior twice with pesticide-grade isopropanol.
- Rinse interior thoroughly with HPLC-grade water.
- Fill clean container with HPLC-grade water. Cap with one layer of PTFE-lined paper and one layer of aluminum foil. Secure cap with rubber band and date the container.

3.3.6 Ice Chests and Reusable Shipping Containers

- Scrub exterior/interior with approved brush and liquinox detergent.
- Rinse off detergent three times with approved water.
- Let air dry and properly store until re-use.

NOTE: If container/ice chest is severely contaminated, clean as thoroughly as possible, render unusable, and properly dispose.

4. MAINTENANCE

HPLC-grade water will be stored only in decontaminated glass containers with aluminum foil lids as stipulated above. The water may not be stored for more than nor used more than 3 days after manufacture.

HPLC-grade water will be manufactured onsite. An approved tap water source will be used as the influent to the system. Procedures for system setup, operation, and maintenance will conform to manufacturer's specifications.

5. PRECAUTIONS

Dispose of all wash water, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed by the Health and Safety Plan.

Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

Do not eat, smoke, or drink onsite.

6. REFERENCES

Site-specific Health and Safety Plan.

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Standard Operating Procedure No. 007
for
Surface Water Sampling

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for sampling surface water. This procedure can be applied to the collection of surface water samples from marine and estuarine systems, streams, rivers, ditches, lakes, ponds, and lagoons. Surface water samples provide an indication of the amount of contaminant in the surface water. It is, therefore, important to collect a representative sample.

2. MATERIALS

The following materials may be required:

0.45-µ disposable filters	Sample bottles
Cooler with ice	Short-handled dip sampler (PTFE or stainless steel)
Long-handled dip sampler (polytetrafluoroethelyne [PTFE] or stainless steel)	Stainless steel or PTFE-lined bucket
Peristaltic pump with 0.45-µM filters and disposable Tygon tubing	Niskin bottle (or similar sampling device)

3. PROCEDURE

For all surface water samples, use a Global Positioning System to record sampling coordinates and mark the sampling locations on a site map. Photograph (if cameras are allowed onsite) and describe each location, place a numbered stake above the visible high water mark on the bank closest to the sampling location, and/or mark adjacent trees with surveyor's flagging. The photographs and descriptions must be adequate to allow the sampling station to be relocated at some future date by someone other than the original sampling crew. Use a long-handled dip sampler where access is poor or non-contact with water is suggested in the Health and Safety Plan.

Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample. If wading in a stream, sample downstream of the sampling location to prevent disturbance of the bottom. To prevent contamination of the exterior of the sample container, and/or potential contamination of the surface water sample by laboratory contaminants on the exterior of the bottle, the sample container should never be dipped into the water, rather a decontaminated sampling device should be used to collect unfiltered samples.

Sampling with the PTFE or stainless steel sampler (long-handled or measuring cup-type):

- Remove the cap from the sample bottle.
- Dip a sample of surface water using the sampler.

- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.

- Add preservative as required by SOP No. 039. Replace cap, and place in cooler immediately.

Sampling with stainless steel or PTFE-lined bucket:

- Remove cap from sample bottle.

- Gently dip collection bucket in the water. Fill bucket and carefully lift from water body.

- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.

- Add preservative as specified by the project-specific Sampling and Analysis Plan. Replace cap, and place in cooler immediately.

– OR –

- Use smaller sampling cup to transfer sample from bucket to sample bottle as described above.

Sampling with a Niskin bottle (or similar device):

- Prepare the bottle for deployment by placing the ends of the bottle in the open position and lock the ends into the trigger mechanism.

- Lower the bottle to desired depth of sampling (on either a wire cable or rope).

- Place a messenger (triggering device) on the cable/rope and deploy by allowing free-fall down the cable/rope.

- Bring the bottle back to the surface and pour sample into a sample container.

Sampling with a peristaltic pump and Tygon tubing:

- Cut a length of Tygon tubing to the depth of sampling specified by the client or project-specific Sampling and Analysis Plan.

- Insert one end of the tubing into the intake hose on the peristaltic pump.

- Place a weight on the tubing and lower to the specified depth;

- Cut a length of tubing and insert into the output (out-flow) hose on the peristaltic pump.

- After applying power to the peristaltic pump, proceed to pump site water through the tubing apparatus. Approximately five times the hose volume should be pumped through the tubing before sampling.

- Fill the required sample containers.

- If filtering is required, obtain filtered sample by placing a 0.45-µM in-line filter on the end of the output tube and fill the required sample containers.

Both filtered and unfiltered samples may be required for metals analyses. Bulk samples for filtration will be collected using the stainless steel or PTFE-lined bucket method described above. Sample filtration must be performed immediately upon retrieval of the bulk sample as follows.

Filtration will be performed immediately after collecting sample. Set up filtration equipment prior to collecting sample. Filtration may be accomplished by gravity or, if necessary due to slow filtering, a peristaltic pump will be used to pressure filter the sample. Vacuum filtration will not be used due to the possibility of analyte volatilization.

Gravity filtration will be accomplished as follows:

- Using decontaminated forceps, place a 0.45-µM membrane in a decontaminated filter funnel.

- Slowly pour sample into the funnel and collect filtrate directly into appropriate sample container(s).

- Add preservative(s) as required by project-specific Sampling and Analysis Plan. Immediately cap container and place in cooler.

- Dispose of filter membrane.

Pressure filtration will be accomplished as follows:

- Using previously assembled disposable tubing, 45-µ in-line filter, and peristaltic pump, filter sample from collection bucket into appropriate container.

- Adjust pump rate to avoid aeration of sample.

- Fill container, preserve as indicated in SOP No. 039, immediately cap container, and place in cooler.

- Dispose of filter and tubing.

Refer to SOP Nos. 001, 002, 004, 005, 016, and 039.

4. MAINTENANCE

Refer to manufacturer's specifications for maintenance procedures on generators and pumps.

5. PRECAUTIONS

Avoid disturbing bottom sediments.

Consult the Health and Safety Plan prior to collecting any samples for personal protective equipment such as dermal and respiratory protection and personal flotation devices when sampling in or near deep water or from boats.

Always decontaminate the sampling and filtration equipment, and change gloves between sampling locations to minimize the risk of cross-contamination.

Always set up generators downwind of working area. Never service generators onsite.

6. REFERENCES

None.

Standard Operating Procedure No. 008
for
pH Measurement

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring the pH of all types of aqueous solutions, including drinking water, saline water, and industrial and domestic wastes. As a measure of the hydrogen ion content of a solution, pH gives a general indication of the acidity or alkalinity of a water sample.

Use of brand names in this SOP is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable SOPs for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

Φ ® 12 pH Meter
Automatic temperature compensator (ATC) probe
Beakers
Combination (pH) electrode
Commercial buffer solutions (standards) of pH 4.00, 7.00, and 10.00
HPLC-grade water
Laboratory wipes for blotting electrodes
Wash bottle

3. PROCEDURE

3.1 CALIBRATION CHECK

Calibration of the pH meter will be checked on a daily basis. A two-point calibration should be used as follows:

1. Prepare beakers of buffer solutions of pH 4.00, 7.00, and 10.00.
2. Calibration should closely bracket the expected pH range of the samples to be taken.
3. Turn on instrument, clear instrument.
4. Rinse the electrode with distilled water and blot excess.
5. Immerse probes in beaker of pH 4.00 or 7.00 standard, swirl gently.
6. Press pH key, then STD key.

7. Keep the probes in the sample until the reading stabilizes. The reading should be the pH of the standard.

8. Rinse the electrode with distilled water and blot excess.

9. Repeat the procedure with pH 7.00 and 10.00 standards.

10. Record the initial readings.

11. If the measured values vary from the expected value by greater than 0.2 pH units, recalibrate the instrument with fresh aliquots of buffer solution. If the discrepancy persists, alert the Field Operations Leader, who has the option of trying to fix the meter or obtaining a second pH meter.

12. Record all measurements in the field logbook.

13. Verify calibration by reading the pH of the third buffer solution.

14. Refer to SOP No. 016.

3.2 pH MEASUREMENTS

Measurements of pH will be taken using the two-point standardization method as follows:

1. Connect the ATC and pH electrodes to the appropriate inputs.

2. Turn on instrument, clear instrument.

3. Prepare two small beakers of standard buffer solutions. Ideally, the pH values of these standards will “bracket” the expected pH value of the sample and be as close as possible to the pH of the sample.

4. Rinse a small beaker with distilled water, then sample water. Fill the beaker with sample water.

5. Rinse the probes with distilled water. Blot excess.

6. Immerse electrode and ATC in first standard. Swirl gently. Press pH key and STD key. Wait for display to stop flashing.

7. Rinse the probes with distilled water. Blot excess.

8. Immerse electrode and ATC in second standard. Swirl gently. Press STD key. Wait for display to stop flashing.

9. Rinse the probes with distilled water. Blot excess.

10. Immerse the probes in the sample and swirl gently, keeping the probes in the sample until the display stops flashing.

11. Record the sample pH and temperature after stabilization. Note any problems such as meter drift.

12. Rinse the probes with distilled water. Blot excess.

13. Repeat Steps 9 through 12 for additional samples.

Decontaminate probe according to manufacturer's specifications.

Decontaminate beakers according to SOP No. 005, Section 3.3.1.4 (Labware).

4. MAINTENANCE

The following steps will be taken to maintain the pH meter:

1. Check the batteries each time the meter is used.

2. Keep the probe stored in a 0.1 M KCl solution adjusted to pH 4 when the meter is not in use. Alternatively, the electrode may be rinsed with deionized water and the protective cap put on, trapping any residual water inside it (do not blot the electrode dry prior to putting the cap on).

5. PRECAUTIONS

Remove coatings of oil material or particulate matter that can impair electrode response by gentle wiping or detergent washing, followed by distilled water rinsing.

As noted in Section 1, these procedures may not apply to alternate manufacturer's equipment.

Calibration is always performed using the pH 7.00 and one end point (pH4.00 or 11.00) standard. **Never** calibrate the instrument using two end points only.

6. REFERENCES

Beckman Instruments, Inc. Users Manual for Φ® 10 pH Meter, Φ® 11 pH meter, and Φ® 12 pH/ISE Meter.

Franston, M.H. et al. (eds). 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. American Public Health Association, American Water Works Association and Water Pollution Control Federation.

U.S. Environmental Protection Agency. 1983. Methods for Chemical Analysis of Water and Wastes. March.

Standard Operating Procedure No. 009
for
Temperature Measurement

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring the temperature of a solid or liquid sample, in particular, for measuring water temperature. Groundwater temperature does not vary dramatically over the course of a year. Therefore, groundwater temperature can be used to help identify an aquifer, identify stream reaches where groundwater inflow is occurring, identify thermal gradients in lakes or ponds, and also indicate when sufficient water has been removed from a well during purging.

2. MATERIALS

The following materials may be required: digital reading thermocouple thermometer in combination meter or in a stick. Accuracy = ±0.5°C.

3. PROCEDURE

Rinse the probe with distilled water. Insert the probe into the sample, and leave it in the sample until the temperature stabilizes. Record the temperature reading, being sure to indicate °C or °F. Decontaminate the probe according to Section 3.3 of SOP No. 005 (Field Decontamination).

Refer to SOP Nos. 005 and 016.

NOTE: °C = (°F - 32) (5/9)
°F = ([9/5]°C) + 32.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency. 1983. Methods for Chemical Analysis of Water and Wastes. March.

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Standard Operating Procedure No. 010
for
Water Level and
Well Depth Measurements

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring water level and well depth. This procedure is applicable to the sampling of monitoring wells and must be performed prior to any activities which may disturb the water level, such as purging or aquifer testing.

2. MATERIALS

The following materials may be required:

Electric water level indicator (dipmeter) with cable measured at 0.01-ft increments OR weighted steel tape and chalk OR transducer and datalogger
Oil/water interface probe
Plastic sheeting
Photoionization detector or intrinsically safe flame ionization detector

3. PROCEDURE

3.1 PRELIMINARY STEPS

Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing. Gain access to the top of the well casing.

Locate the permanent reference mark at the top of the casing. This reference point will be scribed, notched, or otherwise noted on the top of the casing. If no such marks are present, measure to the top of the highest point of the well casing and so note this fact in the field logbook. Determine from the records and record in the notebook the elevation of this point.

Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.

Keep all equipment and supplies protected from gross contamination; use clean plastic sheeting. Keep the water level indicator probe in its protective case when not in use.

3.2 OPERATION

Sample the air in the well head for gross organic vapors by lifting the well cap only high enough for an organic vapor meter (photoionization detector or flame ionization detector) probe to be entered into the well casing. This will indicate the presence of gross volatile contaminants as well as indicating potential sampler exposure.

Remove cap. Allow well to vent for 60-90 seconds. Resample headspace. Record both readings. If the second reading is lower than the first, use the second reading to determining whether respiratory protection will be required during subsequent water level and well depth determinations, and sampling.

Note that all headspace sampling must be performed at arm's length and from the upwind side of the well if possible.

Refer to SOP Nos. 011, 023, or 024 as appropriate.

If non-aqueous phase liquid (NAPL) contamination is suspected[1], use an interface probe to determine the existence and thickness of NAPLs.

Open the probe housing, turn the probe on, and test the alarm. Slowly lower the probe into the well until the alarm sounds. A continuous alarm indicates a NAPL while an intermittent alarm indicates water. If a NAPL is detected, record the initial level (first alarm). Mark the spot by grasping the cable with the thumb and forefingers at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Withdraw the cable sufficiently to record the depth.

Continue to slowly lower the probe until it passes into the water phase. Slowly retract the probe until the NAPL alarm sounds and record that level in the manner as described above.

Record the thickness of the light NAPL[2] (Section 3.3).

Continue to slowly lower the interface probe through the water column to check for the presence of dense NAPL.

Measure and record the thickness of the dense NAPL layer (if any) as described above.

Slowly raise the interface probe, recording the depth to each interface as the probe is withdrawn. If there is a discrepancy in depths, clean the probe sensors and re-check the depths.

NOTE: Air/liquid interface depth is more reliable if probe is lowered into liquid. NAPL/water depths are more accurate if probe is moved from water into NAPL.

Always lower and raise interface probe slowly to prevent undue mixing of media.

1. Interface probes will be used in all wells for first round sampling, regardless of site history. If no NAPLs are detected during the first round of sampling, this step may be omitted during subsequent sampling events **unless** conditions such as site history or headspace vapors would indicate otherwise.
2. If NAPL is viscous, such as coal tar or weather bunker oil, several confirmation measurements should be made after decontamination of the probe to verify that the NAPL is not sticking to the probe and causing erroneous readings. One way to accomplish this would be to partially fill a 5-gal bucket with water and dip the probe to ensure that decontamination has effectively removed the NAPL.

Always perform NAPL check in wells installed in areas with suspected NAPL contamination. Always perform NAPL check if headspace test reveals presence of volatiles. Always perform NAPL check the first time a well is sampled. **If** a well has been sampled previously **and** no NAPLs were present **and** none of the preceding conditions are met, the NAPL check may be omitted.

If no NAPL is present, use an electronic water level detector as follows:

- Remove the water level indicator probe from the case, turn on the sounder, and test check the battery and sensitivity scale by pushing the red button. Adjust the sensitivity scale until you can hear the buzzer.

- Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter **just** buzzes. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Withdraw the cable and record the depth.

Alternatively use a steel tape with an attached weight if aquifer gradients are lower than 0.05 ft/ft. Due to the possibility of adding unknown contaminants from chalk colorants, only white chalk is permitted.

Rub chalk onto the first 1 ft of the steel tape and slowly lower the chalked end into the well until the weighted end is below the water surface. (A small splash can be heard when the weighted end hits the water surface.)

Using the method described above read and record the length from the steel tape.

Remove the steel tape. The chalk will be wet or absent where the tape was below the water surface. Locate, read, and record this length. Subtract wetted length from total length and record the difference. This is the depth to water table.

Transducers and dataloggers will be used where water level fluctuations over time are to be measured, such as tidal fluctuation studies (SOP No. 045) and aquifer (hydraulic) tests (SOP No. 033). Note that transducers are inappropriate for measuring well depth.

Slowly lower the transducer into the well until it is below the lowest possible piezometric level (typically 2-3 ft below the water table).

Tape the umbilical to the protective casing to prevent the transducer from falling further.

Attach the umbilical leads to the datalogger.

Turn datalogger on.

To measure the well depth, lower electric water level indicator probe or tape until slack is noted. Very slowly raise and lower the cable until the exact bottom of the well is "felt." Measure (cable) or read the length (tape) and record the depth.

Note that if the electric water level indicator is used to determine depth of well, the offset distance between the tip of the probe and the electrode must be added to the reading to determine actual depth.

Withdraw the probe or tape. Decontaminate the probe(s) and cable(s).

3.3 DATA RECORDING AND MANIPULATION

Record the following computations:

- Date and time
- Weather
- Method of measurement
- Casing elevation
- NAPL surface elevation = casing elevation – depth to NAPL
- NAPL thickness = depth to bottom of NAPL – depth to top of NAPL
- Water level elevation = casing elevation – depth to water
- Well bottom elevation = casing elevation – depth to bottom (or read directly from tape).

Refer to SOP Nos. 005 and 016.

4. CALIBRATION

No calibration is needed.

5. PRECAUTIONS

Depending upon the device used, correction factors may be required for some measurements. Check instrument batteries prior to each use. Exercise care not to break the seals at the top of the electric water level indicator probe.

6. REFERENCES

McAlary, T.A. and J.F. Barker. 1987. Volatilization Losses of Organics during Groundwater Sampling from Low Permeability Materials in Groundwater Monitoring Review. Fall.

Thornhill, J.T. 1989. Accuracy of Depth to Groundwater Measurements in U.S. Environmental Protection Agency Superfund Groundwater Issue EPA/540/4-89/002.

Standard Operating Procedure No. 011
for
Photoionization Detector

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with the photoionization detector (MiniRae). The photoionization detector uses an ultraviolet emitting lamp designed to detect, measure, and display the total concentration of airborne ionizable gases and vapors. This information is used to determine control measures such as protection and action levels.

Use of brand names in this SOP is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable SOPs for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

Battery pack	Tedlar bag
Calibration gas (100 ppm isobutylene)	Tygon tubing
Microtip/MiniRae	Regulator

3. STARTUP/CALIBRATION PROCEDURE

Turn the instrument on by pressing the back of the power switch located on the handle of the instrument.

The message “Warming up now, please wait” will be displayed for up to 3 minutes. After normal display appears, the instrument is ready for calibration.

Fill a Tedlar bag with the desired calibration gas (usually 100 ppm Isobutylene).

Press SETUP button and select the desired Cal Memory using the arrow keys (normally set to 200 ppm). Press EXIT button to leave setup function.

Press CAL button and expose instrument to Zero Gas. (Usually clean outdoor air will be suitable. If any doubt exists as to the cleanliness of the background air a commercial source of zero gas should be used.)

The instrument then asks for the Span Gas concentration. Enter the known span gas concentration and then connect the Tedlar bag containing the Span Gas.

NOTE: The span gas concentration is dependent upon both the concentration of the span gas used and the rating of the UV lamp in the instrument at time of calibration. If using 100 ppm isobutylene and the standard 10.6 eV lamp, the span gas concentration will be 56 ppm.

Press enter and the instrument sets its sensitivity. Once the display reverts to normal, the instrument is calibrated and ready for use. Remove the Span Gas from the inlet probe. The instrument should be calibrated at least once a day.

4. BATTERY CHARGING

Ensure instrument is off. Set the voltage selector switch on the bottom of the battery charger to the appropriate AC line voltage. Press the release button on the bottom of the instrument and remove the battery pack by sliding it backwards. Plug charger into the battery pack and then into an AC outlet and allow the battery to charge for at least 8 hours. After charging, remove the charger, first from the outlet then from the battery pack, and slide the battery pack back onto the instrument.

5. PRECAUTIONS

Instrument does not carry an Intrinsic Safety Rating and must not be used in a hazardous location where flammable concentrations of gases or vapors are constantly present.

All calibration, maintenance, and servicing of this device, including battery charging, must be performed in a safe area away from hazardous locations.

Do not open or mutilate battery cells. Do not defeat proper polarity orientation between the battery pack and battery charger. Substitution of components may affect safety rating.

6. REFERENCES

Instrument User's Manual.

Standard Operating Procedure No. 012
for
Specific Conductance Measurements

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring the specific conductance of any aqueous solution, including drinking water, saline water, and industrial and domestic wastes. Conductivity is the ability of an aqueous solution to pass an electrical current. The current is primarily carried by dissolved inorganic ions such as chlorides, nitrates, sulfates, along with cations such as sodium, calcium, magnesium and others. Organic compounds do not carry current and, therefore, have almost no conductivity.

2. MATERIALS

The following materials may be required:

Conductivity meter with integral temperature compensation; accuracy = ±2 percent at 25°C (77°F)
Conductivity cell
Appropriate conductivity reference solution
High performance liquid chromatography (HPLC)-grade water (see SOP No. 005, Footnote 2)
Thermometer (optional, Section 5)

3. PROCEDURE

3.1 CALIBRATION

The specific conductivity meter should be calibrated at the beginning of each day[1] as follows:

1. Thoroughly rinse the probe with appropriate conductivity reference solution.

2. Zero meter if appropriate.

3. Measure the specific conductance of fresh appropriate conductivity reference solution record it in the field notebook, and adjust the calibration knob until the meter reads properly.

4. Rinse probe with HPLC-grade water.

5. Measure the specific conductance of HPLC-grade water and record in the field logbook. If specific conductivity of HPLC-grade water is not 0 (±2 percent) recalibrate instrument.

1. The meter should be recalibrated any time the readings are suspect (e.g., out of expected range).

3.2 OPERATION

The specific conductivity meter will be operated as follows:

1. Thoroughly rinse the probe and sample beaker with sample water.

2. Measure the temperature of the sample water. Convert Fahrenheit temperature readings to Celsius using C = 5/9(F - 32) if Celsius temperature is not obtained directly.

3. Place the probe in the sample beaker with sufficient sample to completely submerge the probe. Swirl the probe to remove any air bubbles trapped in the probe.

4. Select the highest multiplier scale on the meter and turn the instrument on. Progressively use lower multiplier scales until a mid-scale deflection is obtained.

5. If appropriate, check probe accuracy by pressing cell test button. If value change is >10 percent check probe.

6. Record the temperature and conductivity values.

7. Specific conductivity values are corrected for temperature using:

   K^25^oC = {*K measured*} over {1+ 0.0191 (t-25)}

   where

   K = Conductivity in µmhos
   t = Temperature, °C

8. Decontaminate the probe (see SOP No. 005, Section 3.3.3).

Refer to SOP Nos. 005 and 016.

4. MAINTENANCE

The following steps will be taken to properly maintain the conductivity meter:

1. Check the batteries each time the instrument is used.

2. Inspect the probe on a daily basis for damage or loss of platinum black plating from the electrode. If the platinum is damaged, alert the Field Team Leader and arrange to get a new cell.

3. Follow manufacturer's specifications regarding storage of probe between uses.

5. PRECAUTIONS

Be certain there is no air in the cell before taking a reading. If conductivity meter does not have integral temperature compensation, use a thermometer to determine temperature of the sample.

6. REFERENCES

Manufacturer's Manual.

U.S. Environmental Protection Agency. 1983. Methods for Chemical Analysis of Water and Wastes. March.

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Standard Operating Procedure No. 013
for
Collection of Monitoring Well Samples

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for the collection of groundwater samples from monitoring wells.

2. MATERIALS

The following materials may be required:

0.45 μM filters	Polyvinyl chloride bailer (for purging only)
Bladder pump (dedicated to one well only)	Sample bottles and labels
Conductivity meter	Stainless steel bailer (for purging and sampling)
Dissolved oxygen meter	Submersible pump and hose (for purging only)
Generator	Thermometer (optional)[1]
Logbook or book of field parameter forms	Transparent bailer with a double check valve
Peristaltic pump with tubing for filtering samples	Turbidity meter
pH meter with oxidation-reduction potential probe	Tygon tubing
Photoionization detector organic vapor analyzer.	Variable speed, low flow submersible pump (e.g., Grundfos MP1 groundwater sampling pump) (for purging and sampling)
Plastic sheeting	Water level indicator
Polypropylene rope	
Polytetrafluoroethelyne (PTFE) bailer with PTFE-coated stainless steel cable, double check valve top, and controlled flow bottom discharge attachment[2] for volatile organic compound (VOC) sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles) (for purging and sampling)	

3. PROCEDURE

3.1 GENERAL

Groundwater sampling will follow these general steps:

- Arrive onsite
- Set up apparatus (generators, pumps, etc.)
- Glove
- Organic vapor check, water level, and well depth measurements

1. Temperature compensation and measurement capabilities are generally available as integral functions of pH meters and conductivity meters. If this is the case, a separate thermometer is not required.
2. Although use of a controlled flow bottom discharge valve is historically preferred, use of such a device can cause aeration of the sample.

- Sample non-aqueous phase liquids (NAPLs) (as required)
- Begin purge procedure
  - If using bailer to purge and sample, see Section 3.6
  - If using pump to purge and bailer to sample, see Section 3.7
  - If using bladder or low-flow pump to purge and sample, see Section 3.8
- Decontaminate/reglove
- Take samples
  - If with bailer, see Section 3.6
  - If with bladder or low flow pumps, see Section 3.8
- Decontaminate/dispose of wastes, move equipment to next site.

3.2 GENERAL RULES FOR GROUNDWATER FIELD PARAMETER LOGBOOK

Use only one site or installation per logbook, and only one sampling location per page or form (if using pre-printed forms). The same book may be used for more than one sampling event. First five pages will be reserved for index, general notes, etc. Sign and date each entry. Last five pages will be reserved for recording calibration data for the pH, temperature, turbidity, oxidation-reduction potential, dissolved oxygen, and conductivity meters. Use the page number or a separately recorded "Cal Reference Number" to refer to each calibration. As appropriate, insert the cardboard flap under the form being filled out, so that writing does not go through to the pages below. As appropriate, fill in the forms from front to back of the logbook, tearing out the white copy for each sample when the sample has been collected. This copy goes in the cooler with the sample, directly to the laboratory. The original copy must be torn out before you write on the back of the duplicate form. As appropriate, duplicate copies, index pages, and calibration sheets remain intact.

3.3 GROUNDWATER SAMPLING GENERAL RULES

Groundwater samples will be collected from the least contaminated wells first, progressing to the most contaminated[3]. Upon arrival at the well site, immediately set up and organize the purging, sampling, and filtration equipment. If needed, due to muddy or contaminated ground, remoteness from sampling vehicle, and\or for placement of hose(s) and\or power cord if a pump is used, place clean plastic sheeting at, or around the well, to serve as a clean staging area for purging and sampling equipment, as conditions warrant. Care must be exercised not to step on plastic sheeting. If the well is remote from the sampling vehicle, set up the filtration equipment

3. First round samples are to be collected from upgradient wells first, moving to downgradient wells under the assumption that upgradient wells will be less contaminated than downgradient wells. Results of first round analysis may mandate a change in sampling sequence.

and place rope, wrapped bailer, and pre-labeled sample containers on the plastic sheet, from the well. When a pump is to be used, situate the portable generator on level ground approximately 15 ft away from and downwind from the well. All generator maintenance (oil and fueling) is to be performed offsite. If the hose(s) and/or power cord of the pump are not on a reel, place the pump with its hose and power cord on the plastic sheeting downhill from the well.

Check well headspace for organic vapor which may pose a health and safety hazard and indicate the presence of NAPL. Measure depth(s) to and thickness(es) of NAPL(s) as appropriate. Measure the depth to water and depth of well. From the water depth, well diameter, sand pack length, etc., calculate the equivalent volume (1 EV) of water in the well.

1 EV = volume in casing + volume in saturated sand pack. Therefore, if the water table lies below the top of the sandpack, use the following equation:

$$1\ EV = (\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_w) * (0.0043)$$

If the water table lies above the top of the sandpack use this equation:

$$1\ EV = [(\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_s)] * (0.0043)$$

where

R_s = Radius of sandpack in inches
R_w = Radius of well casing in inches
h_s = Height of sandpack in inches
h_w = Water depth in inches

0.0043 gal/in.^{3}
Assumed filter pack porosity = 30 percent.

Samples will always be collected in order of decreasing volatility (i.e., the samples to be analyzed for the volatile constituents should be collected first). Deliver the VOC sample to the vial by allowing the water to trickle down the inside wall of the vial at a rate no greater than approximately 100 ml/min. Other samples may be delivered at a faster rate. Sampling rates will at no time exceed 1 L/min. Procedures for each class of samples are contained in the site-specific Quality Assurance Project Plan.

When collecting samples for volatile analysis, care should be taken to prevent analyte loss by volatilization. The following procedures should be adhered to when collecting these samples:

- Avoid excessive aeration and agitation of sample.
- Fill vial so that a reverse meniscus is present by adjusting the flow rate from the sampling device.

- Place septum on vial so that the PTFE side is in contact with the sample. After the cap is on the bottle, check for air bubbles in the sample. If air bubbles are present, properly dispose of that sample and recollect the sample in the same vial.

- Make sure vial is labeled and immediately transfer the vial to the cooler with ice.

Filtered and unfiltered samples will be taken for inorganics (metals) analyses. The samples will be filtered through an in-line 0.45-µM filter (preferred method), or by gravity through a 0.45-µM membrane placed in a filter funnel. Use forceps to place the membrane into the funnel and pour sample through funnel until appropriate volumes have been filtered.

If necessary, due to slow filtering, a peristaltic pump may be used to filter the sample through an in-line filter. Connect the pump to the generator, attach tygon tubing to the bottom discharge valve on the bailer. Start pump and collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

— OR —

If a low flow pump is used collect the samples, filtered samples will be taken by installing a 0.45-µM filter in-line and pumping the water through the filter. Collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

Unfiltered samples will be collected by slowly pouring the sample water into the appropriate sample container, being careful not to agitate or cause bubbles to form. Do not overfill bottles. Make sure sample bottle is labeled and the cap is on tightly, then place the sample in cooler with ice immediately.

All samples will be delivered to the laboratory as soon as possible. If possible, samples will be shipped on the same day as they are collected. If samples must be retained due to weekend sampling (Friday through Sunday), the laboratory will be notified as to the time sensitive nature of the samples.

3.4 SAMPLING OF NON-AQUEOUS PHASE LIQUIDS

If NAPLs are detected in the well, a sample from all layers must be collected prior to any purging activities. NAPLs may be indicated by the presence of volatiles in the well headspace, and confirmed by the oil/water interface probe.

Collecting light non-aqueous phase liquid (LNAPL) will be accomplished using a transparent bailer with a double check valve. This bailer will be slowly lowered until the bottom of the bailer is 1-2 in. below the LNAPL-water interface, then slowly withdrawn. Verify that the interface was sampled by visual inspection of the bailer contents through the side of the bailer. Measure the thickness of the LNAPL in the bailer and note in the Field Logbook. Sample for laboratory analysis. An additional field verification may be performed by decanting the remainder of the contents of the bailer into a glass jar, adding a hydrophobic dye such as Sudan IV, or Redoil, shaking the sample and looking for coloration of NAPL. Alternate field tests are: examine the sample under ultraviolet light (many fluoresce), or allow the sample to stand overnight, and examine for interface and/or volatiles in the headspace the following day. Refer to following sections on purging and sample collection for setup and general operation.

Collecting dense non-aqueous phase liquids (DNAPLs) will be accomplished using a transparent bailer with a double check valve. The bailer must be lowered very slowly to the bottom of the well and raised slowly out of the well in a controlled fashion. Sample for analysis as above. The same field check described above may be employed for DNAPL. Refer to following sections on purging and sample collection for set up and general operation.

If NAPLs are present in the well, **and** a low-flow pump is to be used for purging and sampling, the well will be allowed to re-equilibrate prior to purging and sampling. This will be accomplished by allowing the well to stand undisturbed for at least 8 hours prior to purging and sample collection.

3.5 WELL PURGING GENERAL RULES

Water within the casing of a well will stagnate, degas, lose volatiles, possibly precipitate metals due to changes in redox potential, and may react with the screen and/or casing material. It is, therefore, necessary to purge a sufficient volume of this stagnant water from the well and/or casing to ensure that a representative sample of formation water can be obtained. Traditionally, the volume of water to be purged was arbitrarily set at 3-5 equivalent volumes. Recent advances in sampling technologies have caused a re-thinking of such arbitrary purge volumes. It is for this reason that monitoring of select chemical and physical properties of the sample medium will be used instead of strict volumes to determine when a representative sample may be taken from a well.

Acceptable purge/sampling devices include: bailers, high-discharge submersible pumps (purge only), and variable speed, low-flow pumps which include both submersible pumps (purge and sample) and dedicated bladder pumps (purge and sampling). It is recommended to purge and sample at similar rates with one type device per well. An acceptable exception to this general rule is to use a high-discharge submersible pump to purge a deep, fast-recharging well, and a bailer to sample the same well.

Peristaltic, gas-lift, and centrifugal pumps can cause volatilization, produce high pressure differentials, and can result in variability in the analysis of some analytes of interest. These types of pumps will not be used to purge or sample wells.

To prevent groundwater from cascading down the sides of the screen into an open hole, thereby aerating the sample, purge rates will closely match recharge rates. If the static water level is within the casing, the initial purge rates may be set high enough to lower the water level to the top of the screen, then reduced to maintain that level.

Purging will be accomplished with either a submersible pump, a low-flow (submersible or bladder) pump, or bailer. The choice of bailer or pump will be based on depth to water table, volume to be purged, and permeability of the aquifer. If the well recharges rapidly and/or has greater than 20 gal (estimated EV) to be purged, water may be removed with a submersible pump or a low-flow pump. If the well recharges slowly and/or has less than 20 gal to be purged, water will be removed with a bailer or a low-flow pump.

Purging will be accomplished with as minimal disturbance to the surrounding formation as possible.

Purge water will be containerized onsite until analysis of samples is completed. Based on sample results, accumulated purge water will be properly disposed.

If the water level is within the screened interval and the well recharge rate is less than 0.1 L/min, purge the well using a low-flow pump as follows:

1. Draw the water down to within 1 ft of the top of the pump.

2. Allow the well to recover.

3. Check and record field parameters.

4. Repeat Steps 1 through 3 then collect samples for metals analysis only[4].

5. Note the event in the Field Logbook, and report the problem to the Project Manager. If this extremely low recharge problem consistently occurs in a given well, the well may be considered for re-development and/or replacement.

6. If adjacent wells have elevated VOC levels, additional soil gas surveys will be considered in the vicinity of the low recharge well to help determine the need for replacement.

3.6 PURGING AND SAMPLING WITH BAILERS

Bailers may be used for both purging and sampling wells if: (a) the well recharge rate is less than 4 L/min, (b) depth to the water table is less than 50 ft, and (c) less than 20 gal are to be purged (5 EV < 20 gal)[5].

4. Analyte losses due to volatilization in a drained well are too high for valid VOC sampling (McAlary and Barker 1987).

When purging with a bailer, either a polyvinyl chloride, PTFE, or stainless steel bailer may be used. The bailer will be attached to either a spool of PTFE-coated stainless steel cable or polypropylene rope. If using cable, attach it to the bailer using stainless steel cable clamps. Thoroughly decontaminate the cable after each use, prior to rewinding cable onto spool. Cable clamps and raw cable ends may serve to trap contamination. Exercise particular caution in decontaminating these areas. If using rope, attach the rope to the bailer using a bowline knot, dispense the needed length (a few feet more than the well depth) and cut the remainder away; then, at the end opposite the bailer, make a slip knot and place it around the well casing or protective posts to prevent losing the bailer and rope down the well. The polypropylene rope will be not reused; it will be properly disposed of. Either type of bailer will be repeatedly lowered gently into the well until it fills with water, removed, and the water will be discharged into an appropriate container until purging is complete. Care must be taken not to unduly agitate the water, as this tends to aerate the sample, increase turbidity, makes stabilization of required parameters difficult to achieve, and generally prolongs purging.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples, sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

Immediately upon completion of purging, collect samples for laboratory analysis using a PTFE bailer on a PTFE-coated stainless steel cable. The bailer will be equipped with double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool of PTFE-coated cable. Allow bailer to fill, withdraw smoothly. Refill bailer as needed.

If the controlled flow bottom discharge attachment is used for VOC sampling, attach it to the bottom of the bailer. Using the stopcock valve on the bailer to control the flow, fill sample vials as described above in Section 3.3.

Remove check valve top and pour unfiltered sample into inorganics sample bottles.

Collect filtered samples as described in Section 3.3. Decontaminate bailer and cable.

5. These numbers are based on the following assumptions: (1) In purging, it is preferable to remove water at approximately the recharge rate; (2) 4 L/min is estimated as the approximate maximum rate at which water can be removed with a bailer from depths of 20-50 ft; and (3) 20 gal is estimated to be at the limit of the sampler's endurance, at which point fatigue and sloppiness of technique begin.

3.7 PURGING WITH PUMP, SAMPLING WITH BAILER

If the recharge rate of the well is greater than 30 L/min, or the water level is deeper than 50 ft, or more than 20 gal of purge water will be generated (5 EV > 20 gal), then purging and sampling may be accomplished using a submersible pump/bailer combination.

When purging with a pump, gradually lower the intake until it is submerged within the screened interval. Lower an electronic water level probe to the top of the screen (as determined from completion records) to the monitor water level, start pump, and slowly lower the pump as the water level continues to fall. Care should be exercised to lower the water column to the top of the screened interval (water level probe will stop beeping) but not below the top of the screen if possible. This will ensure that the stagnant layer has been removed, but should minimize the detrimental effects of over pumping the well. Secure hose(s) and/or power cord to casing and place discharge hose into the proper container, downhill and as far away from the well as possible. Determine and record the discharge rate.

Discharge rate = volume of container/time to fill container

The discharge rate will be established at approximately equal to or just greater than the well's recharge rate (determined from well development). If well development records are incomplete, recharge rate can be determined by monitoring the rise/fall of the water level within the casing as one purges the well. If the water level is static at a given pumping rate, but fluctuates up or down as pumping rate is decreased or increased, the pumping rate at which the water level is static is the recharge rate.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples, sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

Immediately upon completion of purging, collect samples for laboratory analysis using a PTFE bailer on a PTFE-coated stainless steel cable. The bailer will be equipped with double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles). Filtration of metals samples will be accomplished using either an in-line filter attached to the bottom of the bailer, or a funnel and appropriate filter (Section 3.3).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool of PTFE-coated cable. Allow bailer to fill, withdraw smoothly, fill sample containers as described in Section 3.6. Decontaminate bailer and cable in and decontaminate pump.

3.8 PURGING AND SAMPLING WITH LOW-FLOW PUMP

To obtain representative samples, subsurface disturbances should be kept to a minimum, thereby preventing sample alteration due to sampling actions. The reasoning behind the use of low-flow pumps to purge and sample monitoring wells is that these pumps minimize physical disturbance (turbulence) at the sampling point and chemical changes (aeration) in the medium. For these reasons, the low-flow pump is the preferred method for both purging and sampling in most cases. For the purposes of this SOP, "low-flow pumps" are defined as either dedicated bladder pumps or variable speed submersible pumps. Practical operational flow rates for these sampling devices range from 0.1 L/min to 30 L/min.

Low-flow pumps may be used for purging and sampling any well having recharge greater than 0.1 L/min, which is the practical lower limit of pump performance. Below that pumping rate, pump inefficiencies and/or overheating may alter the physical and chemical properties of the sample. If the pump is continuously operated at sampling rates higher than the well recharge rate, the water level will be lowered in the well, possibly allowing aeration of the sample which is unacceptable sampling procedure. Low-flow pumps are suitable for sampling wells with recharge rates lower than 0.1 L/min if precautions are taken to avoid aeration of the sample.

Low flow submersible pumps will be used as follows:

- Lower the pump into the well, slowly so as not to agitate the water, until the pump is at the mid-point of the screened interval or the mid-point of the water column if the static water table lies below the top of the screen[6]

- Attach the pump's umbilical cord (which will consist of power cord and sampling tubing) to the protective casing, or lock the cord spool so that the pump cannot move vertically in the well during sampling.

- Lower the water level probe into the well behind the pump until it just touches water. This will allow the sampler to monitor the water level while purging and sampling, and prevent the inadvertent drying of the well.

6. This assumes a 10-ft screened interval. If the screened interval is greater than 10 ft, multiple samples should be taken as follows:
   - If the screen is 10-12 ft, sample the canter of the water column, as outlined above.
   - If the screen is longer than 12 ft, and the water column is 10 ft or less, sample the center of the water column.
   - If the screen is longer than 12 ft, and the water column fills the screen, or extends above the screen, sample at 1/3 and 2/3 the height of the water column, or about every 6 ft.

- Begin purging at the pump's lowest setting, then gradually increase rate[7] until the pumping rate matches the aquifer recharge rate. **If the water level is above the top of the screen**, the pumping rate may be allowed to slightly exceed recharge rate, lowering the water level to no less than 1 ft above the screen, then reduced until it matches recharge rate and purging continued. **If the water level is below the top of the screen**, always keep the purge rate lower than well's recharge rate.

- Monitor stabilization parameters listed in Section 3.6 beginning immediately, using an in-line monitoring system. Record parameters regularly, at a rate of one set of parameters per each 1-3 liters of water removed from the well. When these parameters stabilize to within 10 percent over three consecutive readings, reduce[8] flow rate to 0.1 L/min (if needed) and begin collecting VOC samples directly from the discharge line.

- If the well recharges at a rate less than 0.1 L/min, purge until the water level is even with the top of the screen, allow the well to recover, and sample immediately.

- Remove and decontaminate water level probe and pump.

4. MAINTENANCE

Refer to manufacturer's requirements for maintenance of pumps and generators.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for appropriate personal protective equipment.

6. REFERENCES

Garske, E.E. and M.R. Schock. 1986. An Inexpensive Flow-Through Cell and Measurement System for Monitoring Selected Chemical Parameters in Groundwater.

Gass, T.E., J.F. Barker, R. Dickhout, and J.S. Fyfe. 1991. Test Results of the Grundfos Groundwater Sampling Pump, in Proceedings of the Fifth National Symposium on Aquifer Restoration and Groundwater Monitoring.

7. Some sources indicate that the pumping rate should not exceed 1 L/min, with 0.5 L/min being preferable. The optimal purge rate is highly aquifer dependent, and may range from less than 0.5 L/min to greater than 10 L/min. The purge rate for a given well will, therefore, be a field decision, based on well development, purge, and sampling records rather than SOP mandate.
8. Sampling should occur at the same rate as purging as long as aeration of sample does not occur.

McAlary, T. A. and J.F. Barker. 1987. Volatilization Losses of Organics During Groundwater Sampling From Low Permeability Materials, in Groundwater Monitoring Review. Fall.

Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Groundwater Quality Samples for Metals, in Groundwater Monitoring Review. Summer.

Puls, R.W., J.H. Eychaner, and R.M. Powell. 1990. Colloidal-Facilitated Transport of Organic Contaminants in Groundwater: Part I. Sampling Considerations, in EPA Environmental Research Brief. EPA/600/M-90/023. December.

Puls, R.W., R.M. Powell, D.A. Clark, and C.J. Paul. 1991. Facilitated Transport of Inorganic Contaminants in Groundwater: Part II Colloidal Transport, in EPA Environmental Research Brief. EPA/600/M-91/040. July.

Puls, R.W., R.M. Powell, B. Bledsoe, D.A. Clark, and C.J. Paul. 1992. Metals in Groundwater: Sampling Artifacts and Reproducibility, in Hazardous Waste & Hazardous Materials. Volume 9, No. 2.

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Standard Operating Procedure No. 014
for
Collection of Production Well Samples

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December 2014

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples from production wells. This protocol will allow for collection of samples from both active production wells and inactive production wells (Section 3).

2. MATERIALS

The following equipment may be required:

Conductivity meter	pH meter
Dissolved oxygen meter	Sample bottles and labels
Logbook or field parameter form	Temperature meter
Oxidation-reduction potential probe	Turbidity meter

3. PROCEDURE

Upon arrival at the well site, immediately set up and organize the sampling and ancillary equipment. If needed, due to muddy or contaminated ground and/or remoteness from sampling vehicle, place plastic sheeting at or around the sampling location as conditions warrant. Exercise caution not to step on and contaminate the sheeting.

If the well is remote from the sampling vehicle, set up the filtration equipment and place sample containers on the plastic sheet, uphill of the sampling location.

If a pump is to be used for filtration, situate the portable generator on level ground approximately 15 ft away from and downwind from the sampling location. All generator maintenance (oil and fueling) is to be preformed offsite.

If the well is currently in use, as close as possible to the well, open a tap to a high flow rate and allow the well to purge.

Obtain a sample of groundwater for temperature, conductivity, oxidation-reduction potential, dissolved oxygen, turbidity, and pH measurements. Record values in sampling logbook.

Take samples for physical stabilization (water quality) parameters every 5 minutes during the well purging process.

Allow the well to purge until the water quality parameters of pH, temperature, conductivity, turbidity, oxidation-reduction potential, and dissolved oxygen measurements stabilize within 10 percent in three consecutive 5-minute sampling periods, purging will be considered complete and sampling may proceed. Slow water flow rate to a trickle.

For procedures for collecting samples, with the exception of the sample source being a bailer, refer to SOP No. 013.

If the well is not currently in use, use a pump and bailer, or low-flow pump for sampling. Refer to SOP No. 013 for purging and sampling protocol. Decontaminate equipment. Refer to SOP Nos. 001, 002, 004, 005, 013, and 016.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Not applicable.

6. REFERENCES

U.S. Army Toxic and Hazardous Materials Agency. 1990. Installation Restoration Quality Assurance Program, December 1985, 1st Edition, March 1987, 2nd Edition.

Standard Operating Procedure No. 016
for
Surface Water, Groundwater, and Soil/Sediment Field Logbooks

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for recording surface water, groundwater, soil/sediment sampling information, instrument calibration data, and data from hydrologic testing in the field logbooks. Acceptable field logbooks are: bound, unprinted books such as a surveyor's field book, or a federal supply service No. 7530-00-222-3525 record book (or equivalent); or they may be company-proprietary, pre-printed forms bound into a field logbook. Example forms are provided herein. Alternate, equivalent forms are acceptable.

2. MATERIALS

The following material may be required: applicable field logbook and indelible ink pen.

3. PROCEDURE

Information pertinent to soil/sediment, groundwater, or surface water sampling will be recorded in the appropriate logbook. Each page/form of the logbook will be consecutively numbered. Entries will be made in indelible ink. Corrections will consist of line-out deletions that are initialed and dated. If using carbon paper or self-duplicating forms, before entering data in logbook, insert a sheet protector between form sets to isolate first blank form from remaining forms.

3.1 SOIL/SEDIMENT LOGBOOK (Requires Figures SOP016-1 and SOP016-3)

3.1.1 Field Parameter Form (Items on Figures SOP016-1 and SOP016-2)

1. HIGH CONCENTRATION EXPECTED?: Answer "Yes" or "No."

2. HIGH HAZARD?: Answer "Yes" or "No."

3. SITE: Record the complete name of the site.

4. AREA: Record the area designation of the sample site.

5. INST CODE: Record the 2-letter installation code appropriate for the installation or site. Correct abbreviations can be found on Pages 3-6 of the IRDMS User's Guide for chemical data entry.

6. FILE NAME: Record "CSO" for a soil sample or "CSE" for a sediment sample.

7. SITE TYPE: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry. This entry must match the Site Type on the map file form.

8. SITE ID: Record a code up to 10 characters or numbers which is unique to the site.

9. FIELD SAMPLE NUMBER: Record a code specific for the sample.

10. DATE: Enter the date the sample was taken.

11. TIME: Enter the time (12-hour or 24-hour clock acceptable as long as internally consistent) the sample was taken.

12. AM PM: Circle "AM" or "PM" to designate morning or afternoon (12-hour clock).

13. SAMPLE PROG: Record "GQA" (Groundwater Quality Assessment) or other appropriate sample program.

14. DEPTH (TOP): Record the total depth sampled.

15. DEPTH INTERVAL: Record the intervals at which the plug will be sampled.

16. UNITS: Record the units of depth (feet, meters)

17. SAMPLE MEASUREMENTS: Check the appropriate sampling method.

18. CHK: Check off each container released to a laboratory.

19. ANALYSIS: Record the type of analysis to be performed on each sample container.

20. SAMPLE CONTAINER: Record the sample container type and size.

21. NO.: Record the number of containers.

22. REMARKS: Record any remarks about the sample

23. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: Record the total number of containers.

24. SITE DESCRIPTION: Describe the location where the sample was collected.

25. SAMPLE FORM: Record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System.

26. COLOR: Record the color of the sample as determined from standard Munsell Color Charts.

27. ODOR: Record the odor of the sample or "none." See SOP No. 001 Section 5.

28. PID (HNu): Record the measured PID (HNu) values.

29. UNUSUAL FEATURES: Record anything unusual about the site or sample.

30. WEATHER/TEMPERATURE: Record the weather and temperature.

31. SAMPLER: Record your name.

3.1.2 Map File Form (Figure SOP016-3)

1. The map file logbook form will be located on the reverse of the field parameter logbook form, or on an adjoining page of the field logbook (if level book is used).

2. SITE ID: Record the Site ID from the field parameter form.

3. POINTER: Record the field sample number for the sample being pointed to.

4. DESCRIPTION/MEASUREMENTS: Describe the location where the sample was taken, along with distances to landmarks.

5. SKETCH/DIMENSIONS: Diagram the surroundings and record the distances to landmarks.

6. MAP REFERENCE: Record which U.S. Geological Survey Quad Map references the site.

7. COORDINATE DEFINITION: Write the compass directions the X- and Y-Coordinates of the map run.

8. COORDINATE SYSTEM: Write “UTM” (Universal Transverse Mercator).

9. SOURCE: Record the 1-digit code representing the Map Reference.

10. ACCURACY: Give units (e.g., write “1-M” for 1 meter).

11. X-COORDINATE: Record the X-Coordinate of the sample site location.

12. Y-COORDINATE: Record the Y-Coordinate of the sample site location.

13. UNITS: Record the unit’s map sections are measured in.

14. ELEVATION REFERENCE: Record whether topography was determined from a map or a topographical survey.

15. ELEVATION SOURCE: Record the 1-digit code representing the elevation reference.

16. ACCURACY: Record the accuracy of the map or survey providing the topographical information.

17. ELEVATION: Record the elevation of the sampling site.

18. UNITS: Write the units in which the elevation is recorded.

19. SAMPLER: Write your name.

3.2 SURFACE WATER LOGBOOK (Requires Figures SOP016-2 and SOP016-3)

3.2.1 Field Parameter Form (Items Unique to Figure SOP016-3)

1. CAL REF: Record the calibration reference for the pH meter.

2. pH: Record the pH of the sample.

3. TEMP: Record the temperature of the sample in degrees Celsius.

4. COND: Record the conductivity of the water.

5. For all other sections, see Section 3.2.1.

3.3 GROUNDWATER SAMPLING LOGBOOK (Requires Figures SOP016-2, SOP016-3, and SOP016-4)

3.3.1 Field Parameter Form (Items on Figure SOP016-4)

1. WELL NO. OR ID: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry.

2. SAMPLE NO.: Record the reference number of the sample.

3. WELL/SITE DESCRIPTION: Describe the location where the sample was taken, along with distances to landmarks.

4. X-COORD and Y-COORD: Record the survey coordinates for the sampling site.

5. ELEV: Record the elevation where the sample was taken.

6. UNITS: Record the units the elevation was recorded in.

7. DATE: Record the date in the form MM/DD/YY.

8. TIME: Record the time, including a designation of AM or PM.

9. AIR TEMP.: Record the air temperature, including a designation of C or F (Celsius or Fahrenheit).

10. WELL DEPTH: Record the depth of the well in feet and inches.

11. CASING HT.: Record the height of the casing in feet and inches.

12. WATER DEPTH: Record the depth (underground) of the water in feet and inches.

13. WELL DIAMETER: Record the diameter of the well in inches.

14. WATER COLUMN HEIGHT: Record the height of the water column in feet and inches.

15. SANDPACK DIAM.: Record the diameter of the sandpack. Generally, this will be the same as the bore diameter.

16. EQUIVALENT VOLUME OF STANDING WATER: Use one of the following equations, to determine one equivalent volume (EV):

1 EV = Volume in casing + volume in saturated sand pack. Or to restate:

$$1\ EV = (BR_w^2 h_w + 0.30B(R_s^2 - R_w^2)h_s) * (0.0043)$$

where

R_s = Radius of sandpack in inches
R_w = Radius of well casing in inches
h_s = Height of sandpack in inches
h_w = Water depth in inches

0.0043 = gal/in.^{3}
and filter pack porosity is assumed as 30 percent

— OR —

$$\text{Volume in casing} = (0.0043\ \text{gal/in.}^3)(B)(12\ \text{in./ft})(R_c^2)(W_h)$$

where

R_c = Radius of casing in inches
W_h = Water column height in feet

$$\text{Vol. in sandpack} = (0.0043\ \text{gal/in.}^3)(B)(12\ \text{in./ft})(R_b^2 - R_c^2)(W_h)(0.30)$$

(if W_h is less than the length of the sandpack),

— PLUS —

Vol. in sandpack = $(0.0043\ gal/in.^3)(B)(12\ in./ft)(R_b^2 - R_c^2)(S_h)(0.30)$

(if W_h is greater than the length of the sandpack).

where
R_b = Radius of the borehole
S_h = Length of the sandpack.

Show this calculation in the comments section.

17. VOLUME OF BAILER OR PUMP RATE: Record bailer volume or pump rate.

18. TOTAL NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers required to remove 3 equivalent volumes (EV) of water from the well or the total purge time and volume as applicable.

19. WELL WENT DRY? Write “YES” OR “NO.”

20. NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers or pump time which made the well go dry.

21. VOLUME REMOVED: Record the volume of water (gal) removed before the well went dry.

22. RECOVERY TIME: Record the time required for the well to refill.

23. PURGE AGAIN?: Answer “YES” or “NO.”

24. TOTAL VOL. REMOVED: Record the total volume of water (in gal) removed from the well.

25. CAL REF.: Record the calibration reference for the pH meter.

26. TIME: Record time started (INITIAL T[0]), 2 times DURING the sampling and the time sampling ended (FINAL).

27. pH: Record the pH at start of sampling (INITIAL), twice DURING the sampling and at the end of sampling (FINAL).

28. TEMP: Record the water temperature (Celsius) at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

29. COND: Record the conductivity of the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

30. D.O.: Record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

31. TURBIDITY: Record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

32. ORD: Record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

33. HEAD SPACE: Record any positive readings from organic vapor meter reading taken in well headspace prior to sampling.

34. NAPL: Record the presence and thickness of any non-aqueous phase liquids (light or dense)

35. COMMENTS: Record any pertinent information not already covered in the form.

36. SIGNATURE: Sign the form.

3.4 FIELD CALIBRATION FORMS (Maintained as a separate logbook, or incorporated into sampling logbooks)

3.4.1 Items on Figure SOP016-5

1. Record time and date of calibration. Note whether 12- or 24-hour clock was used.

2. Record calibration standard reference number.

3. Record meter I.D. number

4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line.

5. Record value of reference standard (as required).

6. COMMENTS: Record any pertinent information not already covered on form.

7. SIGNATURE: Sign form.

3.5 GROUNDWATER HYDROLOGY TESTS LOGBOOK (Must include Figures SOP016-6 and SOP016-7 and/or SOP016-8, OR SOP016-9 or SOP016-10)

3.5.1 Field Permeability Test Data Sheet (Items on Figures SOP016-6)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

4. PROJECT NO.: Record the contractor assigned project number or the contract number.

5. LOCATION: Specific location

6. CLIENT: Agency or company with the contract under which the work is being performed.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

9. TEST TYPE: Short description of the type of test to be performed.

10. RISING/FALLING HEAD WITH SLUG: Check if the test involved the insertion/removal of and inert object.

11. RISING/FALLING HEAD WITHOUT SLUG: Check if the test involved the addition/removal of a quantity of water.

12. START DATE: Date on which the test was begun.

13. CLOCK TIME: Time each datum (depth to groundwater level) is collected. Note whether 12- or 24-hour clock was used.

14. ELAPSED TIME: Time since the last datum was collected.

15. DEPTH TO GWL (ft): Depth to the top of the groundwater table (Groundwater Level) as measured by manual methods.

16. REC. (ft): Water level as reported by transducer/datalogger (this is the depth of water above the transducer.

17. TIME: Time the discharge rate check was begun (addition or removal of water method). Note whether 12- or 24-hour clock was used.

18. FLOW METER (Addition or removal of water method): The amount of water added or removed as registered by the flowmeter, in gal of liters.

19. DISCHARGE RATE: Flowmeter reading divided by time interval (gal/min or liters/min).

20. SIGNATURE: The person completing this form must sign the form at the end of the test.

21. DATE: Date the form was signed.

3.5.2 Groundwater Levels – Single Well (Items on Figure SOP016-7)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: Remedial investigation wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATE: Date of each water level reading

16. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

17. ELAPSED TIME: Time since test was begun.

18. DEPTH TO WATER: Measured depth to the groundwater table.

19. WATER ELEVATION: Elevation of the top of the groundwater table (use datum listed above).

20. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

21. TAPE NO.: The unique identification number of the traceable standard tape used to calibrate the measuring device.

22. WELL STATUS: Condition of the well at the time of measuring (see abbreviation key at the bottom of the data sheet).

23. REMARKS: Any additional pertinent comments not specifically required above.

24. INITIALS: Initials of person completing this data entry.

25. ABBREVIATION KEYS: Self explanatory.

26. SIGNATURE: The person completing this form must sign the form at the end of the test.

27. DATE: Date the form was signed.

3.5.3 Groundwater Levels – Single Well (Items on Figure SOP016-8)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATALOGGER: This section is record of pertinent datalogger information.

16. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

17. MODEL: Enter the model number of the datalogger.

18. S/N: Enter the serial number of this datalogger.

19. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

20. TRANSDUCER: This section is a listing of pertinent information about the transducer used.

21. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

22. MODEL: Enter the model number of the transducer.

23. S/N: Enter the serial number of this transducer.

24. INPUT/UNITS: What are the units this transducer uses?

25. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

26. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer. (Usually in psi, or kpa).

27. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

28. VOLUME WATER ADDED/REMOVED: (Applicable if inert object insertion/removal method was not employed.) Record the volume of water added to or removed from the well.

29. DISCHARGE RATE: If z (above) is filled, enter the rate at which this water was added or removed.

30. INITIAL WATER LEVEL (ft): Enter the water level in the well at the beginning of the test.

31. PRESSURE TRANSDUCER SUBMERGENCE: Record the depth to which the transducer is submerged at the beginning of the test and the depth to the transducer at the end if the test. All depths will be recorded to the nearest 0.01 ft.

32. TIME: Record the time the test is begun and ended. Note whether 12- or 24-hour clock was used.

33. OBSERVED CHANGES IN ADJACENT WELLS: Note any changes in water levels in nearby wells.

34. RESULTS RECORDED ON DISKETTE #: Tracking number of the diskette on which these data are archived.

35. DISKETTE FILE NAME: Name of the file(s).

36. SIGNATURE: The person completing this form must sign the form at the end of the test

37. DATE: Date the form was signed.

3.6 GROUNDWATER LEVELS – MULTIPLE WELLS (Items on Figure SOP016-9)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

5. LOCATION: Specific location.

6. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

7. CLIENT: Agency with the contract under which the work is being performed.

8. REMARKS: Any pertinent observations not specifically required above.

9. WELL: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

10. DATE: Date this measurement was made.

11. TIME: Time this measurement was made. Note whether 12- or 24-hour clock was used.

12. DEPTH TO WATER: Depth from MP to top of groundwater table.

13. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

14. MP ELEV.: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

15. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

16. REMARKS/MP: Describe the location and nature of the measuring point.

17. INITIALS: Initials of the person completing this form.

18. ABBREVIATION KEYS: Self explanatory.

19. SIGNATURE: The person completing this form must sign the form at the end of the test.

20. DATE: Date the form was signed.

3.7 GROUNDWATER LEVELS – DATALOGGERS (Items on Figure SOP016-10)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019, Section 3.4).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

DATALOGGER (This section is a record of pertinent datalogger information)

15. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

16. MODEL: Enter the model number of the datalogger.

17. S/N: Enter the serial number of this datalogger.

18. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

TRANSDUCER (This section is a listing of pertinent information about the transducer used)

19. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

20. MODEL: Enter the model number of the transducer.

21. S/N: Enter the serial number of this transducer.

22. INPUT/UNITS: What are the units this transducer uses?

23. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

24. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer (usually in psi, or kpa).

25. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

26. DATE: Date of each water level reading

27. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

28. LOGGING TIME INTERVAL: Time since test was begun.

29. WL FEET BELOW MP: Measured depth to the groundwater table from measuring point.

30. SUBMERGENCE: Depth of water above the transducer.

31. MEAS.METHOD: What device/method was used to measure the water level.

32. TAPE NO.: Record the tape identification number.

33. TRANSDUCER MOVED?: Was the transducer moved since the last water level reading?

34. REMARKS: Any pertinent remarks not otherwise specified.

35. INITIALS:

DATA TRANSFER TO DISKETTE:

36. DATE: Date data were archived onto diskette.

37. TIME: Time stamp the computer assigns the data file.

38. FILE NAME: Name assigned the data file.

39. SOFTWARE USED FOR TRANSFER: Any special software, or computer operating system used to write the files to diskette. NOTE: If a "shareware" archiver which compresses files was used, and the archived file is not self-extracting, a copy of the unarchive program should be copied onto the diskette also.

40. OUTPUT FORMAT: What is the format of the output file? (DOS, UNIX, Binary, Compressed?)

41. INITIALS: Initials of the person who copied the data to diskette.

42. ABBREVIATION KEY: Self-explanatory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency. 1984. User's Guide to the Contract Laboratory Program. July.

FIGURE SOP016-1
FIELD PARAMETER LOGBOOK
SOIL AND SEDIMENT SAMPLES

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

INSTALLATION/SITE _____ AREA _____

INST CODE FILE NAME _____

SITE TYPE SITE ID
FIELD SAMPLE NUMBER

DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.

DEPTH (TOP) DEPTH INTERVAL UNIT _____

SAMPLING METHOD:

SPLIT SPOON AUGER SHELBY TUBE SCOOP OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS
SITE DESCRIPTION:_____
SAMPLE FORM _____ COLOR _____ ODOR _____
PID (HNu) _____ UNUSUAL FEATURES _____
_____
WEATHER/TEMPERATURE
SAMPLER

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

FIGURE SOP016-2
FIELD PARAMETER LOGBOOK
GROUNDWATER AND SURFACE WATER SAMPLES

INSTALLATION/SITE AREA
INST CODE FILE NAME SITE TYPE
SITE ID FIELD SAMPLE NUMBER
DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.
DEPTH (TOP) DEPTH INTERVAL UNITS

SAMPLING MEASUREMENTS

CAL REF.	pH	TEMPERATURE C	CONDUCTIVITY	OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION
SAMPLING METHOD
SAMPLE FORM COLOR ODOR
PID (HNu)
UNUSUAL FEATURES
WEATHER/TEMPERATURE _____ SAMPLER _____

FIGURE SOP016-3
MAP FILE LOGBOOK

SITE ID POINTER _____
DESCRIPTION/MEASUREMENTS
SKETCH/DIMENSIONS:

MAP REFERENCE
COORDINATE DEFINITION (X is Y is)
COORDINATE SYSTEM SOURCE ACCURACY
X-COORDINATE Y-COORDINATE UNITS
ELEVATION REFERENCE
ELEVATION SOURCE ACCURACY ELEVATION
UNITS

SAMPLER

FIGURE SOP016-4
MAP FILE AND PURGING LOGBOOK
GROUNDWATER SAMPLES

WELL COORD. OR ID SAMPLE NO._____
WELL/SITE
DESCRIPTION_____
_____
X-COORD. Y-COORD. _____ ELEV. UNITS
DATE ____/____/____ TIME AIR TEMP.

WELL DEPTH _____ ft _____ in. CASING HT. _____ ft _____ in.
WATER DEPTH _____ ft _____ in. WELL DIAMETER _____ in.
WATER COLUMN HEIGHT _____ ft _____ in. SANDPACK DIAM. _____ in.
EQUIVALENT VOLUME OF STANDING WATER _____ (gal) (L)
VOLUME OF BAILER _____ (gal) (L) or PUMP RATE _____ (gpm) (lpm)
TOTAL NO. OF BAILERS (5 EV)_____ or PUMP TIME _____ MIN.
WELL WENT DRY? [Yes] [No] NUM. OF BAILERS _____ or PUMP TIME_____MIN
VOL. REMOVED _____ (gal) (L) RECOVERY TIME _____ MIN
PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED _____ (gal) (L)

Date and Time	Quantity Removed	Time Required	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/ clarity/odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

COMMENTS:_____
_____
_____
_____

_____
SIGNATURE

FIGURE SOP016-5
FIELD CALIBRATION: pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, OXIDATION-REDUCTION POTENTIAL, AND DISSOLVED OXYGEN METERS

INITIAL CALIBRATION	FINAL CALIBRATION
DATE:	DATE:
TIME:	TIME:

pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _____

METER ID _____

pH STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
7.0			
10.0			
4.0			

CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _____

METER ID _____

COND. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

TEMPERATURE METER CALIBRATION

METER ID _____

TEMP. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
ICE WATER			
BOILING WATER			
OTHER			

FIGURE SOP016-5 *(continued)*

TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _____

METER ID _____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _____

METER ID _____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _____

METER ID _____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

COMMENTS:_____

_____

_____

_____

_____

SIGNATURE

FIGURE SOP016-6
FIELD PERMEABILITY TEST DATA SHEET

Contractor: **Seq. #** /

Project Name:	Project #:
Location:	Client:
Party Chief:	Contractor:
Observation Well:	
Test Type: Rising/Falling Head w/Slug	Rising/Falling Head w/out Slug
Start Date:	

								Discharge Rate		
Clock Time	Elapsed Time (min)	Depth to GWL (ft)	Rec (ft)	Clock Time	Elapsed Time	Depth to GWL (ft)	Rec (ft)	Time	Flow Meter	Discharge Rate

Signature: _____ **Date:** _____

FIGURE SOP016-7
GROUNDWATER LEVELS – SINGLE WELL

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:
Well No.: Site: Area:
Site: Area:
Area:

up (+)/down (-) from: Datum = MSL or:
Datum = MSL or:

Measuring Point Description:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:

Transducer: Manufacturer: Model: S/N:
Input/Units: Range:

Calibration:
Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v) / (mv)

Volume Water Added/Removed:
Discharge Rate:
Initial Water Level (ft):

Pressure Transducer Submergence
Initial (ft): Final(ft): Time:Start: End:
Observed Changes in Adjacent Wells:

Results Recorded on Diskette #:
Diskette File Name:

Signature: _____ Date: _____

FIGURE SOP016-8
GROUNDWATER LEVELS – MULTIPLE WELLS

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:

Measuring Point Description:
Remarks:
Well No.:
Site: Area: up (+)/down (-) from:
up (+)/down (-) from:
up (+)/down (-) from:
Datum = MSL or:

Date	Time	Elapsed Time	Depth to Water	Water Elevation	Meas. Meth.	Tape No.	Well Status	Remarks	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

Signature: _____ Date: _____

FIGURE SOP016-8 *(continued)*

Contractor: **Seq. #** /

Project No.:
Project Name: Location:
Field Party Chief: Client:

Well	Date	Time	Depth to Water	Stickup	MP Elev.	Meas. Meth.	Tape No.	Remarks/MP	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

FIGURE SOP016-9
GROUNDWATER LEVELS DATALOGGERS

Contractor
Project No.: **Well No.:**
Project Name: **Site:**
Field Party Chief: **Area:**

WELL DATA: Stickup: (**ft**) **up (+)/down (-) from:**
MP Elevation: **Datum = MSL or:**

Measuring Point Description:
Remarks:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:
Transducer: Manufacturer: Model: S/N:
Input/Units: Range:
Calibration: Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v)

Logging	Date	Time	Logging Time Interval	WL, ft Below MP	Submergence (logger reading)	Meas. Method	Tape No.	Well Status	Transducer Moved	Remarks	Initials
Start											
Stop											
Start											
Stop											

Data Transfer to Disk

Date	Time	File Name	Software Used for Transfer	Output Format	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently
NP = Nearby well pumping
NRP = Nearby well recently pumped
X = Obstructed

Signature **Date**

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Standard Operating Procedure No. 019
for
Monitoring Well Installation

Prepared by

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Revision 0
December 2014

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APPENDIX A: FIELD RECORD OF WELL DEVELOPMENT FORM

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1. SCOPE AND APPLICATION

The installation of monitoring wells is contingent upon the existing conditions at the project site. The purpose of this Standard Operating Procedure is to delineate the quality control measures required to ensure the accurate installation of monitoring wells. The applicable Work Plan should be consulted for specific installation instructions. The term "monitoring wells," as used herein, is defined to denote any environmental sampling well. An example well log form is provided in Appendix A. Alternate, equivalent forms are acceptable.

2. MATERIALS

2.1 DRILLING EQUIPMENT

The following drilling equipment may be required:

- Appropriately sized drill adequately equipped with augers, bits, drill stem, etc.
- Steam cleaner and water obtained from approved source for decontaminating drilling equipment.
- Photoionization Detector: Microtip HL-200 (or equivalent)
- Water level indicator
- Weighted steel tape measure
- Lower explosive limit – oxygen monitor
- Steel drums for intrusion derived wastes (drill cuttings, contaminated personal protective equipment, decontamination solutions, etc.)
- Source of approved water
- Heavy plastic sheeting
- Sorbent pads and/or log.

2.2 WELL INSTALLATION MATERIALS[1]

The following well installation materials may be required:

- Well screen:[2]

  — Polyvinyl chloride (PVC): JOHNSON (or equivalent); PVC 0.010 slot; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with American Society for Testing and Materials (ASTM) D2665, ASTM D1784, and ASTM F480; free of ink markings; cleaned and prepackaged by manufacturer.

  — Stainless steel: JOHNSON (or equivalent); stainless steel 0.010 slot; 304 stainless steel[3]; ASTM F480 flush threads; cleaned, wrapped, and heat sealed by manufacturer.

- Riser pipe:

  — PVC: JOHNSON (or equivalent); STD; PVC; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with ASTM D2665, ASTM D1784, and ASTM F480; free of ink markings; cleaned and prepackaged by manufacturer.

  — Stainless steel: JOHNSON (or equivalent); Schedule 5; 304 stainless steel; ASTM Type A312 material; 4-in. diameter; cleaned, wrapped, and heat sealed by manufacturer.

- Plugs/caps: JOHNSON (or equivalent); standard PVC or stainless steel.

- Filter pack: MORIE, 100 well gravel (or equivalent). NOTE: Final gradation may vary as a function of the gradation of the formation.[2]

- Fine Ottawa sand.

- Bentonite seal: BAROID, bentonite pellets (3/8-in. diameter)

- Cement: Type II Portland Cement (table below).

1. Technical information on all installed materials (screens, riser pipe, filter pack, bentonite, cement, etc.) and representative samples of the proposed filter pack, bentonite powder, and bentonite pellets will be supplied to the Project Manager.
2. Well screen slot size and filter pack gradation will be determined from sieve analysis of aquifer materials. Screen and casing material type will be determined based on field tests of groundwater chemistry and contaminants.
3. Unless the sum of Cl-, F-, and Br- is >1,000 ppm, in which case Type 316 should be used.

Cement Type	Special Characteristics	Recommended Usage
I	No special properties	General use as grout mix or cement plug (if sulfates <250 ppm), surface pad.
IA	Air-entraining Type I (Note that air entrainment properties can be achieved by chemical admixtures)	Air entrainment gives cement greater freeze-thaw resistance. Recommended for surface pads.
II	Moderate sulfate resistance, low heat of hydration	General use as grout mix or cement plug where groundwater sulfate >250 ppm and <1,500 ppm, surface pad.
IIA	Air-entraining Type II	See Type IA.
III	High early strength, high heat of hydration	Elevated temperature can damage well casing and fracture grout/cement plugs. NOT RECOMMENDED.
IIIA	Air-entraining Type III	NOT RECOMMENDED.
IV	Low heat of hydration	General use as grout mix or cement plug preferred type for well abandonment to ensure intact grout/cement plug.
V	High Sulfate resistance	Use when groundwater sulfate levels >1,500 ppm.

- Bentonite powder: BAROID, Aquagel Gold Seal.
- Steel protective casing: BRAINARD-KILMAN (or equivalent) zinc-plated steel, lockable, painted.[4]
- Geotextile: MIRAFI (or equivalent); GTF 130; non-woven; 4 oz.
- Coarse (blanket) gravel: Crushed stone aggregate.
- Containers for purged water, as required.
- Submersible pump or bailer of appropriate capacity, and surge block sized to fit well.
- Hach DREL 2000 portable laboratory (or equivalent).
- Conductivity, pH, oxidation-reduction potential (ORP), turbidity, dissolved oxygen, and temperature meters.
- Electric well sounder and measuring tape.
- Portland Type II cement (see previous table).
- Steel Posts (pickets), painted (see footnote).

4. All painted components (protector casing, steel pickets) will be painted high-visibility orange and allowed to dry completely prior to being brought onsite.

2.3 DOCUMENTATION

The following document may be provided:

- Copy of appropriate Work Plan
- Copy of approved Health and Safety Plan
- Copies of well and excavation permits
- Boring log forms
- Well completion diagram form
- Well development form.

2.4 GEOLOGIST'S PERSONAL EQUIPMENT

The following equipment may be required for the geologist:

- 10X handlens
- Unified Soil classification System chart
- Munsell color chart
- Sieve set (Keck model SS-81 or equivalent)
- Personal protective equipment as required by the Health and Safety Plan.

3. PROCEDURE

3.1 MATERIALS APPROVAL

Water sources for drilling, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the drilling equipment. Information required for the water source includes: water source, manufacturer/ owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analyses over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives (bentonite) will be the only drilling fluid additive allowed, and its use must be approved by the Project Manager prior to the arrival of the drilling equipment. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product description, and intended use for the product.

Granular Filter Pack material must be approved by the Project Manager prior to drilling. A 1-pint representative sample must be supplied to the Project Manager. Information required includes: lithology, grain size distribution, brand name, source, processing method, and slot size of intended screen.

Portland Type II cement will be used for grout (see previous table).

3.2 DRILLING

The objective of the selected drilling technique is to ensure that the drilling method provides representative data while minimizing subsurface contamination, cross-contamination of aquifers, and drilling costs. The preferred drilling method is with a hollow-stem auger. Other drilling methods[5] are approved as conditions warrant, and will not require variances be issued by the U.S. Environmental Protection Agency. The method used at a specific site will be proposed in the work plan and evaluated by the Project Manager. Any drilling method not listed herein will require approval on a case by case basis by the U.S. Environmental Protection Agency.

A Site Geologist will be present during all well drilling and installation activities and will fully characterize all tasks performed in support of these activities into the monitoring well logbook. The Site Geologist will be responsible at only one operating rig for the logging of samples, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of the rig. The Site Geologist will have onsite sufficient equipment in operable condition to perform efficiently his/her duties as outlined in the contractual documents. Items in the possession of each Site Geologist will include the approved Health and Safety Plan, this Standard Operating Procedure, a hand lens (10X), a standard color chart, grain-size chart, and a weighted (with steel or iron) steel tape long enough to measure the deepest well, heavy enough to reach that depth, and small enough to fit readily within the annulus between the well and drill casing. The Site Geologist will also have onsite, a water level measuring device, preferably electrical.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole drilling equipment. Additives containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls will not be permitted in hydraulic fluids or other fluids used in the drilling rig, pumps, and field equipment/vehicles.

---

5. If the design depth of the well is <100 ft, open, hollow-stem augers will be used to drill the well unless "running sands" preclude the use of open augers. In that case, an inert "knockout" plug may be used in the bottom of the auger string. This plug will be driven out of the augers and left at the bottom of the hole when the well is installed.

   If the design depth of the well is >100 ft, rotary drilling methods may be used to install wells. The following drill fluids and methods are approved in the order listed: (1) rotary drilling with water from an approved source as drilling fluid (clays from the formations will tend thicken the fluid and coat the walls of the borehole and this is acceptable); (2) rotary drilling with water as a fluid, advancing a temporary casing with the bit to maintain an open hole; and (3) mud rotary using water with additives as drill fluid. Due to the potential for aquifer contamination and plugging, mud rotary drilling is not recommended for monitoring wells. If, however, "running sands" are encountered and the aquifer is expected to have a relatively high flow rate, then mud rotary is considered an approved method. Pure sodium bentonite is the only approved additive. Mud rotary drilling must be halted at the last aquitard above the target aquifer. Casing must be set, all bentonite-bearing fluids flushed from the hole and drill rig, and drilling may be resumed using water only as the drill fluid until the target depth is reached.

Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction.

Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. Antifreeze is prohibited in areas in contact with drilling fluid. The ground surface at the well site will be protected from possible coolant, fuel, and hydraulic fluid spills and/or leakage by placement of plastic sheeting with raised edges, draining into a lined catch basin large enough to contain spills and/or leakage from motors, radiators, or vehicle tanks. Sorbent pillows will be placed to catch obvious leaks from the drill rig. Sorbent logs may be used instead of, or in conjunction with, a lined catch basin to contain spills.

An accurate measurement of the water level will be made upon encountering water in the borehole and later upon stabilization. Levels will be periodically checked throughout the course of drilling. Any unusual change in the water level in the hole, such as a sudden rise of a few inches may indicate artesian pressure in a confined aquifer, will be the basis for cessation of drilling. The geologist will immediately contact the Project Manager[6]. Particular attention for such water level changes will be given after penetrating any clay or silt bed, regardless of thickness, which has the potential to act as a confining layer.

Anticipated depths of wells are given in well specific work plans. In case the previously defined criteria have not been met before the depth range for a given hole is reached, the geologist will stop the drilling and confer with the Project Manager. The current boring conditions (depth, nature of the stratigraphic unit, and water table depth) will be compared to those of other wells nearby to decide to continue drilling or to terminate and complete the well.

If the well is to be installed in the surficial aquifer, drilling will be terminated before penetrating the basal aquitard. The basal aquitard is defined as the first 2 ft-thick clay below the water table, or below 5 ft in the case of a shallow aquifer.

If the well is to be installed in a lower, confined aquifer:

- Penetrations of aquifers located lower than the water table aquifer will be limited to avoid cross-contamination.

- Placement of new upper confined aquifer wells will be initially limited to those areas where contamination has been confirmed.

- The location of upper confined aquifer wells will be based upon the findings of the water table aquifer investigation. Areas of known contamination will be targeted for installing upper confined aquifer wells for the purposes of delineating vertical contamination.

6. The contract technical oversight will also be contacted for guidance.

- Where possible, upper-confined aquifer wells will be located such that they afford triangulation with other wells within the same aquifer to allow for a determination of groundwater flow direction.

- Some upper-confined aquifer wells will be installed approximately 10-15 ft from water table wells to enable the accurate assessment of vertical hydraulic gradients. If the direction of groundwater flow is known, wells within a group will be located sidegradient of each other.

- The boring will be advanced until the base of the surficial aquifer is reached (Section 3.2).

- An outer, surface casing will be set 2-5 ft into the confining layer to minimize the potential for cross-contamination from the unconfined aquifer during drilling activities.

- The surface casing will be driven into the confining bed and grouted into place. Grout will be tremied into the annulus around the outside of the casing to within 5 ft of the ground surface. A grout plug at least 2 ft thick will be tremied into the bottom of the surface casing. The grout will be permitted to cure for 24 hours. All drilling fluids within the surface calling will then be removed, and the casing will be flushed with clean potable water.

- The drilling equipment will be decontaminated, a smaller bit or auger selected, and the hole will be continued through the grout plug into the confined aquifer.

- If deeper aquifers are to be screened, repeat preceding steps until total depth is reached.

If dense non-aqueous phase liquid (DNAPL) contamination is detected during drilling, the well will be terminated and completed at the base of the aquifer. Drilling will not continue through the confining unit.

Stainless steel screens will be used in DNAPL wells. Screen size selection will be according to criteria set forth in Section 3.4. The formation grain size will be multiplied by the higher factor (6) to determine filter pack grain size. This will ensure that the filter pack is sufficiently coarse to permit DNAPL to pass freely from the formation into the coarser filter pack, then into the open well (Cohen and Mercer 1993).

DNAPL sampling cups are prohibited. The well screen will be capped, and set 0.3 ft (0.5 ft max.) into the top of the confining bed and rest on the bottom of the hole or bentonite backfill (if used). No sand will be placed below the screen. The remainder of the well installation and completion will be accomplished according to Section 3.4.

3.3 LOGGING

All borings for monitoring wells will be logged by a geologist. Logs will be recorded in a field logbook and/or a boring log. If the information is recorded in a logbook, it will be transferred to Boring Log Forms on a daily basis. Field notes are to include, as a minimum:

- Boring number
- Material description (as discussed below)
- Weather conditions
- Evidence of contamination
- Water conditions (including measured water levels)
- Daily drilling footage and quantities (for billing purposes)
- Notations on man-placed materials
- Drilling method and borehole diameter
- Any deviations from established field plans
- Blow counts for standard penetration tests
- Core and split-spoon recoveries.

Material description for soil samples must include:

- Classification
- Unified Soil Classification symbol
- Secondary components and estimated percentages
- Color
- Plasticity
- Consistency
- Density
- Moisture content
- Texture/fabric/bedding and orientation
- Grain angularity
- Depositional environment and formation
- Incidental odors
- Photoionization detector reading(s)
- Staining.

Material description for rock samples must include:

- Classification
- Lithologic characteristics
- Bedding/banding characteristics
- Color
- Hardness
- Degree of cementation
- Texture
- Structure and orientation

- Degree of weathering
- Solution or void conditions
- Primary and secondary permeability
- Sample recovery
- Incidental odors
- Photoionization detector reading(s)
- Staining.

3.4 WELL CONSTRUCTION AND INSTALLATION

After the hole is drilled and logged, backfill hole as required for proper screen placement. The integrity of the aquitard will be restored by placing a bentonite plug of an appropriate thickness, either to the top of the aquitard (normal well installation) or to within 0.3 ft of the top of the aquitard (DNAPL well). Aquifer fill will be clean filter pack.

Normal screen placement for the water table (surficial) aquifer will be within 2 ft of the screen extending above the static water level. The bottom of the screen will rest no more than 6 in. from the bottom of the hole or backfill material, whichever is applicable.

NOTE: The end cap in DNAPL wells will rest on the bottom of the bottom of the hole, or bentonite backfill if applicable (Section 3.2).

Screen placement for a confined aquifer well will normally be at the top of the confined aquifer.

Screen lengths will not normally exceed 10 ft. If it appears advantageous in a given situation (e.g., to screen an entire aquifer which is thicker than 10 ft), approval must be sought on a case-by-case basis from the appropriate regulatory agency. Otherwise, wells will be screened as follows:

Thickness of Aquifer	Action
<10 ft	Screen entire aquifer
>10 ft <30 ft	Screen top 10 ft consider vertically nested well cluster
>30 ft	Install vertically nested well cluster

The installation of monitoring wells in uncased or partially cased holes will begin within 12 hours of completion of drilling, or if the hole is to be logged, within 12 hours of well logging, and within 48 hours for holes fully cased with temporary drill casings. Once installation has begun, work will continue until the well has been grouted and the drill casing has been removed.

Well screens, casings, and fittings will conform to National Sanitation Foundation Standard 14 or ASTM equivalent for potable water usage. These materials will bear the appropriate rating logo. If the logos are not present, a written statement from the manufacturer/supplier stating that the materials contain the appropriate rating must be obtained. Material used will be new and essentially chemically inert to the site environment.

Well screen and casing should be inert with respect to the groundwater; therefore, the selection of screen and casing material will be based on select field tests of aquifer chemistry and potential contaminants. The screen will be capped without sediment trap or DNAPL sampling cup, and lowered into the hole. The well casing will be pre-cut to extend 2-2.5 ft above ground surface. Prior to placement of the last piece of well casing, a notch or other permanent reference point will be cut, filed, or scribed into the top edge of the casing.

Screen slot size will be appropriately sized to retain 90-100 percent of the filter pack material, the size of which will be determined by sieve analysis of formational material (Section 3.4).

The tops of all well casing will be capped with covers composed of materials compatible with the products used in the well installation. Caps may either be vented, or a telescopic fit, constructed to preclude binding to the well casing caused by tightness of fit, unclean surfaces, or weather conditions. In either case, it should be secure enough to preclude the introduction of foreign material into the well, yet allow pressure equalization between the well and the atmosphere.

Filter pack material will be placed, lightly tamped, and leveled. Filter pack will extend from the bottom of the hole to a height of 1-2 ft above the top of the screen. The filter pack will be capped with a minimum of 1 ft of fine (Ottawa) sand to prevent the bentonite seal from infiltrating the filter pack. If the bentonite seal is placed as a slurry, a minimum of 2 ft of fine sand will be required.

If the hole is less than 20-ft deep, the filter pack may be poured into the annulus directly. If the hole is deeper than 20 ft, the filter pack must be tremied into place.

Granular filter packs will be chemically and texturally clean, inert, and siliceous.

Filter pack grain size will be based on formation grain-size analysis. The D30 (70 percent retained) sieve size multiplied by a factor of not less than 3 nor greater than 6 will be used to determine the appropriate grain size.

Calculations regarding filter pack volumes will be entered into the Field Logbook along with any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the Field Logbook.

Bentonite seals will be no less than 2-ft thick nor more than 5-ft thick as measured immediately after placement. The normal installation will include a 5-ft seal. Thinner seals may be used in special cases. The final depth to the top of the bentonite seal will be measured and recorded.

3.4.1 Grout

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, type II) (see previous table)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- 8-gal (maximum) approved water per 94-lb bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement. Grout placement will be performed using a commercially available grout pump and a rigid, side discharge tremie pipe.

The following will be noted in the Field Logbook: (1) calculations of predicted grout volumes; (2) exact amounts of cement, bentonite, and water used in mixing grout; (3) actual volume of grout placed in the hole; and (4) any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the Field Logbook.

Well protective casings will be installed around all monitoring wells on the following day as the initial grout placement around the well. Any annulus formed between the outside of the protective casing and the borehole will be filled to ground surface with cement.

The construction of each well will be depicted as built in a well construction diagram. The diagram will be attached to the boring log and will graphically denote:

- Screen location, length
- Joint location
- Granular filter pack
- Seal
- Grout
- Cave-in
- Centralizers
- Height of riser
- Protective casing detail.

3.5 MONITORING WELL COMPLETION

Assemble appropriate decontaminated lengths of pipe and screen. Make sure these are clean and free of grease, soil, and residue. Lower each section of pipe and screen into the borehole, one at a time, screwing each section securely into the section below it. No grease, lubricant, polytetrafluoroethelyne tape, or glue may be used in joining the pipe and screen sections.

If a well extends below 50 ft, centralizers will be installed at 50 ft and every 50 ft thereafter except within screened interval and bentonite seal. Centralizer material will be PVC, polytetrafluoroethelyne, or stainless steel. Determination of centralizer material will be based on the same criteria as screen and calling selection.

Cut the riser with a pipe cutter approximately 2-2.5 ft above grade. All pipe cuts MUST be square to ensure that the elevation between the highest and lowest point of the well casing is less than or equal to 0.02 ft Notch, file, or otherwise permanently scribe a permanent reference point on the top of the casing.

Torches and saws may not be used to cut the riser. Care must be taken that all filings or trimmings cut from the reference point fall outside the riser rather than into the well. **Under no circumstances will a permanent marker or paint pencil be used to mark the reference point**.

In some locations, safety requirements may mandate that a well be flush-mounted with no stick-up. If a flush-mounted well is required at a given location, an internal pressure cap must be used instead of a vented cap to ensure that rainwater cannot pool around the wellhead and enter the well through the cap.

When the well is set to the bottom of the hole, temporarily place a cap on top of the pipe to keep the well interior clean.

Place the appropriate filter pack (Section 3.4). Monitor the rise annulus with a weighted tape to assure that bridging is not occurring.

After the pack is in place, wait 3-5 minutes for the material to settle, tamp and level a capped PVC pipe, and check its depth weighted steel tape.

Add a 1-2 ft cap of fine-grained (Ottawa) sand to prevent infiltration of the filter pack by overlying bentonite seal. See Section 3.4 for guidance on appropriate thickness of fine sand layer.

Install the bentonite seal (2- to 5-ft thick) by dropping bentonite pellets into the hole gradually. If the well is deeper than 30 ft, a tremie pipe will be used to place either bentonite pellets or slurry. Tamp and level pellets. If the well is 30 ft, tamp with a capped PVC pipe, if >30 ft, tamping bay be accomplished with the weighted end of the tape. In either case, check the depth to the top of the seal with a weighted tape as above.

If the bentonite pellets are of poor quality, they may have a tendency to hydrate and swell inside the tremie pipe and bridge. This situation may be solved by the following procedure:

1. Use a different brand of pellets. Different brands may have longer hydration times.

2. Freeze the pellets[7]. Note that this will require a longer wait time to allow proper hydration after the pellets thaw.

3. Place the bentonite seal as a slurry using a side-discharge tremie pipe as though installing grout. Note (Section 3.4) this will require that a minimum of 2 ft of fine sand be placed as a cap on top of the filter pack material.

Wait for the pellets to hydrate and swell. Hydration times will be determined by field test or by manufacturer's instructions. Normally this will be 30-60 minutes. Document the hydration time in the field notebook. If the pellets are above the water level in the hole, add several buckets of clean water to the boring. Document the amount of water added to the hole.

Mix an appropriate cement-bentonite slurry (Section 3.4). Be sure the mixture is thoroughly mixed and as thick as is practicable.

Lower a side discharge tremie pipe into the annulus to the level of the pellet seal.

Pump the grout slurry into the annulus while withdrawing the tremie pipe and temporary casing.

Stop the grout fill at 5 ft below the ground surface. Allow to cure for not less than 12 hours. If grout settles more than 6 in., add grout to bring level back up to within 5 ft of ground surface. Place approximately 2 ft of bentonite pellets (minimum 0.5 ft) in annulus. Seat the protective casing in the bentonite seal, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Fill inner annulus (between well casing and protective casing) with bentonite pellets to the level of the ground surface. Cover bentonite pellets with 1 ft of clean granular material (coarse sand or pea gravel filter pack). Fill the outer annulus (between the protective casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing. Lock the cap.

— OR —

Continue the grout fill to the ground surface. Seat the protective casing in the grout, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Lock the cap.

— AND —

Allow the grout slurry to set overnight.

7. Bentonite pellets may be "flash-frozen" by brief immersion in liquid nitrogen (LN2). This can be accomplished by pouring LN2 over a small quantity (0.25-0.5 bucket) of pellets, allowing the LN2 to boil off, then pouring the pellets into the tremie pipe. **NOTE:** Use of LN2 is an additional jobsite hazard and must be addressed in the contractor's Health and Safety Plan. This contingency must be covered before drilling starts in order to avoid delays in well installation.

Fill the outer annulus (between the casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing.

Slope the ground surface away from the casing for a distance of 2 ft, at a rate of no less than 1 in. in 2 ft. Surface this sloping pad with a geotextile mat covered by 3 in. of coarse gravel.

— OR —

Frame and pour a 4-ft square × 6-in. thick (4 ft × 4 ft × 6 in.) concrete pad centered around the protective casing.

— AND —

Set pre-painted protective steel pickets (3 or 4) evenly around and 4 ft out from well. These pickets will be set into 2 ft deep holes, the holes will then be filled with concrete; and if the pickets are not capped, they will also be filled with concrete.

3.6 WELL DEVELOPMENT

Well development is the process by which drilling fluids, solids, and other mobile particulates within the vicinity of the newly installed monitoring well have been removed while restoring the aquifer hydraulic conductivity. Development corrects any damage to or clogging of the aquifer caused by drilling, increases the porosity of the aquifer in the vicinity of the well, and stabilizes the formation and filter pack sands around the well screen.

Well development will be initiated after 48 consecutive hours but no longer than 7 calendar days following grouting and/or placement of surface protection.

Two well development techniques, over pumping and surging, will be employed in tandem. Over pumping is simply pumping the well at a rate higher than recharge. Surging is the operation of a plunger up and down within the well casing similar to a piston in a cylinder.

3.6.1 Materials Required

The following materials will be required for well development:

- Well Development Form
- Boring Log and Well Completion Diagram for the well
- Submersible pump or bailer of appropriate capacity, and surge block
- Conductivity, pH, ORP, turbidity, dissolved oxygen, and temperature meters
- Electric well sounder and measuring tape
- Containers for purged water, if required.

3.6.2 Summary of Procedures and Data Requirements

Pump or bail the well to ensure that water flows into it, and to remove some of the fine materials from the well. Removal of a minimum of one equivalent volume is recommended at this point. The rate of removal should be high enough to stress the well by lowering the water level to approximately half its original level. If well recharge exceeds 15 gpm, the requirement to lower the head will be waived.

Slowly lower a close-fitting surge block into the well until it rests below the static water level, but above the screened interval. (NOTE: This latter is not required in the case of a light non-aqueous phase liquid well.)

Begin a gentle surging motion which will allow any material blocking the screen to break up, go into suspension, and move into the well. Continue surging for 5-10 minutes, remove surge block, and pump or bail the well, rapidly removing at least one equivalent volume.

Repeat previous step at successively lower levels within the well screen until the bottom of the well is reached. Note that development should always begin above, or at the top of, the screen and move progressively downward to prevent the surge block from becoming sand locked in the well casing. As development progresses, successive surging can be more vigorous and of longer duration as long as the amount of sediment in the screen is kept to a minimum.

Development is expected to take at least 2 hours in a small well installed in a clean sand, and may last several days in large wells, or in wells set in silts with low permeabilities.

Development will continue until little or no sediment can be pulled into the well, and target values for parameters listed below are met.

At a minimum, development will remove 3-5 well volumes of water. One development volume (DV) is defined as (1) equivalent volume, plus (1) the amount of fluid lost during drilling, plus (1) the volume of water used in filter pack placement.

1. Monitor water quality parameters before beginning development procedures, and after removing 2, 2.5, and 3 well volumes of water.

2. If these parameters have stabilized over the three readings, the well will be considered developed.

3. If the parameters have not stabilized after these three readings, continue pumping the well to develop, but stop surging. Monitor the stabilization parameters every half DV.

4. When the parameters have stabilized over three consecutive readings at half DV intervals, the well will be considered developed.

All water removed must be disposed of as directed by the Work Plan.

Record all data as required on a Well Development Record Form (Appendix A), which is made a part of the complete Well Record. These data include:

- Depths and dimensions of the well, casing, and screen obtained from the well diagram.
- Water losses and uses during drilling, obtained from the boring log for the well.
- Measurements of the following indicator parameters: turbidity, pH, conductivity, ORP potential, dissolved oxygen, and temperature.
- Target values for the indicator parameters listed above are as follows: pH – stabilize, conductivity – stabilize, ORP – stabilize, dissolved oxygen –- stabilize, temperature – stabilize, turbidity – 5 nephelometric turbidity units or stabilize. A value is considered to have stabilized when three consecutive readings taken at half DV intervals are within 10 percent of each other.
- Notes on characteristics of the development water.
- Data on the equipment and technique used for development.
- Estimated recharge rate and rate/quantity of water removal during development.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during well development activities.

6. REFERENCES

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Appendix A

Field Record of Well Development Form

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FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

NOTE: NTU = Nephelometric turbidity unit.
ORP = Oxidation-reduction potential.

COMMENTS AND OBSERVATIONS: _____

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

Standard Operating Procedure No. 021
for
Sediment Sampling

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) delineates protocols for sampling sediments from streams, rivers, ditches, lakes, ponds, lagoons, and marine and estuarine systems.

EA recognizes that other protocols have been developed that meet the criteria of quality and reproducibility. Clients may have their own sediment sampling protocols which may contain methodologies and procedures that address unique or unusual site-specific conditions or may be in response to local regulatory agency requirements. In such cases, EA will compare its and the client's protocols. The goal is to provide the client with the most quality; therefore, if the client's protocols provide as much or more quality assurance than EA's protocols for the particular site or project, EA will adopt those particular protocols and this SOP will be superseded in those respects. If EA is required to implement the client's protocols in lieu of EA's protocols, EA will make the client formally aware of any concerns regarding differences in protocols that might affect data quality and will document such concerns in the project file.

2. PROCEDURES

The water content of sediment varies. Sediments range from soft to dense and fine to rocky. A variety of equipment may be necessary to obtain representative samples, even at a single site. Factors to consider in selecting the appropriate sampling equipment include sample location (edge or middle of the waterbody), depth of water and sediment, grain size, water velocity, and analytes of interest.

3. GENERAL PROCEDURES

1. Surface water and sediment samples are to be collected at the same location (if both are required in the project-specific Sampling and Analysis Plan).

2. Collect the surface water sample first. Sediment sampling usually results in disturbance of the sediments, which may influence the analytical results of the surface water samples.

3. Wear gloves when collecting samples. Comply with the Health and Safety Plan specifications for proper personal protective equipment.

4. If sampling from a boat or near waterbodies with depths of 4 ft or more, the sampling team will wear life jackets.

5. Wading into a waterbody disturbs the sediment. Move slowly and cautiously, approach the sample location from downstream. If flow is not strong enough to move entrained particles away from the sample location, wait for the sediment to resettle before sampling.

6. Collect samples first from areas suspected of being the least contaminated, thus minimizing the risk of cross-contamination.

7. Collecting samples directly into sample containers is not recommended. Sediment samples should be placed in Teflon®, stainless steel, or glass trays, pans, or bowls for sample preparation.

8. Use the proper equipment and material construction for the analytes of interest. For example, for volatile organic compound analysis, the sampling material in direct contact with the sediment or surface water must consist of Teflon, polyethylene, or stainless steel.

9. Refer to EA SOP No. 005 (Field Decontamination) for proper decontamination methods before and after sampling and between samples.

10. Collect samples for volatile organic compound analysis first. Do not mix such samples before placing them in the sample containers. For composite volatile organic compound samples, place equal aliquots of each subsample in the sample container.

11. Sediment that will be analyzed for other than volatile organic compounds should be prepared as follows:

    - Place the sediment in a mixing container.
    - Divide the sediment into quarters.
    - Mix each quarter separately and thoroughly.
    - Combine the quarters and mix thoroughly.
    - For composite samples, mix each subsample as described above. Place equal aliquots of each subsample in a mixing container and follow the procedure described above.

12. Mark the sampling location on a site map. Record sampling location coordinates with a Global Positioning System unit, photograph (optional, recommended) and describe each location, and place a numbered stake above the visible high water mark on the bank closest to the sampling location. The photographs and description must be adequate to allow the sampling station to be relocated at a future date.

13. Dispose of investigation-derived wastes according to applicable rules and regulations.

4. CORERS

A corer provides a vertical profile of the sediment, which may be useful in tracing historical contaminant trends. Because displacement is minimal, a corer is particularly useful when sampling for trace metals and organics. Corers can be constructed out of a variety of materials.

For example, a 2-in. diameter polyvinyl chloride pipe with a Teflon or polyethylene liner can be lowered into the sediment; a 2-in. diameter well cap can be used to form an airtight seal and negative pressure as the pipe is withdrawn.

- Ensure that the corer and (optional) liner are properly cleaned.
- Stand downstream of the sample location.
- Force the corer into the sediment with a smooth continuous motion. Rotate (not rock) the corer if necessary to penetrate the sediment.
- Twist the corer to detach the sample; then withdraw the corer in a single smooth motion. If the corer does not have a nosepiece, place a cap on the bottom to keep the sediment in place.
- Remove the top of the corer and decant the water (into appropriate sample containers for surface water analysis, if required).
- Remove the nosepiece or cap and deposit the sample into a stainless steel, Teflon, or glass tray.
- Transfer the sample into sample containers using a stainless steel spoon (or equivalent device).

5. SCOOPS AND SPOONS

When sampling at the margins of a waterbody or in shallow water, scoops and spoons may be the most appropriate sampling equipment. For collecting samples several feet from shore or in deeper water, the scoop or spoon may be attached to a pole or conduit.

- Stand downstream of the sample location.
- Collect the sample slowly and gradually to minimize disturbing the fine particles.
- Decant the water slowly to minimize loss of fine particles.
- Transfer the sediment to sample containers or mixing trays, as appropriate.

6. DREDGES

Three types of dredges are most frequently used: Peterson, Ponar, and Eckman. Many other dredge types are available; their applicability will depend upon site-specific factors.

6.1 PETERSON AND PONAR DREDGES

These dredges are suitable for hard, rocky substrates, deep waterbodies, and streams with fast currents. Ponars have top screens and side plates to prevent sample loss during retrieval.

- Open the jaws and place the cross bar into the proper notch.
- Lower the dredge to the bottom, making sure it settles flat.
- When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.
- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval.
- Open the jaws and transfer the sediment to sample containers or to a mixing tray.

6.2 ECKMAN DREDGE

The Eckman dredge works best in soft substrates in waterbodies with slow or no flow.

- Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.
- Lower the dredge to the bottom, making sure it settles flat.
- Holding the line taut, send down the message to close the jaws.
- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval.
- Open the jaws and transfer the sediment to sample containers or a mixing tray.

7. REFERENCES

None.

Standard Operating Procedure No. 022
for
Sediment and Benthic Macroinvertebrate Sampling with Eckman Grab

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1. SCOPE AND APPLICATION

This Standard Operating Procedure covers the protocol for obtaining qualitative or quantitative samples of soft sediments and macroinvertebrates inhabiting soft sediments in lakes, reservoirs, and other waterbodies. The Eckman grab sampler is well suited to collecting samples in deeper (up to 100 ft) waterbodies.

Use of brand names in this Standard Operating Procedure is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable standard operating procedures for the maintenance and calibration of same.

2. MATERIAL

The following materials may be required:

Eckman grab sampler: a box-shaped device with two scoop-like jaws	Sample containers
Boat	Sieve – 500 µ (U.S. Standard No. 30)
Personal protective equipment	Stainless steel spoon or trowel
Personal flotation devices	

3. PROCEDURES

The following is a summary of procedures on use of the Eckman grab sampler:

- Cock the sampler by raising each jaw upward into the cocked position using the attached able and secure the cable to the catch pin located at the top of the sampler.
- Once cocked, lift the sampler overboard and lower slowly but steadily to the bottom.
- Once on the bottom, indicated by a slack line, the weighted messenger is sent down the line tripping the catch mechanism, causing the spring loaded jaws to close the bottom of the sampler, containing the sediment.
- Raise the sample at a slow but steady rate to prevent sample loss or washout.
- Once the sample is on board, empty the sample into a stainless steel, polytetrafluoroethelyne, or polytetrafluoroethelyne-lined bowl or tray for processing.
  - If the sediment will be analyzed for volatile organic compounds, transfer the sample into the appropriate sample containers immediately.

- If the sediment will not be analyzed for volatile organic compounds, use Stainless steel spoon to thoroughly homogenize sample, then transfer sample into appropriate containers. Add preservative (if required) and place in ice-filled chest.

  — If benthic macroinvertebrates are to be collected, sieve sample and transfer macroinvertebrates into appropriate container.

- Thoroughly decontaminate the device.

4. MAINTENANCE

Maintain according to manufacturer's suggestions.

5. PRECAUTIONS

The following precautions should be taken while using an Eckman grab sampler:

- Inspect the device for mechanical deficiencies prior to its use.
- This sampler is inefficient in waters deeper than approximately 75-100 ft, under adverse weather conditions, and in waters of moderate to strong currents or wave action.
- Exercise caution at all times once the grab is loaded or cocked because a safety lock is not part of the standard design.
- Operate the sampler from a boat with a winch and cable.
- Wear gloves when collecting sediment samples. Be sure to consult the health and safety plan for the proper dermal and respiratory protection prior to collecting any samples.
- Higher levels of personal protective equipment may be required by the Health and Safety Plan.
- While sampling from a boat in waterbodies with a depth of 5 ft or more, the sampling team will wear personal flotation devices (life jackets).
- Collect samples first from those areas that are suspected of being the least contaminated, thus minimizing the risk of cross-contamination.

6. REFERENCES

American Society for Testing and Materials. Standard 2.1. D4387 Guide for Selecting Grab Sampling Devices for Collecting Benthic Macroinvertebrates.

U.S. Environmental Protection Agency. 1990. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters. Office of Research and Development. EPA/600/4-90/030. November.

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Standard Operating Procedure No. 023
for
Organic Vapor Analyzer

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for field operations with the organic vapor analyzer (OVA) (Foxboro Model 128 GC). The OVA is an intrinsically safe, flame ionization detector designed to detect and measure organic vapor concentrations by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. This information is used to determine control measures such as protection and action levels.

Use of brand names in this Standard Operating Procedure is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable standard operating procedures for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

Probe/readout assembly	Fuel (zero grade hydrogen - 99.999 percent)
Sidepack assembly	Tygon tubing
Tedlar bag	Regulator
Calibration gas (e.g., methane 90-100 ppm)	

3. PROCEDURES

3.1 OPERATING PROCEDURES

- Connect the Probe/Readout Assembly to the Sidepack Assembly by attaching the sample line and the electronic jack to their respective receptacles located on the side of the Sidepack.

- Check the battery condition by moving the INSTRUMENT toggle switch to the “BATT.” position and ensure that the meter needle is beyond the white BATTERY OK line.

- Move the INSTRUMENT toggle switch to the ON position, and allow a 5-minute warm-up.

- Adjust the CALIBRATION ADJUST knob to set the meter needle to the level desired for activating the audible alarm. If the alarm level is other than zero, the CALIBRATION range toggle switch must be set to the appropriate range (i.e., X1, X10, or X100).

- Turn the ALARM VOLUME knob fully clockwise.

- Using the ALARM LEVEL ADJUST knob (located on the back of the Probe/Readout Assembly), turn the knob until the audible alarm is activated.

- Move the CALIBRATION range toggle switch to the X1 position and adjust the meter reading to zero using the CALIBRATION ADJUST knob.

- Turn the PUMP toggle switch ON. Place the instrument in the vertical position. Observe the SAMPLE FLOW RATE tube. Ensure flow rate is between 1.5 and 2.5 units.

- Open the H2 TANK valve and the H2 SUPPLY valve; wait 1 minute for hydrogen to purge the system.

- Press the red IGNITER BUTTON (located on the side of the Sidepack Assembly) until the alarm sounds and the needle on the Probe/Readout Assembly jumps upscale. CAUTION: THE IGNITER BUTTON SHOULD NOT BE DEPRESSED FOR MORE THAN 8 SECONDS. IF FLAME DOES NOT LIGHT WITHIN 8 SECONDS, WAIT 1 MINUTE AND TRY AGAIN.

- The instrument is ready for use. Use the CALIBRATION ADJUST knob to zero out ambient background organics.

3.2 SHUT-DOWN PROCEDURES

- Close H2 TANK VALVE
- Close H2 SUPPLY VALVE
- Move “INSTRUMENT” BATT/OFF/ON toggle switch to OFF.
- Wait 5 seconds and move the “PUMP” toggle switch to OFF.

3.3 FUEL RE-FILLING

WARNING: THERE SHOULD BE NO POTENTIAL IGNITERS OR FLAMES IN THE AREA.

- The instrument and charger should be completely shut down prior to hydrogen tank refilling operations. Refilling should be done in a well ventilated non-hazardous area.

- If this is the first filling of the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen prior to filling the instrument tank.

- The filling hose should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED valve on the instrument end of the hose is in the OFF position. Connect the hose to the refill connection on the Sidepack Assembly.

- Open the hydrogen supply bottle valve slightly. Open the H2 REFILL VALVE and the H2 TANK VALVE on the instrument and place the FILL/BLEED valve on the filling hose assembly to the FILL position.

- After the fuel tank is filled, close the H2 REFILL VALVE on the instrument, close the FILL/BLEED valve on the refill hose, and close the valve on the hydrogen supply bottle.

- The hydrogen trapped in the refill hose must now be bled off. CAUTION: THE REFILL HOSE WILL CONTAIN A SIGNIFICANT AMOUNT OF HYDROGEN AT HIGH PRESSURE. Turn the FILL/BLEED valve on the filling hose to the BLEED position. After the hose is bled down to atmospheric pressure, the FILL/BLEED valve should be turned to the FILL position to allow the hydrogen trapped in the connector fittings to move into the hose assembly. Turn the FILL/BLEED valve to the BLEED position and exhaust the trapped hydrogen. Then turn the FILL/BLEED valve to the OFF position to keep the remaining hydrogen in the hose at one atmosphere to ensure no air will be trapped in the hose for the next filling.

- Close the H2 TANK VALVE.

- Observe the H2 TANK PRESSURE meter and ensure that the pressure reading does not decrease rapidly.

3.4 CALIBRATION

Field calibration is accomplished using a single known sample of methane in air in the range of 90-100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work. The following summarizes calibration procedures:

- Place instrument in normal operation with the CALIBRATION range toggle switch set to X10 and the GAS SELECT KNOB SET TO 300.

- Use the “CALIBRATION” ADJUST knob to adjust the meter reading to zero.

- Fill a Tedlar bag with methane sample of known concentration (between 90 and 100 ppm) and connect to the OVA sample probe.

- Adjust the CALIBRATION GAS SELECT KNOB until the meter reading is equivalent to the value of the gas standard.

- Record in a field log book: date, time, location, instrument identification number, calibration gas and concentration, final GAS SELECT setting, and the name of the person calibrating the instrument.

3.5 BATTERY CHARGING

WARNING: NEVER CHARGE BATTERY IN A HAZARDOUS ENVIRONMENT

- Insert battery charger cable into the battery pack RECHARGER receptacle. Plug battery charger into 115 VAC outlet.
- Turn battery charger on.
- Approximately 1 hour of charging is required for each hour of use, however, an overnight charge is recommended. The charger can be left on indefinitely without damage to the batteries. When finished, turn the charger off and disconnect the charger from the battery.

4. PRECAUTIONS

The following precautions should be exercised while using the OVA:

- Keep battery on charger when not in use, and recharge battery as soon as possible after use.
- Avoid intake of boiling vapors and liquids.
- Avoid over-tightening of valves.
- Use zero grade H2 (99.999 percent, certified total hydrocarbons as methane <0.5 ppm recommended).
- Calibration gas mixture must be balanced in air.
- Do not over tighten valves.

5. REFERENCES

Foxboro OVA 128 Reference Manual. 1985. December.

ICF Field Equipment Manual. 1988. November.

Standard Operating Procedure No. 025
for
Soil Sampling

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for sampling surface and subsurface soils. Soil samples give an indication of the area and depth of site contamination, so a representative sample is very important.

2. MATERIALS

The following materials may be required:

Bucket auger or push tube sampler	Split-spoon, Shelby tube, or core barrel sampler
Drill rig and associated equipment	Stainless steel bowl
Personal protective equipment as required by the Health and Safety Plan	Stainless steel spoon, trowel, knife, spatula (as needed)

3. PROCEDURE

3.1 SUBSURFACE SAMPLES

Don personal protective equipment. Collect split-spoon, core barrel, or Shelby Tube samples during drilling. Upon opening sampler, or extruding sample, immediately screen soil for volatile organic compounds using either a photoionization detector or flame ionization detector. If sampling for volatile organic compounds, determining the area of highest concentration, use a stainless steel knife, trowel, or laboratory spatula to peel and sample this area. Log the sample in the Field Logbook while it is still in the sampler. Peel and transfer the remaining sample in a decontaminated stainless steel bowl. Mix thoroughly with a decontaminated stainless steel spoon or trowel. Place the sample into the required number of sample jars. Preserve samples as required. Discard any remaining sample into the drums being used for collection of cuttings. Decon sampling implements. All borings will be abandoned.

NOTE: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. The Field Logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Samples taken for geotechnical analysis will be undisturbed samples, collected using a thin-walled (Shelby tube) sampler.

3.2 SURFICIAL SOIL SAMPLES

Don personal protective equipment. Remove vegetative mat. Collect a sample from under the vegetative mat with a stainless steel trowel, push tube sampler, or bucket auger. If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite as follows:

- As each sample is collected, place a standard volume in a stainless steel bowl.
- After all samples from each hole or area are in the bucket, homogenize the sample thoroughly with a decontaminated stainless steel spoon or spatula.

If no compositing is to occur, place sample directly into the sample jars. Place the leftover soil in the auger borings and holes left by sampling. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas. Samples for volatile organic compounds will not be composited. A separate sample will be taken from a central location of the area being composited and transferred directly from the sampler to the sample container. Preserve samples as required. Decon sampling implements.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the Health and Safety Plan.

Soil samples will not include vegetative matter, rocks, or pebbles, unless the latter are part of the overall soil matrix.

6. REFERENCES

ASTM International. Method D1586-84, Penetration Test and Split-Barrel Sampling of Soils.

———. Method D1587-83, Thin Walled Sampling of Soils.

Department of the Army, Office of the Chief of Engineers. 1972. Engineer Manual 1110-2-1907 Soil Sampling. 31 March.

Standard Operating Procedure No. 028
for
Well and Boring Abandonment

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocols by which all wells and borings will be safely abandoned. The primary objective of well abandonment is to ensure that the abandoned well or boring does not provide a conduit for the vertical migration of contamination between aquifers.

2. MATERIALS

The following materials may be required:

Drill rig	Bentonite pellets (seal)
Filter pack material	Cement (Portland Type II)
Pure sodium bentonite with no additives (bentonite) powder (grout)	Approved water

3. PROCEDURE

The procedures used in boring abandonment will ideally accomplish two objectives: (1) protect aquifers from cross-contamination by sealing the borehole, and (2) restore the strata in the borehole to nearly original conditions by selective placement of fill material.

Any casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site or cluster.

If the hole is within 10 ft of a monitoring well in the same aquifer, or a replacement well is to be installed within 10 ft of the well, any temporary casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be backfilled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2 ft or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, 2 ft of bentonite will be placed above the sand and a 3-ft concrete plug will be placed at the surface. Otherwise, backfill materials will be placed from the bottom of the hole to within 3 ft of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 10 ft of another monitoring well, or if there are no substantial, continuous sand bodies, and no replacement well is planned within 10 ft of the original well location, then the hole may be grouted from the bottom to the top.

3.1 GROUT

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, Type II or V)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- 8 gal (maximum) approved water per 94-lb bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement.

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe removal and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout flows from the boring at ground surface. Efforts will be made to grout incrementally as the temporary casing is removed.

After 24 hours, the abandoned drilling site will be checked for grout settlement. On that day, any settlement depression will be filled with grout and rechecked 24 hours later. This process will be repeated until firm grout remains at the ground surface.

3.2 BORINGS

The term “Borings” as used in this Standard Operating Procedure applies to any drilled hole made during the course of a remedial investigation which is not completed as a well. This includes soil test borings, soil sampling borings, and deep stratigraphic borings. Whether completed to the planned depth or aborted for any reason prior to reaching that depth, borings will be grouted and normally closed within 4 hours, or within 4 hours or completion of logging of completion of logging.

3.2.1 Shallow Borings not Penetrating Water Table

Shallow borings made for the collection of subsurface soil samples will be abandoned by backfilling the hole with cuttings from the hole, **if and only if the boring does not penetrate the water table.** Clean sand will be used to make up any volume not filled by the cuttings.

3.2.2 Borings Penetrating the Water Table

Shallow borings made for the collection of subsurface soil samples **which penetrate the water table** will be abandoned by grouting the hole from the bottom to the top.

3.2.3 Deep Stratigraphic Borings

Deep stratigraphic borings will normally be located in areas which, by virtue of the historical record, are presumed relatively uncontaminated. Therefore, these borings are usually over 100 ft from any sampling well locations. Any boring located within 10 ft of a proposed well location, or located directly upgradient or downgradient (on anticipated flow line) of a proposed well location, will be abandoned by placing clean sand in the aquifer intervals and bentonite or grout in aquitard intervals as described above. If the boring is over 10 ft from and/or not upgradient of a proposed well location, the boring will be completely filled with grout.

3.3 WELLS

The following procedure applies to wells aborted prior to completion and existing wells determined to be ineffective or otherwise in need of closure.

Prior to abandoning any developed well, the proper well licensing body will be provided written notification along with an abandonment plan for that well.

If the well is within 10 ft of another monitoring well in the same aquifer, or a replacement well is to be installed within 10 ft of the well, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be backfilled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2 ft or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, 2 ft of bentonite will be placed above the sand and below the concrete plug near the surface. Backfill materials will be placed from the bottom of the hole to within 3 ft of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 10 ft of another monitoring well, and is not to be replaced by another well within 10 ft of the original location, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

4. REPLACEMENT WELLS

Replacement wells (if any) will normally be offset at least 10 ft from any abandoned well in a presumed upgradient or crossgradient groundwater direction. Site-specific conditions may necessitate variation to this placement.

5. PRECAUTIONS

None.

Standard Operating Procedure No. 036
for
Turbidity Measurements (DRT 100)

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring the turbidity of all types of aqueous solutions, including drinking water, saline water, and industrial and domestic wastes. Turbidity is an indication of the optical properties that cause light to be scattered or absorbed through an aqueous sample. Turbidity is largely a function of the refractive index and the size and shape of the particles suspended or dissolved in the solution. Turbidity meters do not produce an "absolute" measurement, but one that is "relative" to the optical nature of the solids in solution.

Use of brand names in this SOP is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable SOPs for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

Turbidity meter (DRT 100 or equivalent)
Lint free laboratory wipes (Kimwipes or equivalent)
Formazin standards (from manufacturer)
Sample bottle
Cuvettes

3. PROCEDURE

Calibration of the turbidity meter will be checked on a daily basis as follows:

- Set the range switch to 1000 range before turning the turbidity meter on and whenever the light shield is not in place over the sample well.
- Allow the turbidity meter 15-60 minutes to warmup.
- Clean the reference standard with kimwipes.
- Place the formazin suspension or reference standard in the turbidity meter sample well.
- Place the light shield over the reference standard.
- Rotate the front panel range switch counterclockwise to the appropriate nephelometric turbidity unit range.

- Adjust the reference adjust knob counterclockwise to read the same value as the reference standard value. This value is stamped on top of the reference standard.
- The turbidity meter is now standardized on all ranges to the factory formazin calibration and unknown samples may be read directly in nephelometric turbidity unit, feeder terminal unit, or Jackson turbidity unit.
- Rotate the range switch clockwise to the 1000 range before removing the reference standard.
- Record reading in field logbook (Refer to SOP Nos. 003 and 016).
- Do not leave the reference standard in the sample well for long periods.

Turbidity will be measured as follows:

- Pour aqueous sample into a new cuvette assuring no air bubbles.
- Place the cuvette into the sample well.
- Place the light shield over the sample.
- Rotate the range switch counterclockwise to the range which provides best readability and sensitivity for the sample being measured.
- Allow the turbidity meter to stabilize before recording the nephelometric turbidity unit value.
- Turn the range switch clockwise to the 1000 range and then remove the sample.
- Do not leave the filled cuvette in the sample well for long periods.
- Repeat above steps for additional samples.

Cuvette cleaning procedure is as follows:

- Cuvette must be clean and free of rubs or scratches.
- Wash the cuvette in a detergent solution.
- Rinse thoroughly 8-10 times, preferably with distilled water to remove all streaks.
- Polish with kimwipes.
- Cuvettes must be stored in a clean dust-free environment.

4. MAINTENANCE

Source lamp may be replaced as follows:

- Remove the instrument case per manufacturer instruction.
- Remove the bulb by loosening a screw and removing the electrical leads.
- Insert the new bulb and reconnect the electrical leads.
- Before tightening the screw, be sure to position the filament so that it will be parallel to the axis of the sample well.
- Insert the lamp alignment tool in the sample well to focus the new bulb.
- Move the lamp bracket assembly in or out until a focused image of the filament is within the rectangular box on the lamp alignment tool.
- Once the filament image has been aligned and focused within the rectangular box on the lamp adjustment tool, tighten all screws snugly.
- Replace the instrument case.

5. PRECAUTIONS

Handle the reference standard or sample cuvettes by the top to prevent surface scratches or finger smudges which will cause analysis errors.

Check the mechanical meter zero when the instrument is in a vertical position and the power switch is off. Adjust to zero only if necessary by means of the black screw on the meter face.

The turbidity meter should be left on for the entire work shift to minimize warm-up and recalibration delays.

Do not leave the reference standard or filled curvette in the sample well for long periods.

Leave the light shield in place on the instrument when it is not in use in order to protect the sample well for long periods.

Always set the range switch to 1000 range before turning the instrument on and whenever the light shield is not in place over the well.

6. REFERENCES

Manufacturer's Manual.

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Standard Operating Procedure No. 037
for
Dissolved Oxygen Measurements
(YSI Model 57)

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring the dissolved oxygen (DO) of all types of aqueous solutions, including drinking water, saline water, and industrial and domestic wastes. DO is a measurement of the amount of soluble oxygen in an aqueous solution. It is a general indication of an aerobic/anaerobic condition of a water sample.

Use of brand names in this SOP is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable SOPs for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

DO meter (YSI Model 57 or equivalent)
Self-stirring biological oxygen demand bottle probe
Membrane standards
Biological oxygen demand bottle

3. PROCEDURE

3.1 SETUP

It is important that before the meter is prepared for use and calibrated, it should be placed in the intended operating position, i.e., vertical, tilted, or horizontal. The instrument may need readjustment if the operating position is altered. The setup procedures should be as follows:

- With the switch set to **OFF**, adjust the meter pointer to zero with the screw in the center of the meter panel.
- Switch to **RED LINE** and adjust the **RED LINE** knob until the meter needle aligns with the red mark if necessary.
- Switch to **ZERO** and adjust to 0 mg/L scale with the **ZERO** control knob.
- Attach the prepared probe to the **PROBE** connector of the instrument and adjust the retaining ring finger tight.
- Before calibrating, allow 15 minutes for optimum probe stabilization. Repolarize whenever the instrument has been **OFF** or the probe has been disconnected.

3.2 CALIBRATION

Calibration is accomplished by exposing the probe to a known oxygen concentration, such as water-saturated air (%), or water of a known oxygen content (mg/L), and then adjusting the calibration controls so the display shows a reading matching the oxygen concentration of the known sample. Calibration can be disturbed by physical shock, touching the membrane, and fouling of the membrane or drying out of the electrolyte. Calibration will be checked after each series of measurements. Calibration of the DO meter will be performed on a daily basis as follows:

1. Place the probe in moist air. Biological oxygen demand probes can be placed in partially filled (50 ml) biological oxygen demand bottles. Wait 10 minutes for temperature to stabilize ± 2°C.

2. Switch to **TEMPERATURE** and read. Refer to Table SOP037-1 for solubility of oxygen in fresh water (calibration value).

3. Determine altitude or atmospheric correction factor from Table SOP037-2.

4. Multiply the calibration value from Table SOP037-1 by the correction factor from Table SOP037-2 to obtain the correct calibration value.

   EXAMPLE: Assume a temperature of 20°C and an altitude of 1,100 ft. From Table SOP037-1, the calibration value of 20°C is 9.09 mg/L. From Table SOP037-2, the correction factor for 1,100 ft is 0.96. Therefore, the corrected calibration value is 9.09 mg/L × 0.96 = 8.73 mg/L.

5. Switch to the appropriate mg/L range, set the **SALINITY** knob to zero and adjust the **CALIBRATE** knob until the meter reads the calibration value from Step 4. Wait 2 minutes to verify calibration stability. Readjust if necessary.

3.3 DISSOLVED OXYGEN MEASUREMENT

- With the instrument prepared for use and the probe calibrated, place the probe in the sample.

- Turn the **STIRRER** knob **ON**.

- Adjust the **SALINITY** knob to the salinity of the sample if appropriate.

- Allow sufficient time for the probe to equilibrate to the sample temperature and DO.

- Read DO on appropriate scale.

- Before measuring the DO of the next sample, rinse probe and sample bottle with distilled water and then with next water sample.

Follow steps above for the next sample(s).

The DO meter should normally be left on during the working day to avoid the delay of waiting for probe repolarization.

4. MAINTENANCE

The following steps will be taken to maintain the DO meter:

- Replace the batteries when the **RED LINE** knob is at its extreme adjustment or at least annually.

- In the **BATT CHECK** position on the **STIRRER** knob, the voltage of the stirrer batteries is displayed on the red **0-10** scale. Do not permit them to discharge below 6 volts.

- Replace membrane every 2 weeks depending on application. Probes will be stored in a humid environment to prevent drying out.

5. PRECAUTIONS

The DO meter case is water resistant when properly closed. As a precaution against damaged gaskets or loose fittings, the instrument case will be opened and inspected for moisture whenever the instrument has been subjected to immersion or heavy spray. The case is opened by removing the screws on the rear cover an lifting the cover off.

6. REFERENCES

Manufacturer's handbook.

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TABLE SOP037-1 SOLUBILITY OF OXYGEN IN WATER EXPOSED TO WATER SATURATED AIR AT 760 mm Hg PRESSURE

Temperature (°C)	Solubility (mg/L)	Temperature (°C)	Solubility (mg/L)	Temperature (°C)	Solubility (mg/L)
0	14.62	17	9.67	34	7.07
1	14.22	18	9.47	35	7.95
2	13.83	19	9.28	36	7.84
3	13.46	20	9.09	37	6.73
4	13.11	21	8.92	38	6.62
5	12.77	22	8.74	39	6.52
6	12.45	23	8.58	40	6.41
7	12.14	24	8.42	41	6.31
8	11.84	25	8.26	42	6.21
9	11.56	26	8.11	43	6.12
10	11.29	27	7.97	44	6.02
11	11.03	28	7.83	45	5.95
12	10.78	29	7.69	46	5.84
13	10.54	30	7.56	47	5.74
14	10.31	31	7.43	48	5.65
15	10.08	32	7.31	49	5.56
16	9.87	33	7.18	50	5.47

NOTE: Derived from 17th Edition, Standard Methods for the Examination of Water and Wastewater.
°C = Degree Celsius.
mg/L = Milligram per liter.

TABLE SOP037-2 CALIBRATION VALUES FOR VARIOUS ATMOSPHERIC PRESSURES AND ALTITUDES

Pressure			Altitude		Calibration Value (Percent)
Inches Mercury	Millimeter Mercury	Kilopascal	Feet	Meter	
30.23	768	102.3	-276	-84	101
29.92	760	101.3	0	0	100
29.61	752	100.3	278	85	99
29.33	745	99.3	558	170	98
29.02	737	98.3	841	256	97
28.74	730	97.3	1126	343	96
28.43	722	96.3	1413	431	95
28.11	714	95.3	1703	519	94
27.83	707	94.2	1995	608	93
27.52	699	93.2	2290	698	92
27.24	692	92.2	2587	789	91
26.93	684	91.2	2887	880	90
26.61	676	90.2	3190	972	89
26.34	669	89.2	3496	1066	88
26.02	661	88.2	3804	1160	87
25.75	654	87.1	4115	1254	86
25.43	646	86.1	4430	1350	85
25.12	638	85.1	4747	1447	84
24.84	631	84.1	5067	1544	83
24.53	623	83.1	5391	1643	82
24.25	616	82.1	5717	1743	81
23.94	608	81.1	6047	1843	80
23.62	600	80.0	6381	1945	79
23.35	593	79.0	6717	2047	78
23.03	585	78.0	7058	2151	77
22.76	578	77.0	7401	2256	76
22.44	570	76.0	7749	2362	75
22.13	562	75.0	8100	2469	74
21.85	555	74.0	8455	2577	73
21.54	547	73.0	8815	2687	72
21.26	540	71.9	9178	2797	71
20.94	532	70.9	9545	2909	70
20.63	524	69.9	9917	3023	69
20.35	517	68.9	10293	3137	68
20.04	509	67.9	10673	3253	67
19.76	502	66.9	11058	3371	66

NOTE: Derived from 17th Edition, Standard Methods for the Examination of Water and Wastewater.

Standard Operating Procedure No. 038
for
Redox Potential Measurements

Prepared by

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for measuring the redox of flooded sediment and soil. Redox is an indication of the reduction of oxidation intensity of an anaerobic system. Redox will be expressed in mV. A complete anaerobic system redox potential is -150 Mv. A positive value indicates an aerobic system.

Redox measurement in a natural system is difficult to obtain due to the absence of true equilibria, heterogeneity of media, and pH effects deprived redox measurements in natural media of precise thermodynamic significance (Ponnamperuma 1972). Despite the difficulties involved in the redox measurements in natural media, it is widely accepted that redox readings in natural anaerobic systems can provide valuable environmental information. Whitfield found redox useful as a semi-quantitative indicator of the degree of stagnation of a particular aquatic environment as did Ponnamperuma for flooded soils and sediments. The redox measurements of natural waters are not representative of that median, since natural waters are in a highly dynamic state rather than in or near equilibrium, according to Stumm and Morgan 1970. It is generally recognized that redox measurements in oxygenated natural waters are invalid.

2. MATERIALS

The following materials may be required:

pH meter	Sample bottle
Combination pH electrode	Standard solution (pH 4 and 7 buffers saturated with quinhydrone)
Lint-free laboratory wipes (Kimwipes, or equivalent)	Wash bottle
Distilled water	

3. PROCEDURE

Calibration of the pH meter will be calibrated on a daily basis as follows.

- Prepare beaker of standard solution with known voltage(s)
- Connect electrodes to instrument
- Turn on and clear
- Rinse electrode with distilled water blot excess with laboratory wipes
- Immerse probe in beaker of standard solution
- Press mV key
- After the reading stabilizes, the absolute mV of solution is displayed.
- Rinse electrode and blot excess.

Redox will be measured after calibration as follows:

- Prepare sample in a beaker
- Rinse electrode and blot excess water
- Immerse electrode in sample and stir briefly
- Press mV switch
- Record the reading after it stabilizes
- For next sample(s), follow above steps.

4. MAINTENANCE

Check the batteries each time the meter is used.

Keep the probe stored in a 0.1 M KCL solution when not in use. Alternatively, the electrode may be rinsed with deionized water and trapping any residual water inside the protective cap.

5. PRECAUTION

Remove coatings of oil material or particulate matter that can impair electrode response by gentle wiping or detergent washing, followed by distilled water rinsing.

6. REFERENCES

Beckman Instruments, Inc. User Manual for 10, 11, and 12 pH/ISE meter.

Ponnamperuma, F.N. 1972. The Chemistry of Submerged Soils, Advances in Agronomy. Vol. 24.

Stumm, W. and J.J. Morgan. 1970. Aquatic Chemistry, Wiley, New York.

Whitfield, M. 1969. Eh as an Operational Parameter in Estuarine Studies. *Limnol. Oceanogr*., Vol. 14.

Standard Operating Procedure No. 039
for
Sample Preservation and Container Requirements

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1. PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to define the preservatives and techniques to be employed in preserving environmental samples between collection and analysis.

2. MATERIALS

The following materials may be required:

Containers (see Section 3 for description)	NaOH
HNO_3	Ice chests
H_2SO_4	Ice

3. DEFINITION OF CONTAINER TYPES

Listed below are the definitions of various container types.

Type	Container	Closure	Septum
A	80-ounce (oz) amber glass, ring handle bottle/jug, 38-millimeter (mm) neck finish	White polypropylene or black phenolic, baked polyethylene cap, 38-430 size, 0.015-mm polytetrafluoroethelyne (PTFE) liner	
B	40-mililiter (mL) glass vial, 24-mm neck finish	White polypropylene or black phenolic, open top, screw cap, 15-mm opening, 24-400 size	24-mm disc of 0.005-inch (in.) PTFE bonded to 0.120-in. silicon for total thickness of 0.125 in.
C	1-L high density polyethylene, cylinder-round bottle, 28-mm neck finish	White polyethylene cap, white ribbed, 28-410 size; F217 polyethylene liner	
D	120-mL wide mouth glass vial, 48-mm neck finish	White polyethylene cap, 40-480 size; 0.015-mm PTFE liner	
E	250-mL Boston round glass bottle	White polypropylene or black phenolic, open top, screw cap	Disc of 0.005-in. PTFE bonded to 0.120-in. silicon for total thickness of 0.125 in.
F	8-oz short, wide mouth, straight-sided, flint glass jar, 70-mm neck finish	White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.030-mm PTFE liner	
G	4-oz tall, wide mouth, straight - sided, flint glass jar, 48-mm neck finish	White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.015-mm PTFE liner	

Type	Container	Closure	Septum
H	1-L amber, Boston round, glass bottle, 33-mm pour-out neck finish	White polypropylene or black phenolic, baked polyethylene cap, 33-430 size; 0.015-mm PTFE liner	
K	4-L amber glass ring handle bottle/jug, 38-mm neck finish.	White polypropylene or black phenolic, baked polyethylene cap, 38-430 size; 0.015-mm PTFE liner	
L	500-mL high-density polyethylene, cylinder bottle, 28-mm neck finish	White polypropylene, white ribbed, 28-410 size; F217 polyethylene liner	

4. PROCEDURE

All containers described in Section 3 must be certified clean, with copies of laboratory certification furnished upon request. There may be circumstances when alternative containers will be used (e.g., aluminum foil around tissue samples placed in plastic bags, plastic buckets for large soil/sediment samples, etc.) for which laboratory certification may not be available. Such containering should be appropriately decontaminated or verified appropriately clean prior to using.

Water samples will be collected into pre-preserved containers appropriate to the intended analyte as given in Quality Assurance Project Plan. Samples taken for volatile organic compounds will be collected in accordance with SOP No. 003, Section 3.3.8. Samples taken for metals analysis will be verified in the field to a pH <2. The container should be tightly capped, then swirled to thoroughly mix the sample. The cap will then be loosened to release any excess pressure this operation may have generated. Samples taken for total phosphorous content will be verified in the field to a pH <2. The container should be tightly capped and swirled to thoroughly mix the sample. The cap will then be loosened to release any excess pressure this operation may have generated. Samples taken for cyanide will be verified for a pH >12. Most other samples do not require added preservation; however, there are analytes that may require special preservation, i.e., sulfide which requires a zinc acetate preservation. Preservation must be performed as documented in the project-specific Quality Assurance Project Plan. These samples will be immediately placed on ice and cooled to 4±2°C.

Soil and sediment samples will be collected into containers appropriate to the intended analyte as given in the Quality Assurance Project Plan. Samples taken for volatile organic compound analysis will collected in accordance with the site-specific SOP. Samples taken for metals analysis will be tightly capped, placed on ice, and maintained at a temperature of 4°C. Samples taken for total phosphorous content will be tightly capped, placed on ice, and maintained at a temperature of 4°C. Under most circumstances, no preservatives will be added to any other soil samples; follow project-specific requirements as documented in the Quality Assurance Project Plan. These samples will be immediately placed on ice and cooled to 4±2°C.

5. MAINTENANCE

Not applicable.

6. PRECAUTIONS

Note that acidifying a sample containing cyanide may liberate HCN gas.

- Avoid breathing any fumes emanating from acidified samples.
- Acidify samples only in the open, rather than in closed spaces, i.e., a vehicle.
- Hold suspected HCN-generating sample away from body and downwind while manipulating it.
- See the Health and Safety Plan for other safety measures.

7. REFERENCES

U.S. Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste, SW-846.

———. 1987. A Compendium of Superfund Field Operations Methods, EPA 540-P87-001.

———. 1991. A Compendium of ERT Soil Sampling and Surface Geophysics Procedures.

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Standard Operating Procedure No. 042
for
Disposal of
Investigation-Derived Material

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to define the required steps for disposing of investigation-derived material (IDM) generated during field activities.

IDM, as used herein, includes soil cuttings, drilling muds, extraneous sediment, purged groundwater, decontamination fluids, and disposable personal protective equipment. For the sake of clarity and ease in use, this Standard Operating Procedure is subdivided into procedures for disposal of liquid IDM and solid IDM as follows:

- Liquid IDM (Section 3.2) includes the following materials:
  - Water from initial development of new wells and the redevelopment of existing wells
  - Purge water from groundwater sampling
  - Decontamination fluids (Section 3.4)
- Solid IDM (Section 3.3) consists of the following materials:
  - Soil drill cuttings from monitoring well installation
  - Sediment remaining after collection of the required sample volume
  - Grout, a mixture of cement and bentonite, generated during installation of monitoring wells
  - Disposable personal protective equipment (Section 3.4).

2. MATERIALS

The following materials may be required:

Any additional equipment that may be dictated by project or site-specific plans	Hazardous waste labels
Bar codes	Permanent marker
Chain-of-custody forms	Field logbook (bound)
Department of Transportation 17C specification metal containers	Waste identification labels

3. PROCEDURE

3.1 GENERAL

No container will be labeled as a “Hazardous Waste” unless the contents are in fact known to be hazardous as defined by 40 Code of Federal Regulation 261.

IDM may be disposed onsite if it is: (1) initially screened, or evaluated to determine whether it is contaminated; (2) not abandoned in an environmentally unsound manner; and (3) not inherently waste-like.

IDM is to be considered contaminated if: (1) it is visually or grossly contaminated; (2) it has activated any field monitoring device that indicates that the level exceeds standard Level 1; (3) it has previously been found to exhibit levels of contamination above environmental quality standards; and (4) the responsible party and/or appropriate regulator deem(s) that records of historical uses indicate that additional testing of the IDM is needed, or additional caution is warranted handling IDM from a given site.

3.2 PROCEDURES FOR LIQUID INVESTIGATION-DERIVED MATERIAL DISPOSAL

Listed below are the procedures for the disposal of liquid IDM:

1. All water from the initial development of new wells, and purge water generated during the first round of groundwater sampling, will be containerized in Department of Transportation approved 55-gallon drums. Decontamination fluids may be bulk-containerized until completion of the field task.

2. Label all containers as to type of media, date the container was sealed, point-of-generation, and points-of-contact. The well number and container number will be identified on the container.

3. The contractor/support personnel will log all media generated onsite into a bound Field Logbook. Media information should include the following: date of generation, contents of containers, number of containers with the same contents (if applicable), location of containers, well number the media is associated with, personnel sampling the media, sampling dates, and sampling results.

4. Containers of well development water and purge water may be stored at the well site pending the first round analytical results.

5. Laboratory turnaround time must be no greater than 30 days. Upon receipt of the analytical results, a copy will be furnished to the client within 3 working days. Both the client and contractor will evaluate the data to determine disposal requirements, per state and local regulations. A disposal decision is required within 10 days of receipt of sampling results. Appropriate disposal must be performed no later than 50 days from the

1. This value is defined as two times background, where "background" values are to be determined as follows: (1) regional background values will be used where they are available; and (2) if regional values are not available, background may be empirically determined at uncontaminated sampling sites using onsite sensors such as organic vapor analyzers (photoionization detector or flame ionization detector), scintillometers, etc.

decision date unless prevented by inclement weather (e.g., rain and muddy conditions may preclude site access, freezing weather may freeze media).

Dispose of media in accordance with Steps 6 and 7 of this procedure, as appropriate.

6. If the first round analytical data of the liquid media are below the Maximum Contaminant Levels established by the Federal Safe Drinking Water Act, the water may be gradually infiltrated into the ground at least 50 feet downgradient of the well.

   If the well location has no downgradient area, the water will be infiltrated into the ground in an area deemed appropriate by the client and the contractor/support personnel.

   Disposal locations must allow percolation of the water and prohibit "ponding."

   Upon completion of water discharge to ground, enter type of media, amount of media, date of disposal, and discharge point(s) in a bound Field Logbook and provide this information to the client.

   Empty containers are to be properly decontaminated, stored, and reused by the appropriate personnel.

   If the liquid media sampling results do not meet the required Maximum Contaminant Levels and cannot be discharged to the ground, then determine if the waste meets the sanitary sewer discharge criteria (National Pollutant Discharge Elimination System standards).

7. If, at any time, visual contamination of purge/development water is observed, or if organic vapor monitor readings (HNu, photoionization detector) register more than 5 parts per million above background and/or radiological meters register more than twice the background mrems, then the liquid will be drummed and a composite sample will be taken that day. A disposal decision will be based on the analytical results of this sample rather than the first round of analytical results.

3.3 PROCEDURES FOR SOLID INVESTIGATION-DERIVED MATERIAL DISPOSAL

Listed below are the procedures for the disposal of solid IDM:

1. If the conditions outlined in Section 3.1 are met, proceed to Section 3.3, Step 2; otherwise, proceed to Section 3.3, Step 7.

2. During soil drilling operations or sediment sampling, the resulting cuttings, mud, and/or extraneous sediment will be discharged onto the ground (or waterbody for sediment) near the well (or sample location for sediment) if the following conditions are met: (1) no visual contamination is observed, (2) organic vapors are less than 5 parts per million

above background, (3) radiological meter readings (if applicable) are under two times background, and (4) the medium has been screened and found to be less than two times background if the potential for contamination exists.

Proper sediment and erosion control measures will be implemented as follows:

- Soil drill cuttings will be uniformly spread and contoured to blend with the surroundings of the site.
- If amount of solid IDM exceeds 5,000 square feet or 100 cubic yards of material, a sediment and erosion control plan is required.
- If the amount of solid IDM is under 5,000 square feet or 100 cubic yards, the site will be stabilized as soon as possible. Stabilization includes mulch, seed, and tack.
- Critical areas require stabilization within 7 days from the date of well completion. Critical areas include swales, water sources, drainage ditches, etc.
- All other disturbed areas require stabilization within 14 days from the date of well completion.

3. If the well location is in or near a wetland, the soil drill cuttings will be drummed and transported away from the site for spreading.

4. Label all IDM containers that will not be spread on the day of generation. Each container should be labeled with the type of media, date the container was sealed, point-of-generation, and name of the contact person. The well number or sample location and container number should be identified on the container.

5. The contractor/support personnel will log all media generated onsite into a bound Field Logbook. Media information should include: date of generation, contents in containers, number of containers with the same contents, location of containers, and well number or sample location the media is associated with.

6. Containers will be staged at the well site until contractor/support personnel spread the cuttings in the appropriate locations, using proper sediment and erosion control measures per Section 3.3.

7. If soil drilling mud, cuttings, or sediment show visible contamination, or organic vapor readings are more than 5 parts per million above background levels, or radiological meter readings (if applicable) show greater than two times background levels, or if the potential for contamination exists (levels greater than two times background), media will immediately be containerized, labeled appropriately (Section 3.2), and sampled on the same day.

8. The solid IDM should be sampled and appropriate Toxicity Characteristic Leaching Procedure analyses conducted prior to determining disposition. Laboratory turn-around time must be no greater than 30 days. Upon receipt of analytical results, a copy will be furnished to the client within 3 working days. The contractor will evaluate the data to determine disposal requirements within 10 days. Appropriate disposal must be performed no later than 50 days after the decision date if weather permits (Section 3.2).

    - If the solid IDM is determined to be non-hazardous and uncontaminated, proceed to Section 3.3.

    - If the solid IDM is determined to be non-hazardous but contaminated, proceed to Section 3.3.

    - If the solid IDM is found to be hazardous wastes, proceed to Section 3.3.

9. If the solid IDM is not a hazardous waste **and** analytical data show contaminant concentrations below the U.S. Environmental Protection Agency Region 3 (or applicable Region where work is being performed) Risk-Based Concentrations, contact the appropriate federal, state, or local agency for approval to discharge onto the ground or back to the waterbody near the site of generation.

    - Follow steps detailed in Section 3.3, Step 2 (above) pertaining to sediment and erosion control.

    - Upon completion of the solid IDM discharge to the ground or waterbody (for sediment), enter type of media, amount of media, date of disposal, and discharge point(s) in a bound Field Logbook. This information must be provided to the client.

    - Empty containers are to be properly decontaminated, stored, and reused by appropriate personnel.

10. If the intrusive media is not a hazardous waste but analytical data show concentrations above the screening criteria, dispose of the IDM according to state and local regulations.

    - Ensure that the waste containers are properly labeled as applicable in accordance with Section 3.3, Step 4.

    - Inform the client of the type and amount of waste, and location of the waste.

    - When the waste is removed, enter the type of waste, amount of waste, date of pickup, and destination of the waste in a bound Field Logbook. This information must be provided to the client.

3.4 PROCEDURES FOR DECONTAMINATION SOLUTION AND PERSONAL PROTECTIVE EQUIPMENT DISPOSAL

Decontamination solutions include catch water from steam-cleaning operations performed on large sampling equipment, drill rigs, and drums, as well as smaller quantities of soapy water and rinse solutions used in decontaminating field sampling equipment. At the completion of the field event, a composite sample of the decontamination solution will be taken. The decontamination solution will be treated as liquid IDM pending results (Section 3.2).

Personal protective equipment will be containerized onsite, appropriately labeled, and disposed in a designated trash receptacle.

4. MAINTENANCE

The waste manifest document and bill of lading should be uploaded to the project file as soon as possible in either hard copy or electronic format. Refer to EA's Records Retention Policy for archiving information.

5. REFERENCES

Environment Article Section 7-201(t).

U.S. Environmental Protection Agency. 1991. Management of Investigation-Derived Wastes during Site Inspections PB91-921331, OERR Directive 9345.3-02. Office of Emergency and Remedial Response U.S. Environmental Protection Agency, Washington, D.C. May.

Standard Operating Procedure No. 047
Direct-Push Technology Sampling

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) establishes the protocol for using direct-push technology (DPT) in media sampling and performing subsurface characterization. This SOP includes the following DPT methods: Geoprobe®, Hydropunch®, Cone Penetrometer Testing (CPT), and Site Characterization and Analysis Penetrometer System (SCAPS).

2. MATERIALS

The following materials may be required:

Appropriately sized, all-terrain vehicle-skid-or track-mounted; DPT equipment; and supplies (i.e., hydraulic derrick and hammer assembly)	Personal protective equipment
Bentonite grout and clean sand for DPT hole abandonment	Phosphate-free, laboratory-grade detergent (e.g., Liquinox, Alconox, etc.)
DPT stainless steel rods	Source of approved water
Heavy plastic sheeting	Steam cleaner/sprayer and water obtained from approved source for decontaminating DPT equipment
Logbook	Steel drums for intrusion derived wastes (e.g., contaminated personal protective equipment, decon solutions, etc.)
Long-handled bristle brushes	Wash and rinse tubs
Mini-bailer or tubing and peristaltic pump (groundwater sampling only)	

3. GEOPROBE® AND HYDROPUNCH®

3.1 MATERIALS

Water sources for Geoprobe® and Hydropunch® activities, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the Geoprobe® and Hydropunch® equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the Geoprobe® and Hydropunch® equipment. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

3.2 GROUNDWATER – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site to facilitate aquifer characterization and analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all sampling and installation procedures, and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole Geoprobe® and Hydropunch® equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means.

- Drive the sampler to the desired groundwater sampling interval. At the desired depth, insert extension rods down the inside diameter of the probe rods until the extension reaches the bottom of the screen. Remove the probe rods and sampler sheath while holding the screen in place.

- Collect the groundwater sample in the screen interval with a mini-bailer, peristaltic or vacuum pump, or other acceptable small diameter sampling device.

- The head of the rod may be equipped with a sensing device for characterization of soil properties or the contaminant content.

The subcontractor will use the equipment-specific guidelines for installation of the Hydropunch® equipment. Rods will be forced into the ground by hydraulic means.

- The Hydropunch® tool is a double cylinder, designed to be sealed until the desired sampling depth is reached. Upon reaching the desired sampling depth, the outer cylinder is pulled back, exposing a perforated, stainless steel sampling barrel covered with filter material.

- The water sample enters the barrel and the sample is retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly. Groundwater is the only media that is sampled by Hydropunch® equipment.

- The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

- The sample volume collected with this technique is approximately 500-1,000 ml. Larger sample volumes can be collected by inserting tubing attached to a peristaltic pump into the rods to obtain water samples.

If desired, a small diameter monitoring well may be installed at this point. Refer to SOP No. 019 (Monitoring Well Installation).

If a well will not be installed, the rods will be removed as the borehole is simultaneously filled with a bentonite/grout mixture. A polyvinyl chloride (PVC) tube fed into the rod casing will allow the addition of grout.

3.3 SUBSURFACE SOIL – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site for characterization of the stratigraphy and for analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all DPT sampling and soil characterization. All procedures and soil characteristics will be fully documented in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole Geoprobe® equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means. Additional rods will be added in 3- to 4-ft increments until the leading edge of the sampler reaches the top of the desired sampling interval.

Once the desired sampling depth has been reached, insert extension rods down the inside diameter of the probe rods until it reaches the top of the sampler assembly. Attach the extension rod handle to the top extension rod. Turn the handle clockwise until the stop-pin detaches from the drive head. Remove the extension rods and the stop-pin. Attach a drive cap to the probe and drive the sampler approximately 2 ft using hydraulic derrick.

The DPT sampler can be retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly.

The liner will be capped with Teflon® tape and vinyl end caps. The liners can be split open to remove samples for composition analysis or for transfer to other containers for shipment to the laboratory for analysis.

The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

3.4 DECONTAMINATION

All Geoprobe® and Hydropunch® DPT equipment must be thoroughly cleaned before and after each use to allow retrieval of representative groundwater samples. Geoprobe® soil sample liners are disposed of after each use. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

After decontamination, a new clean liner will be installed and all parts will be inspected for wear or damage.

Refer to SOP No. 005 (Field Decontamination).

3.5 ABANDONMENT

Pure bentonite or a bentonite/grout mixture (20:1) will be used to fill the resulting borehole if the water table is penetrated. Boreholes that do not penetrate the water table will be backfilled with cuttings from the hole and topped with a bentonite seal. Clean sand will be used to fill any remaining volume in the borehole.

Abandonment of Geoprobe® and Hydropunch® generated DPT boreholes will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

4. CONE PENETROMETER TESTING

4.1 MATERIALS

A CPT rig typically consists of an enclosed 20- to 40-ton truck equipped with vertical hydraulic rams that are used to force a sensor probe into the ground. The weight of the CPT rig is dependent upon the thrust required at the site. The majority of CPT rigs are mounted in heavy-duty trucks that are ballasted to a total dead weight of approximately 15 tons. Screw anchors are utilized to develop the extra reaction to reach the maximum thrust of 20 tons. The rig is separated into two separate workspaces: data acquisition and hydraulic push areas.

Water sources for CPT activities and decontamination must be approved by the Project Manager prior to arrival of the CPT equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the DPT equipment. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

4.2 SUBSURFACE CHARACTERIZATION

The objective of this technology is to collect stratigraphic information using CPT equipment to determine subsurface stratigraphy and geotechnical properties at a particular site. CPT activities will be in accordance with American Society for Testing and Materials D 3441-86 and American Society for Testing and Materials D 5778-95. The stratigraphic information gathered can be used to facilitate the selection of DPT sampling screen intervals. At the same time, it is possible to install a 0.25-in. diameter pre-packed PVC monitoring well.

CPT rods are used to hydraulically push the CPT probe into the subsurface. Probes cannot be pushed into hard rock, and significant gravel or cobble content in the formation may impede or preclude penetration of the probe. The depth of penetration achievable depends on the type of formation, type of sampling probe, and size of the hydraulic equipment used.

The CPT probe includes the following components:

- A conical tip to measure vertical resistance beneath the tip.
- A friction sleeve to measure frictional resistance on the side of the probe, as a function of depth.

- Two internal strain gauge-type load cells, which independently measure the vertical resistance and side friction.

- A cone pressure gauge to measure the water pressure as the probe is pushed into the ground.

- Inclinometer to determine potential drifting of the probe (optional).

- Seismic transducers to perform downhole seismic surveys (optional). Therefore, stratigraphic data collected with the CPT include: tip resistance, local friction, friction ratio, pore pressure, and resistivity.

Data will be transferred from the probe to the data acquisition system or logger through an electrical cable. The hole will be advanced continuously at a rate of 0.6-1.0 in. per second. The data will be logged at every 0.4-0.8 in. of penetration. Monitor the probe's stratigraphic position will be monitored as it advances downward. Perform pore water pressure dissipation tests in representative hydrostratigraphic intervals. Record dissipated pore water pressures to represent hydraulic head values.

Once the confining unit underlying the surficial aquifer or the required depth has been reached, the CPT is pulled from the ground. Target interval samples can be collected during CPT hole advancement using direct push sampling techniques, i.e., Geoprobe® or Hydropunch® (Section 3).

4.3 DECONTAMINATION

All CPT equipment must be thoroughly cleaned before arrival at the work site, between test holes, and prior to being moved out of a work area. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

Refer to SOP No. 005 (Decontamination).

4 .4 ABANDONMENT

If the push hole was developed for the stratigraphic test only, once the testing is completed, grout the hole from bottom to top. If the hole has not collapsed after removing the CPT, PVC piping will be used to grout the hole. If the hole has collapsed after removing the CPT, then hollow CPT rods and a sacrificial tip will be used to grout the hole. The PVC pipe or CPT rods will be pushed to the bottom of the hole. Grout will then be pumped to the bottom of the hole as the PVC pipe or CPT rods are withdrawn.

Refer to SOP No. 028 (Well and Boring Abandonment).

5. SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM

5.1 MATERIALS

SCAPS cone penetrometer and laser induced fluorescence (LIF) technology requires the use of a specialized 20-ton truck. The truck has two separate enclosed compartments. Each compartment is temperature controlled and monitored for air quality. The two rooms are the data acquisition and processing room, and the hydraulic ram/rod handling room. Approximately 20 ft of overhead clearance is required to fully extend the hydraulic ram and allow for leveling jack movement.

All materials required to complete SCAPS analysis are provided by the subcontractor to include cone penetrometer equipment. All hydraulic equipment, SCAPS rods, nitrogen lasers, etc. are included within the vehicle. A decontamination water source and a source of water for mixing the grout are required.

Water sources for equipment decontamination must be approved by the Project Manager prior to arrival of the SCAPS equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the SCAPS equipment. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

5.2 HYDRAULIC PUSHING AND SAMPLING

The objective of the SCAPS technique is to allow grab samples and stratigraphic information to be collected at a selected site to facilitate subsurface characterization and for analysis of potential contaminants. The analytical results obtained can also be used to determine the placement of monitoring wells. At the same time, it is possible to install a small diameter well for sampling purposes. Refer to SOP No. 019 (Monitoring Well Installation). If a well will not be installed, the borehole can be grouted as the equipment is removed.

A site geologist will be present during all installation and sampling procedures and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole SCAPS equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after direct-push activities.

The subcontractor will use the equipment specific guidelines for installation of the SCAPS DPT equipment. Prior to SCAPS field activities, calibration soil samples will be collected and analyzed in order to determine the LIF sensor fluorescence threshold and detection limits for the site.

SCAPS LIF technology uses a pulsed nitrogen laser coupled with an optical detector to make fluorescence measurements via optical fibers. The LIF sensor is mounted on a cone penetrometer probe so that soil classification data and fluorescence data are collected simultaneously. The laser consumes nitrogen gas, which is supplied from cylinders stored on the accompanying trailer.

The SCAPS CPT sensors are used to gather stratigraphic information. See Section 4 for CPT operating procedures.

Target interval samples can be collected during SCAPS hole advancement using direct push sampling techniques such as Geoprobe® or Hydropunch® (Section 3).

5.3 DECONTAMINATION

Decontamination of SCAPS equipment is automated after initialization by a field team member. A pressurized hot water system is used to decontaminate the push rods as they are retracted from the ground. The SCAPS vehicle is equipped with a decontamination collar mounted to the bottom that cleans the rods. The decontamination water is removed by vacuum and transferred to a storage drum prior to disposal or treatment. A trailer attached to the back of the vehicle contains the water pump, heater for decontamination, and decontamination water containment drum.

Worker exposure is reduced by minimizing contact with contaminated media.

Refer to SOP No. 005 (Decontamination).

5.4 ABANDONMENT

SCAPS automatically grouts the penetrometer cavity as the rods are removed. The grout is pumped at high pressure through a 0.25-in. diameter tube in the center of the penetrometer rods. The tip is sacrificed at the bottom of the cavity to allow release of the grout.

A trailer attached to the back of the vehicle contains the 300-gal grout mixing bin and pump.

If the automatic grout feed does not work, the cavity will be manually filled with grout.

Abandonment of SCAPS generated borehole will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

6. MAINTENANCE

Not applicable.

7. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during intrusive activities.

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Standard Operating Procedure No. 048
for
Low-Flow Sampling

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1. GROUNDWATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING DEDICATED PUMPS

1.1 SCOPE OF APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to establish the protocol for collecting groundwater samples using dedicated pump systems. The procedure is designed to permit the collection of groundwater samples with minimum turbidity.

1.2 EQUIPMENT/MATERIALS

- Work Plan.
- Well construction data, location map, and field data from last sampling event.
- Field logbook and Field Record of Well Gauging, Purging, and Sampling forms (Figure SOP048-1).
- Electric water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations.
- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon®.
- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene tubing will be used.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (generator, etc.).
- Water quality indicator parameter monitoring instruments—pH, turbidity, specific conductance, and temperature. Optional indicators—Eh and dissolved oxygen.
- Flow-through cell (preferred) or clean container for water quality probes.
- Decontamination supplies (for monitoring instrumentation).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Cooler with bagged ice for sample bottles.
- Drum for purge water containment.

1.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and groundwater sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.

- Lay out sheet of polyethylene for monitoring and sampling equipment.

- Unlock well and remove well cap (if applicable).

- Measure VOCs with an ionization detector (flame or photo) instrument at the rim of the well and in the breathing zone, and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Dedicated sampling pumps should be positioned with the pump intake mid-point in the screened interval. If non-dedicated equipment is used, care will be taken to position pump or sampling hose intake at the screen mid-point.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will be measured following the completion of sampling because of the potential to stir up sediment at the bottom of the well.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and to the pump.

1.4 WELL PURGING AND SAMPLING PROCEDURE

The following general procedure should be followed to obtain representative groundwater samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Connect the flow-through cell or clean container containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/min, unless a different purge rate has been previously established for that well. Fill the flow cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and groundwater samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Record purge rate, volume purged, depth to water, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units (NTU) are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water at a well will be containerized if a well has exceeded the MEG or MCL in previous sampling events. Any purge water that is collected will be treated at the groundwater treatment plant.

- Prior to sampling, disconnect the discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in field logbook and sampling records.

- Begin filling sample containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the samples in the order below, as applicable:

  — VOCs
  — Inorganics.

- VOC samples requiring pH adjustment will have their pH checked to assure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Details on sample preservation are discussed in Section 1.5.

- Label each sample as collected. Those samples (VOCs, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Inorganic samples, after preservation, do not need to be cooled.

- After collection of the samples, restore the dedicated pumping assembly to the well by hanging the tube, electric line, and support cable inside the well by the specially-designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure SOP048-1) after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

1.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Pre-preserved bottles will be used if possible. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOCs—**Aqueous VOC samples must be collected as specified below. Each VOC sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HC1, and check the pH. Adjust the volume of HC1 to assure pH<2.

— Add the amount of HC1 determined in the above step, and fill the sample vial slowly from the tubing, minimizing air entrainment, until the vial slightly overflows.

— Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down and screw cap on.

— Invert the bottle, tap lightly, and check for air bubbles.

— If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

— Place samples on ice until shipment.

- **Inorganics—**Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples if necessary. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

1.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the groundwater samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each sample delivery group (SDG) (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate—Required at a frequency of 10 percent per SDG.

- Matrix Spike/Matrix Spike Duplicate—Required at a frequency of 5 percent.

- Equipment Rinsate Blank—Required once prior to installation of dedicated pump systems.

- Source Water Blank—Required at a frequency of once per source per sampling event when equipment (rinsate) blank is required.

- Trip Blank—Required for VOC samples at a frequency of one per sample shipment.

1.7 DECONTAMINATION

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Project Manager prior to sampling event. Decontamination fluids will be collected in a 5-gal bucket and treated at the groundwater treatment plant.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

2. GROUNDWATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING PERISTALTIC PUMPS

2.1 SCOPE OF APPLICATION

The purpose of this SOP is to establish the protocol for collecting groundwater samples using peristaltic pump systems. The procedure is designed to permit the collection of groundwater samples with minimum turbidity, and is intended to be used in conjunction with the analyses for the most common types of groundwater contaminants (VOCs and inorganic compounds).

2.2 EQUIPMENT/MATERIALS

- Work Plan.
- Well construction data, location map, field data from last sampling event.
- Field logbook and Field Record of Well Gauging, Purging, and Sampling forms (Figure SOP048-1).
- Water level measuring device, 0.01 ft accuracy (electronic preferred) for monitoring water level drawdown during pumping operations.
- Peristaltic pump.

- In-well tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene, PVC, Tygon, or polyethylene tubing may be used.
- Pump head tubing: Silicon tubing must be used to in the pump head assembly.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (battery, etc.).
- Water quality indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Optional indicators – Eh and dissolved oxygen.
- Flow-through cell (preferred) or clean container for water quality probe.
- Decontamination supplies (for monitoring instrumentation).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Cooler with bagged ice for sample bottles.
- Drum for purge water containment.

2.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and groundwater sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.
- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.
- Unlock well and remove well cap (if applicable).
- Measure VOCs with an ionization detector (photo or flame) instrument at the rim of the well and in the breathing zone and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad, or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will not be measured following the completion of sampling because of the potential to stir up sediment at the bottom of the well.

- Position the intake of the sampling hose at the mid-point of the screened interval.

- Prepare the pump by checking electrical connections and discharge tubing. Locate the battery downwind of the well; connect the peristaltic pump to the battery.

2.4 WELL PURGING AND SAMPLING PROCEDURES

The following general procedure should be followed to obtain representative groundwater samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Measure the water level with the pump in well before starting the pump. Begin purging the well at 0.3-0.5 L/min, unless a different purge rate has been previously established for that well.

- If well diameter permits, establish that the water level has not dropped significantly such that the pump is dry (air in discharge) or tubing suction is broken. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken, or entrainment of air in the pump system. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.3 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and groundwater samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collected the appropriate volume of samples with the pump.

- During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 NTU are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water at a well will be containerized if a well has exceeded the MEG or MCL in previous sampling events. Any purge water that is collected will be treated at the groundwater treatment plant.

- Prior to sampling, disconnect the sample discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing.

- Collect groundwater samples directly from the silicon tubing into preserved (when appropriate) sample containers. Begin filling sample containers from the pump discharge, allowing the water to fill the containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the samples in the order below, as applicable:

  — VOCs
  — Inorganics.

- VOC samples requiring pH adjustment will have their pH checked to assure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Detail on sample preservation are discussed in Section 2.5.

- Label each sample as collected. Those samples (VOCs, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Inorganic samples, after preservation, do not need to be cooled.

- After collection of the samples, restore the dedicated tubing assembly to the well by hanging the tube inside the well by the specially-designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure SOP048-1) after each well is sampled, including: sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

- The silicon tubing used in the peristaltic pump will be changed after use at each well.

2.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Pre-preserved bottles will be used if possible. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOCs—**Aqueous VOC samples must be collected as specified below. Each VOC sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HCL, and check the pH. Adjust the volume of HCL to assure pH<2.

  — Add the amount of HCL determined in the above step, and fill the sample vial slowly from the tubing, minimizing air entrainment, until the vial slightly overflows.

  — Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down, and screw cap on.

  — Invert the bottle, tap lightly, and check for air bubbles.

  — If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

  — Place samples on ice until shipment.

- **Inorganics—**Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples if necessary. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

2.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the groundwater samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each SDG (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate—Required at a frequency of 10 percent per SDG
- Matrix Spike/Matrix Spike Duplicate—Required at a frequency of 5 percent
- Equipment (Rinsate) Blank—Required once prior to installation of dedicated sample tubing
- Source Water Blank—Required at a frequency of one per source per sampling event
- Trip Blank—Required for VOC samples at a frequency of one per sample shipment.
- Temperature Blank—Required at a frequency of once per sample shipment container.

2.7 DECONTAMINATION

Non-dedicated sampling and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternate procedures must be approved by the Project Manager prior to the sampling event. Decontamination fluids will be collected in a 5-gal bucket and treated at the groundwater treatment plant.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

3. SURFACE WATER AND LEACHATE SEEP SAMPLING PROCEDURE

3.1 SCOPE OF APPLICATION

The purpose of this SOP is to establish the protocol for collecting surface water and leachate seep samples. The procedure is designed to permit the collection of representative surface water and leachate seep samples, and has been adapted from the procedure outlined in the Work Plan. This SOP is suitable for collecting surface water and seep samples requiring analyses for the most common types of surface water contaminants (VOCs and inorganic compounds).

3.2 EQUIPMENT/MATERIALS

- Work Plan.
- Location map, field data from last sampling event.
- Field logbook and Field Record of Surface Water and Sediment Sampling forms (Figure SOP048-2).
- Water quality indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Optional indicators – Eh and dissolved oxygen.
- Decontamination supplies (for monitoring instrumentation).
- Dedicated, pre-cleaned 1-L wide-mouth or volatile organic analyte sample container (for sample collection).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Cooler with bagged ice for sample bottles.

3.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing surface water or leachate seep sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, sample station identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Visually inspect sample station for evidence of changes in physical condition; record pertinent observations in field logbook and sampling form.

- Measure VOCs with a flame ionization detector instrument in the breathing zone and record the reading in the field logbook and sampling form.

3.4 SAMPLING PROCEDURE

The technique for surface water and leachate seep sampling must be selected after addressing such items as:

- Depth of waterbody
- Depth of sample
- Stratification
- Seasonal variations
- Analytical parameters of interest.

The following general procedure should be used to obtain representative surface water and leachate seep samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to sampling: date and time, sample method, and sample depth.

- Collect the sample from the surface water, within several tenths of a foot of the streambed, by immersing a new, dedicated 1-L glass or volatile organic analyte sample container into the waterbody. If a stream is being sampled, collect the sample upstream of the sampler with the opening of the sampling device oriented upstream but avoiding floating debris.

- Directly fill the appropriate sample containers from the 1-L or volatile organic analyte sampling device.

- Collect the samples in the order below, as applicable:

  — VOCs
  — Inorganics.

- Water sample containers are generally filled directly from the source or sampler without special considerations. The exception is the collection of aqueous VOC samples requiring pH adjustment. VOC samples will have their pH checked to assure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Details on sample preservation methods are discussed in Section 3.6.

- Label each sample as collected. Those samples (VOCs, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Inorganic samples, after preservation, do not need to be cooled.

- Measure water quality indicator parameters, if possible, by direct immersion of instrument probes into the waterbody immediately following sample collection. If direct measurement is not possible, measure these parameters from water remaining in the sampling device or another sample bottle. Record this information in the field logbook and sample data record.

- Complete remaining portions of the Field Record of Surface Water and Sediment Sampling form (Figure SOP048-2) after each station is sampled, including: time of sample collection, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

3.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOCs—**Aqueous VOC samples must be collected as specified below. Each sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HC1, and check the pH. Adjust the volume of HC1 to assure pH<2.

  — Add the amount of HC1 determined in the above step, and fill the sample vial slowly from the 1-L container, minimizing air entrainment, until the vial slightly overflows.

  — Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down and screw cap on.

  — Invert the bottle, tap lightly, and check for air bubbles.

  — If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

  — Place samples on ice until shipment.

- **Inorganics—**Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

3.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the surface water and leachate seep samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each SDG (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate—Required at a frequency of 10 percent per SDG.
- Matrix Spike/Matrix Spike Duplicate—Required at a frequency of 5 percent.
- Equipment (Rinsate) Blank—Required at a frequency of once per day per media sampled.
- Source Water Blank—Required at a frequency of once per source per sampling event when equipment (rinsate) blank is required.
- Trip Blank—Required for VOC samples at a frequency of one per sample shipment.

3.7 DECONTAMINATION

Field monitoring equipment will be decontaminated prior to use and following sampling of each station by the procedure listed below. Laboratory pre-cleaned, dedicated 1-L glass sample collection containers are used once and discarded and, therefore, do not undergo any decontamination. Decontamination fluids will be collected in a 5-gal bucket and treated at the groundwater treatment plant.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

4. REFERENCES

U.S. Environmental Protection Agency. 1996. Groundwater Issue-Low Flow Sampling (Minimal Drawdown) Groundwater Sampling Procedures. April.

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME

A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	

G. Measurable LNAPL? Yes _____ /ft No _____

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L):			
Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	
Sample Bottle IDs:			
Sample Parameters:			

Figure SOP048-1.

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:	Project Number:	Date:
Well ID:	Field Personnel:	

Parameter	6	7	8	9	10	11
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Parameter	12	13	14	15	16	17
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Comments and Observations:

Figure SOP048-1.

FIELD RECORD OF SURFACE WATER AND SEDIMENT SAMPLING

Site Name:			Project Number:
Sample Location ID:			Date:
Time:	Start:	End:	Sample Team Members:

SURFACE WATER INFORMATION

Type of Surface Water:
( ) Stream ( ) River
( ) Pond/Lake ( ) Seep

Water Depth and Sample Location _____ (ft)

Depth of Sample from Top of Water _____ (ft)

Equipment Used for Collection:
( ) None, Grab into Bottle
( ) Bomb Sampler
( ) Pump _____

Decontamination Fluids Used:
( ) Isopropyl Alcohol
( ) ASTM Type II Water
( ) Deionized Water
( ) Liquinox Solution
( ) Hexane
( ) HNO_3 Solution
( ) Potable Water
( ) None

Water Quality Parameters
( ) Temperature ____
( ) Conductivity ___ µmhs/cm
( ) pH ____ units
( ) Dissolved oxygen ____ mg/L
( ) Turbidity ____ NTU
( ) Eh ____ mv

Velocity Measurements Obtained? ( ) No ( ) Yes, See Flow Measurement Data Record
_____

Field QC Data: ( ) Field Duplicate Collected Sample Location Sketch: Method Used:

Duplicate ID _____ ( ) Yes ( ) Winkler
( ) MS/MSD ( ) No ( ) Probe

SEDIMENT INFORMATION

Type of Sample Collected:
( ) Discrete
( ) Composite

Sediment Type:
( ) Clay
( ) Sand
( ) Organic
( ) Gravel

Equipment Used for Collection:
( ) Gravity Corer
( ) Stainless Steel Split Spoon
( ) Dredge
( ) Hand Spoon/Trowel
( ) Aluminum Pans
( ) Stainless Steel Bucket
( ) _____

Decontamination Fluids Used:
( ) Isopropyl Alcohol
( ) ASTM Type II Water
( ) Deionized Water
( ) Liquinox Solution
( ) Hexane
( ) HNO_3 Solution
( ) Potable Water
( ) None

Sample Observations:
( ) Odor _____
( ) Color

Field QC Data: ( ) Field Duplicate Collected ( ) MS/MSD
Duplicate ID _____

SAMPLES COLLECTED

Check if Required at this Location	Matrix		Check if Preserved with Acid/Base	Volume Required	Check if Sample Collected	Sample Bottle IDs			
	Surface Water	Sediment							

NOTES/SKETCH

Figure SOP048-2.

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Standard Operating Procedure No. 059
for
Field Logbook

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 1
December 2014

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1. SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording field survey and sampling information in the Field Logbook.

2. MATERIALS

The following materials may be required:

- Field Logbook (Teledyne 415 Level Book, or equivalent)[1]
- Indelible ink pen (e.g., Sharpie®).

3. PROCEDURE

All information pertinent to a field survey or sampling effort will be recorded in a bound logbook. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of line-out deletions that are initialed and dated. The person making the correction will provide a brief explanation for the change. Entries are factual only. No personal opinions should be entered.

There should be no blank lines on a page. A single blank line or a partial blank line (i.e., at the end of a paragraph) should be lined to the end of the page. If only part of a page is used, the remainder of the page should have an "X" drawn across it. The bottom of each page must be signed and dated by the field personnel entering the information.

At a minimum, entries in the Field Logbook will include but not be limited to the following:

- Date.
- Project number and project name.
- Name and address of field contact.
- Identification of sample crew members.
- Documentation should include model numbers of equipment used (e.g., drilling rigs) and calibration (if applicable). Each day's entry should begin with time onsite, who is onsite (including observers other than the sampling crew), brief description of what work will be performed that day and how, and the weather.

[1] Pre-printed, bound forms are approved as well. See SOP No. 016 for recommended content and format.

- If samples are being taken in or near tidal waters, the time of high and low tide for the site should be determined from local gauges or tables and recorded.

- References such as maps of the sampling site.

- Times of key daily milestones should be entered (e.g., time borings began, times personnel arrived and left site, times subcontractors arrived and left site, etc.). Time should be recorded in the left-hand margin on the page in military time.

- Sample-specific information:

  — Unique, sequential field sample number

  — Purpose of sampling

  — Location, description, and log of photographs of each sampling point

  — Details of the sample site (e.g., elevation of the casing, casing diameter and depth, integrity of the casing, etc.)

  — Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters and absorbing reagents)

  — Type of media of sample (e.g., groundwater, surface water, soil, sediment, and product)

  — Suspected waste composition

  — Number and volume of sample taken

  — Sampling methodology, including distinction between grab and composite sample

  — Sample preservation

  — Date and time of collection

  — Collector's sample identification number(s)

  — Sample shipment (e.g., name of the laboratory and cartage agent: Federal Express, United Parcel Service, etc.)

  — Field observations (e.g., oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, moisture content, layering, Unified Soil Classification System classification, etc.)

— Any field measurements made (e.g., pH, conductivity, explosivity, water depth, organic vapor analyzer readings, etc.)

— Signature and date by the personnel responsible for observations

— Decontamination procedures.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a Field Logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the sampler's memory. Further, the project work plan or field sampling plan should be reviewed to identify additional specific information or requirements that should be included in the Field Logbook.

The Project Manager will keep a master list of all Field Logbooks assigned to the Sampling Team Leaders. One Field Logbook kept by the Project Manager will be a master site log of daily activities and will contain the list of Field Logbooks assigned to Sampling Team Leaders.

Project name and number should be clearly marked on the outside cover using indelible ink. If more than one Field Logbook exists for the project, then the number of the Field Logbook should also be clearly marked on the outside cover.

4. MAINTENANCE

At the end of the field sampling effort, the Field Logbook should be scanned and filed in the electronic file for the project and maintained according to the EA Records Retention Policy or contract requirements.

5. PRECAUTIONS

None.

6. REFERENCES

EA Engineering, Science, and Technology, Inc., PBC. 2014. Standard Operating Procedure No. 016 for Surface Water, Groundwater, and Soil/Sediment Field Logbooks. December.

U.S. Environmental Protection Agency. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80.

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Appendix A-4

Contract Laboratory Program Guidance for Field Samplers

United States Environmental Protection Agency

Sampler's Guide

Contract Laboratory Program Guidance for Field Samplers

Office of Superfund Remediation and Technology Innovation (OSRTI)
United States Environmental Protection Agency (EPA)
Washington, DC 20460

OSWER 9200.2-147
EPA-540-R-014-013
October 2014

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LIST OF ACRONYMS

ARO	Aroclor
ASB	Analytical Services Branch
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CBC	Chlorinated Biphenyl Congener
CDD	Chlorodibenzo-p-dioxin
CDF	Chlorodibenzofuran
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CLP COR	CLP Contracting Officer's Representative
CLPSS	Contract Laboratory Program Support System
COC	Chain of Custody
CRQL	Contract Required Quantitation Limit
CVAA	Cold Vapor Atomic Absorption
CWA	Clean Water Act
DOT	Department of Transportation
DQO	Data Quality Objective
ERT	Environmental Response Team (EPA)
ET	Eastern Time
EPA	United States Environmental Protection Agency
FSP	Field Sampling Plan
GPS	Global Positioning System
HASP	Health and Safety Plan
HCN	Hydrocyanic Acid
HRSM	High Resolution Superfund Methods Multi-Media, Multi-Concentration Statement of Work
HTML	Hypertext Markup Language
IATA	International Air Transport Association
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ISM	Inorganic Superfund Methods: Multi-Media, Multi-Concentration Inorganics Analysis Statement of Work
MA	Modified Analysis
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
OSC	On-scene/on-site Coordinator
OSHA	Occupational Safety and Health Administration
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PHMSA	Pipeline and Hazardous Materials Safety Administration
PE	Performance Evaluation
ppb	Parts-Per-Billion
PPE	Personal Protective Equipment

ppm	Parts-Per-Million
ppt	Parts-Per-Trillion
PRP	Potentially Responsible Party
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QASPER	Quality Assurance Sampling Plan for Environmental Response
QATS	Quality Assurance Technical Support
QC	Quality Control
RAS	Routine Analytical Services
RPM	Remedial Project Manager
RSCC	Regional Sample Control Coordinator
SAM	Site Assessment Manager
SAP	Sampling Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SIM	Selected Ion Monitoring
SMC	System Monitoring Compound
SMO	Sample Management Office
SOM	Superfund Organic Methods: Multi-Media, Multi-Concentration Organics Analysis Statement of Work
SOP	Standard Operating Procedure
SOW	Statement of Work
SPLP	Synthetic Precipitation Leaching Procedure
SPP	Site Project Plan
SVOA	Semivolatile Organic Analyte
TCLP	Toxicity Characteristic Leaching Procedure
TR/COC	Traffic Report/Chain of Custody
UN	United Nations
USCG	United States Coast Guard
USDA	United States Department of Agriculture
VOA	Volatile Organic Analyte
XML	eXtensible Markup Language

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1.0 INTRODUCTION

The *Contract Laboratory Program Guidance for Field Samplers* (also referred to as the *Sampler's Guide*) describes the organizational roles and responsibilities for those who plan and conduct environmental sample collection for analysis through the United States Environmental Protection Agency (EPA) Contract Laboratory Program (CLP).

The following lists the sections of this Guide:

- Section 1, *Introduction*, introduces the structure and purpose of this document.
- Section 2, *General Sampling Information*, describes the general activities associated with environmental sampling.
- Section 3, *CLP Statements of Work*, describes the statements of work (SOWs) that define the requirements for CLP sampling.
- Section 4, *CLP Sampling Documentation*, lists the types of documentation used to track the CLP samples.
- Section 5, *The Scribe Documentation Software Tool*, provides information about Scribe, a software tool used to create sample documentation.
- Section 6, *CLP Sample Containers*, describes the types of containers required for CLP samples.
- Section 7, *CLP Sample Collection*, describes the process by which CLP samples are collected.
- Section 8, *CLP Sample Transportation and Shipping*, outlines the requirements for the packing and shipping of CLP samples.
- Section 9, *Sampler Resources*, provides links to additional information for sampling organizations.

The following lists the appendixes of this Guide:

- Appendix A, *Functions within a Sampling Project*, describes the functions within a sampling project which are taken from the Quality Assurance Project Plan (QAPP) requirements.
- Appendix B, *Sample Container Type Specifications*, lists the required containers for CLP samples.
- Appendix C, *CLP Sample Collection Requirements by Analysis Type*, contains the sample collection requirements by SOW.
- Appendix D, *CLP Sample Collection Guidelines for Soil VOA Samples by SW-846 Method 5035A and TCLP Extraction – EPA SW 846 1311, SPLP Extraction EPA SW 846 1312* provides guidelines for VOA soil samples.
- Appendix E, *General CLP Sample Collection Guidelines VOAs in Water*, provides guidelines for Volatile Organic Analyte (VOA) water samples.
- Appendix F, *Sampling Techniques and Considerations*, recommends sampling techniques.
- Appendix G, *International Shipping*, contains information regarding shipping samples to laboratories outside the United States.
- Appendix H, *Sampling Checklists*, contains checklists used to help the sampler ensure that all necessary steps are completed.
- Appendix I, *Glossary*, provides definitions for sampling terms.

If the field sampling team is planning to use the CLP, they should use this Guide to develop the Site Project Plan (SPP)/Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) documents.

1.1 Overview of the CLP

The CLP is a national network of EPA personnel, commercial laboratories, and support contractors whose fundamental mission is to provide environmental sample collection and analysis under the Superfund program. The Superfund program was established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and presently exists under the Superfund Amendments and Reauthorization Act (SARA) of 1986. The CLP is directed by the EPA Analytical Services Branch (ASB) from within the Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER).

The primary responsibility of the CLP is to provide analytical data of known and documented quality to CLP customers through its routine and modified chemical analytical services. The CLP provides a framework that allows data to be produced in a cost-effective and efficient manner. In addition, the CLP has established strict Quality Control (QC) procedures and detailed documentation requirements to ensure the consistent quality of the data. Current CLP data users include the EPA Regions, State and Tribal governments, and other Federal agencies.

1.1.1 Key Participants within the CLP

In coordinating Superfund sampling efforts, ASB is supported by the Sample Management Office (SMO) contractor, Quality Assurance Technical Support (QATS), Regional CLP Contracting Officer's Representative (CLP CORs), Regional Sample Control Coordinators (RSCCs), Site Assessment Managers (SAMs), On-scene/On-site Coordinators (OSCs), and Remedial Project Managers (RPMs). Samplers may work directly with the RSCC, and/or an OSC from the Site Support Personnel during a sampling event. Refer to Table 1-1 for a description of the functions performed by key participants (functions may vary by Region).

Table 1-1. Participants in the CLP Sampling Process

Participants	Responsibilities
Analytical Services Branch (ASB)	ASB directs the CLP from within the Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER). ASB responsibilities include: • Development of the Statements of Work (SOWs) that define required analytical methods (including QC, detection/quantitation limits, and holding times) for the analytical services procured under the CLP • Development and implementation of policies and budgets for Superfund analytical operations • Development of information management policies and products for analytical data • Management of SMO and QATS contracts • National administration, evaluation, and management of the CLP • Direction of CLP Quality Assurance (QA) activities in coordination with overall OSWER QA activities To obtain the most current ASB contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/contacts.htm#ASB
CLP Sample Management Office (SMO)	The contractor-operated SMO provides management, operations, and administrative support to the CLP. SMO receives Regional analytical requests, coordinates and schedules sample analyses, and tracks sample shipments. SMO also receives and checks data for completeness and compliance, processes laboratory invoices, and maintains a repository of sampling records and program data.

Participants	Responsibilities
CLP Contract Laboratories	The contractor-operated laboratories within CLP provide analytical services for the separation, detection, and quantitation of the CLP's target analytes. To obtain the most current list of CLP Contract Laboratories, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/lablist.htm
Environmental Response Team (ERT)	The ERT is responsible for the development, implementation, and management of the Scribe software system. In addition, the ERT oversees the development of Scribe training webinars and on-site training.
Environmental Response Team (ERT) Support Contractors	The ERT Support Contractors provide technical and administrative support for the development, implementation, and management of the Scribe software system. In addition, the ERT Contractors support the development of Scribe training webinars and on-site training.
Regional CLP Contracting Officer's Representative (CLP COR)	The CLP COR monitors the technical performance of the contract laboratories in each Region. The CLP COR works closely with ASB Program Managers to identify and resolve laboratory technical issues, and leads laboratory on-site evaluations. To obtain the most current CLP COR contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/reglist.htm
Regional Sample Control Coordinator (RSCC)	In most Regions, the RSCC coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. The RSCC works with SMO to schedule sample shipments to laboratories. In addition, the RSCC's activities may include informing SMO of sample shipment, cancellations, special instructions, and sampling issues. To obtain the most current RSCC contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/reglist.htm
Site Support Personnel	The Site Support Personnel consist of the EPA personnel and contractors responsible for developing the QAPP and Sampling Plan for the sampling episode at the site. It includes such personnel as the sampling team, Quality Assurance personnel, OSC, SAM, and Remedial Project Manager (RPM). In most Regions, the Site Support Personnel develop Standard Operating Procedures (SOPs) for field sampling and related procedures, and assist sampling teams in adhering to the SOPs. The sampling team determines what type(s) of CLP services will be required for a particular sampling event. The Site Support Personnel review Sampling Analysis Plans (SAPs) prepared by sampling teams and oversees sampling teams in the field. In addition, the state or territorial environmental protection agency for the location of the site provides support for the sampling event.

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2.0 GENERAL SAMPLING INFORMATION

2.1 Goals of the Sampling Process

Once the U.S. Environmental Protection Agency (EPA) has determined that physical, chemical, and/or biological testing of a site is necessary, samples of material from the site area must be collected. The type of material that must be collected and the analytical method to be used depends upon the physical location of the site, detection level(s), site history (previous sampling), and known or unknown conditions and contaminants. Samples should be collected according to the approved project and site-specific Quality Assurance Project Plan (QAPP) and Sampling Analysis Plan (SAP). This Guide does not define specific sampling procedures as these depend upon individual site conditions, Regional requirements, and acceptance and performance criteria. Since Regions may have their own specific requirements for individual sampling programs, they are responsible for generating Region-specific sampling Standard Operating Procedures (SOPs).

2.1.1 Follow the Required Sampling Procedures

It is imperative that samplers be aware of the minimum Contract Laboratory Plan (CLP) and Regional requirements that directly impact and define how a sampling event will take place. It is important to note that the procedures and guidelines set forth in this document are considered minimum CLP requirements.

The purpose of sampling is to collect representative portions from a suspected contaminated site. Sample collection is critical to determining the presence, type, concentration, and extent of environmental contamination by hazardous substances; thus, it is a crucial part of every sampling and environmental testing effort. Sampling procedures must be consistently followed to mitigate risk of error and the expense of re-sampling.

Failure to follow proper sampling and shipping procedures could result in samples that are contaminated, in broken containers, mislabeled, lost during shipping, or unusable because of a missed holding time. If procedures are inconsistently or improperly followed, any resultant analytical data may be inaccurate and may not be legally defensible.

If re-sampling is needed due to improper sampling, the sampling team may incur the laboratory cost.

2.1.2 Maintain Chain of Custody of Samples and Data

Acquiring accurate and legally defensible data is the CLP's primary objective; therefore, the sampler must collect samples according to strict sampling procedures, plans, and guidelines. EPA and many other Federal agencies use data resulting from analytical testing of samples to:

- Determine if a site is contaminated with organic and/or inorganic compounds
- Identify pollution sources
- Identify Potentially Responsible Parties (PRPs)
- Validate remedial design methodologies
- Assess response and remedial priorities
- Assess risk to human health and the environment
- Determine appropriate cleanup actions
- Determine cleanup achievements

2.1.3 Field Operation Records

Samplers should maintain complete, accurate, and legible field operations records as they perform a sampling activity. The following records are included:

- Field logbooks
- Corrective Action reports
- Sampling trip reports
- Supplemental standardized forms
- Records such as maps or photographs that document each step of the work performed in the field

Samplers should refer to their project plans for Region-specific field operations record requirements. These records are very important tools because they are considered part of the official project file when legal issues arise.

2.1.4 Comply with Safety Procedures

Care must be taken to maintain the safety of personnel collecting and handling CLP samples. If sampling requires digging in soil, utility lines (gas, soil, cable, etc.) must be marked to prevent injury or utility outage. Samples must be handled, packed, and shipped in accordance with all applicable Federal [Operational Safety and Health Administration (OSHA) and Department of Transportation (DOT)] regulations for hazardous materials. Refer to the Health and Safety Plan (HASP) for detailed site safety requirements.

2.2 Obtain Municipal Permits, Licenses, and Clearances

Before starting a sampling event, samplers must make sure to obtain the proper municipal permits, accesses to the property, and any government clearances, if required. The sampler must also contact any appropriate utility companies to ascertain where any underground pipes, cables, etc., may be located.

2.2.1 Request Access to County, State, Tribal, Military, and/or Federal Property

Proper access to perform sampling activities is important not only for legal reasons, but also to eliminate delays in work and possible refusal to allow sampling to take place. It is crucial that the appropriate permits, licenses, and clearances be secured to obtain access for sampling activities that will be performed on County, State, Tribal, military, and/or Federal property. The sampler must contact the appropriate government offices or personnel well in advance to determine what kinds of approval are required. Pre-approval may be required for specific types of sample

collection such as drilling or excavation. For example, drilling on a military base requires pre-approval. Base security may require clearances for all members of the sampling team, including subcontractors. This process may take two or more days.

2.2.2 Contact Private Property Owners

The sampler must obtain written permission from the private property owner(s) before sampling on his/her property, even if verbal permission has been granted. It is recommended that samplers obtain verbal permission prior to their arrival at the sampling location, but written permission can be obtained on the day of sampling. If a property owner refuses to grant access to his/her property, it may be necessary for the sampling organization to contact the appropriate authorities for assistance. A sampler who enters private property without permission may be subject to a charge of trespassing, and samples may be considered part of an illegal search and invalid for legal proceedings.

2.2.3 Contact Utility Companies

The sampler should contact local utility companies (e.g., power, phone, gas, cable, sanitation, etc.) at least one week prior to the sampling event to have underground cables, lines, and pipes flagged and marked. This is required by law. A national one-call directory can be found at: http://www.call811.com.

It may be necessary to turn off the utilities (i.e., electrical wires or gas lines) in order to obtain samples. The utility service(s) disruption dates should be confirmed at least two days prior to sampling activities. Samplers should follow Regional or other appropriate program procedures for the disruption of utilities.

Pre-payment of survey fees to local utility companies may be required.

2.3 Review Request for Samples

In order to prepare for the sampling event, the sampler should review the request for samples from the CLP. This information may be in the form of the "Scheduling Notification Form" from Sample Management Office (SMO), supplied by the Regional Sample Control Coordinator (RSCC), or in other forms of communication from the Region or other organization. Field team leaders should contact their RSCC or Remedial Project Manager (RPM) to review this information prior to going into the field, and assure that this information matches information in the Site Project Plan (SPP) and/or QAPP.

Use the following information for planning:

- **Sample information**: Take note of the number of samples requested, the sample matrix, and the analyses. This information will be used to determine the equipment and supplies needed for the sampling event.
- **Site location**: Determines whether there are any specific requirements for accessing/exiting the site, or for working at the site.
- **Shipping period**: Determines when the samples are to be shipped to the laboratory. It helps determine when sampling should occur.
- **Laboratory information**: Determines where the samples will be shipped.

2.3.1 Review Sample Request

The sample request determines many of the other preparatory activities for the sample event. Review the sample request for the following information:

- ☐ Determine the number and types of samples to be collected.
- ☐ Review the required sample collection method(s).
- ☐ Review decontamination procedures necessary for site.
- ☐ Make note of sample holding times and conditions.
- ☐ Determine Performance Evaluation (PE) and Quality Control (QC) sample requirements.
- ☐ Determine whether shipping cooler temperature blanks are required.

2.4 Review Project Plans

Project plans describe, in detail, the requirements for the sampling event. All field team members should be familiar with the applicable project plans prior to beginning field sampling. These plans may include the following documents.

2.4.1 Site Project Plan (SPP)

The SPP describes the requirements for any activity taking place at the site. It contains information such as site history, potential contaminants, topographical information, etc. This information may be combined into the QAPP.

2.4.2 Health and Safety Plan (HASP)

The HASP describes the measures necessary to maintain the health and safety of the sampling team during the sampling event. It can include topics such as the following:

- Organization structure
- Job hazard analysis
- Site control
- Training
- Medical surveillance
- Personal protective equipment (PPE)
- Exposure monitoring
- Thermal stress
- Decontamination
- Emergency response
- Standard operating procedures
- Confined space operations
- Spill containment

2.4.3 Quality Assurance Project Plan (QAPP)

The QAPP describes the data quality objectives and data requirements for the project, and is used by samplers to develop any subsequent plans such as the Sampling Analysis Plan (SAP) or the Field Sampling Plan (FSP).

2.5 Assemble Sampling Materials

Samplers must be prepared for a sampling project by assembling the appropriate sampling materials (equipment, supplies, sample containers, packing materials, and shipping materials).

The equipment and supplies must be properly cleaned, calibrated, and tested as necessary to meet the needs of the sampling project.

2.5.1 Equipment and Supplies

Samplers should review the project plans to determine the equipment necessary for sample collection.

The following materials should be obtained prior to a sampling event:

- Sample containers
- Shipping containers
- Packing material
- Access to the Scribe software for creating sample labels, stickers, tags, and Traffic Report/Chain of Custody (TR/COC) records
- Custody seals
- Sampling equipment such as bowls, augers, pumps, etc.
- Personal Protective Equipment (PPE)
- Internet access (either at the time of sampling or soon after the samples are shipped)

The CLP Statement of Work (SOW) may also require field samplers to provide the following:

- Cooler temperature blanks
- Trip blanks for Volatile Organic Analyte (VOA) analysis
- Preservation supplies (e.g., ice or acid)
- Specially prepared sample vials (e.g., VOA analyses)
- Utensils or equipment for handling tissue samples requested by modified analysis

2.6 Perform Readiness Review/Dry Run

A readiness review/dry run is a test run of the proposed sampling event. This is a recommended practice since it gives samplers a chance to review all plans, documentation software (i.e., Scribe), and equipment lists for accuracy and completeness prior to sampling activities. It also provides an opportunity to consult with sampling team members to make sure that all the elements are in place and everyone understands their task before actually going out to the field. Sampling project managers should provide the readiness review or dry run dates and schedules to samplers so that they can prepare accordingly.

2.7 Assess the Status of the Site and the Team

Prior to beginning the sampling, make sure that all of the preparatory work is complete and that the team is ready to begin. Some issues to consider are:

- ☐ Ensure that personnel roles and lines of authority are established.
- ☐ Ensure that permission has been granted to enter the site and collect samples.
- ☐ Ensure that utility work has been completed (if required).
- ☐ Review local weather forecast to be aware of possible dangerous weather conditions. Ensure that sampling staff are prepared for weather conditions.
- ☐ If the sampling location is inaccessible, contact the appropriate field or Regional personnel for instruction.
- ☐ Verify that the correct sampling equipment is on site.
- ☐ Ensure that personal safety measures are in place.
- ☐ Ensure that a site HASP is in place, including procedures for emergency medical treatment and first aid, evacuation procedures, emergency contacts, and location of emergency medical facilities.

- ☐ Identify and mark the sampling location with buoys, flags, or stakes according to the sampling plans, maps, and grids.
- ☐ Park the car/van away from the sampling site and turn off the engine. Be aware of car exhaust (BTEX) contamination to volatile organic samples through all procedures, including loading and unloading the coolers during the shipping.

2.8 Initiate Site Control Measures

The sampling team is responsible for controlling the site during the sampling event. Use the following guidelines to maintain site control:

- ☐ Maintain a log of authorized personnel entering the site.
- ☐ Prevent unauthorized persons from entering the site.
- ☐ Ensure that any decontamination procedures required in the HASP are in place and are followed.

2.9 Maintain Field Logbook

Samplers must maintain a field logbook that documents the field activities. The information from the field logbooks becomes evidence and can be used in court. The following list is criteria for a field log book:

- ☐ Use waterproof ink to record in the field logbook.
- ☐ Record the date and time of all entries.
- ☐ Correct any errors by crossing a line through the error, initialing the error, dating the error, and then adding the correct information.
- ☐ Document sampling project information such as:
  - Project name, ID, and location
  - Names of samplers
  - Geological observations, including maps and Global Positioning System (GPS) information
  - Atmospheric conditions
  - Field measurements
  - Sampling dates, times, and locations
- ☐ Record sampling activity information such as:
  - Sampling dates and times
  - Sample identifications
  - Sample matrices
  - Sample descriptions (e.g., odors and/or colors)
  - Number of samples taken
  - Sampling methods/equipment
- ☐ Record any and all deviations from the sampling plan.
- ☐ Record any and all difficulties in sampling and/or any unusual circumstances.

2.10 Preventing Errors

Errors in the sampling process can result in additional costs and delayed sampling results. The following section lists some of the ways to avoid common sampling errors.

Document samples correctly:

- ☐ Use the CLP Sample Number and SMO-assigned CLP Case Number correctly (sample number on each sample).
- ☐ Submit the signed TR/COC record with the sample(s).

- ☐ Accurately and legibly complete and attach a custody seal to each shipping container. (The project QAPP may also required that custody seals be attached to each sample container or plastic sample bag. Refer to the project QAPP for specific instructions.)

Collect and preserve samples correctly:

- ☐ Collect a sufficient volume of sample so that the laboratory can perform the requested analysis and quality controls, such as Matrix Spike (MS), Matrix Spike Duplicate (MSD), and Duplicates.
- ☐ Make sure that the sample is preserved, if required, and that the sample pH is within the required range.

Ship samples correctly:

- ☐ Pack bottles and containers to avoid breaking or spilling during shipping.
- ☐ For iced samples, evenly distribute bags/packets of ice throughout the cooler and between the sample containers to ensure that all samples are sufficiently cooled to a temperature of ≤6°C, but not frozen.
- ☐ Ensure that shipping containers have custody seals attached.
- ☐ Ensure that samples are shipped to the correct laboratory address.
- ☐ If samples are to be shipped internationally, additional paperwork or customs authorizations may be required. Refer to Appendix G, International Shipping for additional information.
- ☐ Upload the Electronic Chain of Custody (COC) as soon as possible after shipping.

Communicate effectively:

- ☐ It is extremely important that all parties involved in a sampling event be in contact throughout the sampling process. It has been demonstrated that approximately 50% of all sampling efforts have been negatively affected by incorrect sampling procedures and poor communication among participants.
- ☐ The key elements of communication for a sampling event include the relationship between the RSCC, SMO, the samplers in the field, and the laboratories who will be accepting the samples.
- ☐ If there are any changes to the sampling event due to a cancellation or an increase or decrease in the number of samples that will be sent to the laboratory, the sampler should contact the RSCC as soon as possible. The RSCC can work with SMO to remedy potential capacity, availability, or overbooking problems with the CLP laboratories.

2.11 Exiting the Site

The following activities take place before leaving the sampling site:

- ☐ Ensure that all equipment has been collected and removed.
- ☐ Follow Regional guidance regarding decontamination and doffing of PPE, if used.
- ☐ Follow Regional guidance for waste removal and disposal.
- ☐ Ensure that all sampling personnel have cleared the site.
- ☐ If sampling on private property, provide a sample receipt to the property owner for all samples taken and removed from the site.

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3.0 CLP STATEMENTS OF WORK

The overall requirements for sample collection, analysis, and handling under the Contract Laboratory Program (CLP) are described in the CLP Statements of Work (SOWs).

3.1 The CLP SOWs

Table 3-1 lists the CLP statements of work.

Table 3-1. CLP Statements of Work

Statement of Work	Analysis Types	Matrix Types
HRSM01.X	Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Chlorinated Biphenyl Congeners (CBCs)	Soil, sediment, biosolids, oil, sludge, ash, tissue, water, and wipe
SOM02.X	Trace Volatile Organic Analytes (Trace VOA) Volatile Organic Analytes (VOA) Semivolatile Organic Analytes (SVOA) SVOA Selected Ion Monitoring (SIM) Pesticides Aroclors	Soil, sediment, water, Toxicity Characteristics Leaching Procedure (TCLP)/ Synthetic Precipitation Leaching Procedure (SPLP) leachate samples
ISM02.X	Metals by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), Mercury by Cold Vapor Atomic Absorption (CVAA) Spectrometry, Cyanide by Spectrophotometry	Soil, sediment, water, TCLP/SPLP leachate, and wipe samples

These statements of work are available on the U.S. Environmental Protection Agency (EPA) Web site at: http://www.epa.gov/superfund/programs/clp/analytic.htm

3.2 CLP Sample Definition

A CLP sample is defined as one discrete portion of material to be analyzed that is contained at one concentration level from one location for each individual or set of analyses – provided that the analyses are all requested for the same CLP analytical service (i.e., organic or inorganic), and identified by a unique sample number.

A sample consists of all sample aliquots (portions), provided that the analyses are all requested from the same CLP analytical program:

- for each individual or set of analytical methods
- from one location
- for one sample matrix
- at one concentration level
- for one laboratory
- for one analytical program

3.2.1 Mixed-matrix Samples

In some instances, a mixed-matrix sample may be collected which contains either a supernate (for a sediment/soil sample) or a precipitate (for a water sample). The decisions made with regard to the different matrices in such samples can have profound impacts on data usability. In this event,

samplers should consult their sampling plans and/or discuss the required procedures with the Remedial Project Manager (RPM) (or designee).

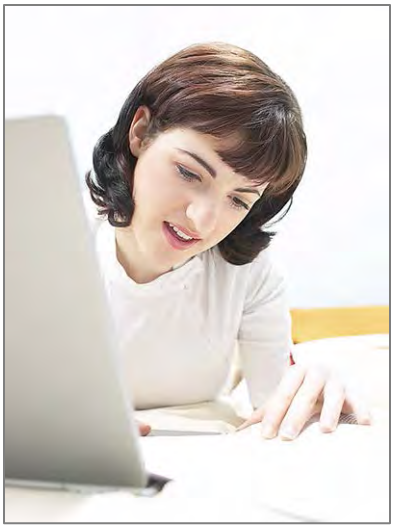
In general, it is recommended that two individual samples be collected by separating the aqueous layer from the solid/precipitate layer at the point of collection if possible. If the phases or layers cannot be separated effectively in the field at the point of collection, arrangements should be made to separate the layers under controlled conditions at the receiving laboratory. In this case, additional sample numbers will be needed for the separate phases. They should be assigned two different sample IDs (e.g., Sample IDs ABC124 and ABC125 for Sample ID ABC123), along with a note in the field sample log and in the Special Instructions section of the Chain of Custody (COC) form that the sample IDs are derived or related to the same sample. Refer to Section 5.15, Using Scribe for Mixed-matrix Samples for information on how to use the Scribe software to track mixed-matrix samples.

When samples are collected from several locations to form a composite sample, the sample should be assigned either a number from one of the locations used during collection, or a unique number that represents the composite sample, for tracking purposes. The numbering scheme used internally at a sampling event for identifying composite samples should also be documented appropriately (e.g., in the field logs).

3.3 CLP Analyses

CLP Routine Analytical Sample (RAS) analysis is generally used for Superfund sites, and includes the routine list of metals and organic analytes. The matrices can be water, leachates derived from the TCLP or SPLP soil, sediment, or wipes. Additional matrices requested under Modified Analysis (MA) may include oil, sludge, ash, construction wastes, biosolid, or tissue (non-human).

4.0 CLP SAMPLE DOCUMENTATION



The U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) is required to produce accurate and legally defensible data. In order to produce legally defensible data, control of the samples must be maintained to ensure that the samples correctly represent the site and location from which they were taken. Sample documents are tools that allow EPA to maintain the chain of custody of the samples from collection, through shipping, to analysis. It also associates the sample to the sample data. Samplers should review their site-specific project plans and Quality Assurance Project Plans (QAPPs) to determine other types of documentation that must be completed for a sampling project. The following section describes the documents used to maintain the chain of custody and the tools used to create these documents.

The following table summarizes the forms used for CLP sample documentation.

Table 4-1. CLP Sample Documents

Form Type	Source	Purpose
CLP Sample Number	Assigned by sampling software (Scribe); ranges are supplied by the Regional Sample Control Coordinator (RSCC)	Identifies sample data. Associates the sample to the sample data.
CLP Case Number	Assigned by the Sample Management Office (SMO)	Identifies groups of samples collected during a single sampling event.
Traffic Report/Chain of Custody (TR/COC) Record	Created in Scribe	Tracks chain of custody of the sample and sample data.
Custody seals	Supplied by the RSCC or field sampling team	Maintains sample integrity; may indicate sample tampering or contamination if broken.
Sample labels	Created in Scribe	Affixed to the sample container to identify an individual sample.
Sample tags	Sample tag labels are created in Scribe or are handwritten by sampler	Identifies a sample bottle or container that contains a sample, provides specific analytical direction, and provides proof that a sample existed. (Sample tags are not a CLP requirement.)
Field operations records (as necessary)	Created and maintained by sampling team	Maintains a record of activities at the site.
Shipping container label (to the laboratory)	Carrier standard form	Used by the carrier to ship the samples to the laboratory.
Cooler shipping label (return from laboratory)	Carrier standard form	Used by the carrier to return the cooler to the Region.

The documentation required by a Region for a sampling event is outlined in project plans such as the QAPP, Sampling Analysis Plan (SAP), and Field Sampling Plan (FSP).

EPA recommends that a dedicated field team member be responsible for all sample documentation steps, including reviewing laboratory scheduling information, creating sample labels and Traffic Report (TR)/Chain of Custody (COC) forms in Scribe, maintaining a field operations log, and relinquishing control of the samples to the laboratory. This person should be identified in the Site Project Plan (SPP) or QAPP.

Under no circumstances should the site name appear on any documentation that is sent to the laboratory (for the CLP).

4.1 CLP Sample Numbers

A sample number is a number that is unique per sampling location and identifies each CLP sample. It is used to identify and track samples throughout the sampling and analytical processes, and is recorded on many types of sampling documentation [e.g., Traffic Report/Chain of Custody (TR/COC) records, sample labels, and sample tags].

Organic CLP Sample Numbers begin with the Regional letter code, followed by four letters and/or numbers. Inorganic CLP Sample Numbers begin with "M" followed by the Regional letter code and then four letters and/or numbers. High Resolution CLP Sample Numbers begin with "P" followed by the Regional letter code and then four letters and/or numbers. See Table 4-2 for Region and letter codes for each sample type (i.e., organic, inorganic, or high resolution).

Table 4-2. CLP Sample Number Letter Codes

Region	Letter Code		
	Organic	Inorganic	High Resolution
1	A	MA	PA
2	B	MB	PB
3	C	MC	PC
4	D	MD	PD
5	E	ME	PE
6	F	MF	PF
7	G	MG	PG
8	H	MH	PH
9	Y	MY	PY
10	J	MJ	PJ

* According to CLP guidelines, each individual inorganic water sample may be analyzed for total metals or filtered metals, but not both. Therefore, water samples collected for total metal and filtered metal analyses from the same sampling location must be assigned separate unique CLP Sample Numbers. A sampler can use the same sample number for an inorganic soil or water sample collected for total metals, mercury, and cyanide analyses.

4.1.1 Requesting Sample Numbers

CLP Sample Numbers are created in Scribe with ranges supplied by the RSCC.

4.2 CLP Case Numbers

SMO-assigned Case numbers are used to track groups of samples from a sampling event throughout the sampling and analytical processes, and are recorded on many types of sampling documentation (e.g., TR/COC records, sample labels, and/or sample tags). Samplers must correctly assign the Case number to the appropriate sample bottle or container. CLP Case Numbers should be requested from the RSCC (or designee) or they may be provided by SMO.

4.2.1 Requesting Case Numbers

Case numbers are assigned by the Sample Management Office (SMO). Samplers request the assigned sample numbers and Case numbers through the RSCC.

4.3 CLP TR/COC Records

A TR/COC record is used as physical evidence of sample custody and as a permanent record for each sample collected. A chain of custody record documents the exchange and transportation of samples from the field to the laboratory.

To meet CLP sample documentation and chain of custody requirements, the sampler must attach a separate, signed TR/COC record to each cooler they ship.

- ☐ The TR/COC record must document each sample within the cooler.
- ☐ Each TR/COC record **must be signed by the designated field sampler**, documenting that they have relinquished control of the samples.
- ☐ TR/COC records should be separated and shipped in the coolers with the samples listed on them. Do not ship samples in a cooler without the corresponding TR/COC record. This practice maintains the chain of custody for all samples in case of incorrect shipment.
- ☐ The electronic COC record should be uploaded as soon as possible after shipping.

If more than one TR/COC record is used for the samples within one cooler, all of the records must have complete header information and original signatures. Samplers are responsible for the care and custody of samples from the time of collection to the time of shipment to the laboratories for analysis. A sample is considered under custody if the following conditions are met:

- It is in possession or in view after being in possession
- It was in possession and then secured or sealed to prevent tampering
- It was in possession when placed in a secured area

Each time the custody of samples is turned over to another person, the TR/COC record must be signed off by the former custodian and accepted by the new custodian.

4.4 Chain of Custody Seals

A chain of custody seal is any adhesive label or tape that can be used to seal a sample bottle, container, plastic bag, or shipping cooler such that if it is opened or tampered with, the seal will be broken. The custody seal is used to maintain the chain of custody, as well as guard against possible sample contamination or tampering during shipping.

- ☐ Custody seals must be placed on each shipping cooler or container, and if required by the project's QAPP or FSP, on each sample bottle, container, or bag (as appropriate).
- ☐ The CLP does not provide custody seals. Custody seals should be obtained from either the RSCC or supplied by site personnel.

4.5 Sample Labels

A sample label is a sticker that is attached to a sample bottle or container that contains a field sample or quality control (QC) sample.

- Sample labels are affixed to each sample container as samples are collected in the field or affixed prior to going in the field.
- A sample label must contain, at a minimum, the sample number so that the sample can be associated with, and listed on, the associated TR/COC record.
- The sample label should also include the required analysis, CLP Case Number, and preservative used (to eliminate confusion at the laboratory). Samplers should refer to their site-specific project plans for Region-specific sample label requirements.

4.6 Sample Tags

A sample tag identifies a sample bottle or container that contains a sample. The sample tag also provides specific analytical direction and proof that a sample existed. To support the use of sample data in potential enforcement actions, samples can be identified with a sample tag. The CLP Sample Number and Case number must be recorded on a sample tag to indicate that the sample container comprises the whole sample where there is just one container of sample, or part of the indicated sample when there are multiple containers of sample.

Sample tags are not a CLP requirement. Consult with specific RSCC regarding Regional requirement. Not all EPA Regions require the use of sample tags, and field samplers should refer to their site specific project plans or contact their RSCC for Regional sample tag requirements.

4.7 Sample Weight Logs

A sample weight log (Figure 4-1) identifies the tared, sample, and final weights per bottle for samples for volatile organic chemical analysis (VOA). In order to support the Superfund Organic Method (SOM) for VOAs, samplers should enter tared and final weights per bottle in the sample weight log.

Page 1 of 2

Sample Weight Log
Chain of Custody Work Sheet

Shipped to: XYZ
Case 99991

Sampled by: ABC

CLP Sample #	A0AA1	A0AA10	A0AA11	A0AA2	A0AA3
Matrix	Soil	Soil	Soil	Soil	Soil
Analyses	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles
Preservative	None	None	None	None	None
Tag	1003	1004	1005	1006	1007
Tared Weight (g)	27.369	32.02	32.44	30.17	31.11
Final Weight (g)	27.369	37.25	37.53	35.07	31.11
Sample Weight (g)	0	5.23	5.09	4.9	0
COC #	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001
Remarks					

CLP Sample #	A0AA4	A0AA5	A0AA6	A0AA7	A0AA8
Matrix	Soil	Soil	Soil	Soil	Soil
Analyses	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles	CLP Semivolatiles
Preservative	None	None	None	None	None
Tag	1008	1009	1001	1010	1002
Tared Weight (g)	32.234	30.56	31.046	27.119	30.579
Final Weight (g)	32.324	30.56	31.046	27.119	30.579
Sample Weight (g)	0	0	0	0	0
COC #	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001	1-082714-170055-0001
Remarks					

Figure 4-1. Scribe Sample Weight Log

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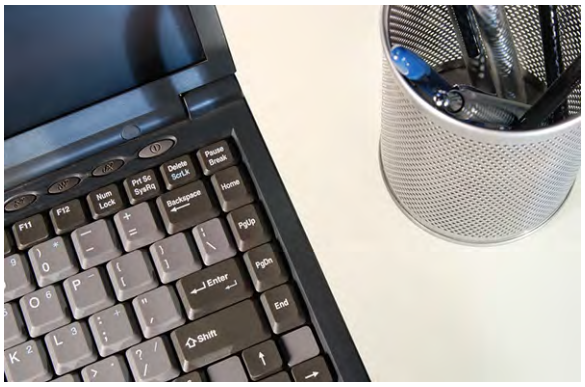
5.0 THE SCRIBE DOCUMENTATION SOFTWARE TOOL



The U.S. Environmental Protection Agency (EPA) Analytical Services Branch (ASB) requires samplers to use the Scribe software to create documentation for all Contract Laboratory Program (CLP) sampling efforts. EPA recommends that a dedicated member of the sampling team be trained in the Scribe software, and responsible for all uses of Scribe, including the sample labels and the Traffic Report/Chain of Custody (TR/COC) forms at the sampling location. For assistance with obtaining or using the Scribe software, contact Environmental Response Team (ERT) Software Support Help Desk at 800-999-6990 from 9:00 AM - 5:00 PM ET. For additional information regarding Scribe use and training materials, refer to the following Web site: http://www.epaosc.org/Scribe

Scribe allows users to create one or more sampling projects, then enter data and create sample documents for that project. Some of the capabilities of Scribe include:

- Tracking sample numbers and Case numbers
- Associating analysis information to sample numbers
- Creating sample labels and sample tags
- Setting label size and printing labels
- Selecting sample numbers to add to the chain of custody form
- Printing chain of custody forms
- Filtering lists of samples
- Exporting sample data in the following formats: text file (.txt, .csv), spreadsheet (.xls, .wb3), HTML (.htm), XML (.xml), or QuickMap (.kml, .kmz)

The Scribe software tool allows users to track samples electronically. It can be downloaded at no charge from the EPA On Scene Coordinator Web site at http://www.ertsupport.org/downloads.htm.

Need more information?
Use this code to access the ERT User Manual for Scribe CLP Sampling or contact the ERT Software Support Help Desk at 800-999-6990.

5.1 Setting Up the Sampling Event in Scribe

Scribe allows the sampler to enter much of the information prior to the event in order to facilitate processing on the day of the event. The following sections describe how to set up the sampling event in Scribe.

5.1.1 Set Up Project

The first step for setting up Scribe is to set up the project as follows:

- ☐ Access the Scribe **New Project Wizard** to set up the sampling project.
- ☐ Enter the project **Site Name**, **Site #**, and **Region #** (required).
- ☐ Additional project information may be entered, if available.

5.1.2 Verify/Create Analysis Types

The analysis types to be used for the sampling event must be defined for the project. Refer to the site sampling plan to determine which analyses are to be used.

- ☐ Use the **Analyses** tab to display a list of all analysis types available.
- ☐ Only analyses with the Program Type of "CLP," such as "CLP ICP-AES Metals," or "CLP Semivolatiles" should be used.
- ☐ If the required analysis type is missing, it can be added manually using the **Add** button.

5.1.3 Set Default Sample Tag Information

Set up the default values for sample number and tag. This allows the sampler to increment sample and tag numbers, rather than hand entering each one.

- ☐ Select **File→Options→CLP/Tag Settings** to display the **CLP/Tag Settings** window.
- ☐ Enter the new default values and click **OK**.

Sample tags are not a CLP requirement. Please consult with specific Regional Sample Control Coordinator (RSCC) as to Regional requirement. Not all EPA Regions require the use of sample tags, and field samplers should refer to their site specific project plans or contact their RSCC for Regional sample tag requirements.

5.1.4 Indicate Modified Analysis (MA) on Scribe COC Records

When completing a TR/COC record in Scribe, indicate an MA as follows:

- ☐ Identify any samples that will be analyzed using a CLP MA by creating a new analysis within the Scribe Analyses table or at the time of entering the Analyses for the sample.
- ☐ The MA analysis should contain the Modification Reference Number within the name assigned to the analysis. For example, if a Region submits an MA for an additional analyte, and SMO assigns the Modification Reference Number 1301.0, the Scribe Analyses could be named "CLP VOA by M.A. 1301.0." The associated abbreviation for this analysis could be "VOA M.A."

Need more information?
Use this code to access the ERT User Manual for Scribe CLP Sampling or contact the ERT Software Support Help Desk at 800-999-6990.

5.1.5 Using Scribe for Mixed-matrix Samples

The Scribe **LinkSampleNo** field links the original sample to the split samples and numbers. Use Scribe to link to the two sample IDs used for the different sample phases as follows:

- ☐ Add two (2) additional samples in Scribe indicating in the matrix field which one is the liquid/aqueous phase and which one is the solid phase (i.e., ABC124 and ABC125).
- ☐ Tie the two additional samples to the original sample number using the 'LinkSampleNo' field.
  - **In Scribe**, in the **Samples** tab, click the **View** button; the **Select Columns** drop-down menu displays. Put a checkmark next to **LinkSampleNo** to make that column visible.
  - Add the 'parent' or the original field sample # in the **LinkSampleNo column** (i.e., ABC123).
  - **On the COC**, indicate in the **Special Instructions** which of the two new sample numbers the laboratory is to use for the liquid/aqueous phase and which sample number to be used for the solid phase.

5.2 Scribe CLP Analysis Codes

The following table lists the analysis codes used for CLP samples in Scribe.

Table 5-1. Scribe CLP Analysis Codes

Analysis Name	Abbreviation
Aroclors	
CLP Aroclors	ARO
High Resolution	
CLP 12 Toxic Congeners	12 Toxic CBCs
CLP 209 Congeners	209 CBCs
CLP Dioxins/Furans	CDD/CDF
Inorganics	
CLP Aluminum	Al
CLP Antimony	Sb
CLP Arsenic	As
CLP Barium	Ba
CLP Beryllium	Be
CLP Cadmium	Cd
CLP Calcium	Ca
CLP Chromium	Cr
CLP Cobalt	Co
CLP Copper	Cu
CLP Cyanide	CN
CLP Hardness	Hardness
CLP ICP-AES Metals	ICP-AES
CLP ICP-MS Metals	ICP/MS
CLP Iron	Fe
CLP Lead	Pb
CLP Magnesium	Mg
CLP Manganese	Mn
CLP Mercury	Hg
CLP Nickel	Ni
CLP Potassium	K
CLP Selenium	Se
CLP Silver	Ag
CLP Sodium	Na
CLP SPLP Alumium	SPLP Al
CLP SPLP Antimony	SPLP Sb
CLP SPLP Aroclors	SPLP ARO
CLP SPLP Arsenic	SPLP As
CLP SPLP Barium	SPLP Ba
CLP SPLP Beryllium	SPLP Be
CLP SPLP Cadmium	SPLP Cd
CLP SPLP Calcium	SPLP Ca

Analysis Name	Abbreviation
CLP SPLP Chromium	SPLP Cr
CLP SPLP Cobalt	SPLP Co
CLP SPLP Copper	SPLP Cu
CLP SPLP Cyanide	SPLP CN
CLP SPLP ICP-AES Metals	SPLP ICP-AES
CLP SPLP Iron	SPLP Fe
CLP SPLP Lead	SPLP Pb
CLP SPLP Magnesium	SPLP Mg
CLP SPLP Manganese	SPLP Mn
CLP SPLP Mercury	SPLP Hg
CLP SPLP Nickel	SPLP Ni
CLP SPLP Potasium	SPLP K
CLP SPLP Selenium	SPLP Se
CLP SPLP Silver	SPLP Ag
CLP SPLP Sodium	SPLP Na
CLP SPLP Thalium	SPLP Tl
CLP SPLP Vanadium	SPLP V
CLP SPLP Zinc	SPLP Zn
CLP TCLP Arsenic	TCLP As
CLP TCLP Barium	TCLP Ba
CLP TCLP Cadmium	TCLP Cd
CLP TCLP Chromium	TCLP Cr
CLP TCLP ICP-AES Metals	TCLP ICP-AES
CLP TCLP Lead	TCLP Pb
CLP TCLP Mercury	TCLP Hg
CLP TCLP Selenium	TCLP Se
CLP TCLP Silver	TCLP Ag
CLP Thallium	Tl
CLP Vanadium	V
CLP Zinc	Zn
Organics	
CLP PAH+PCP	PAH
CLP PAH+PCP by SIM	PAH SIM
CLP Semivolatiles	SVOA
CLP SPLP Semivolatiles	SPLP SVOA
CLP SPLP Volatiles	SPLP VOA
CLP TCLP Semivolatiles	TCLP SVOA
CLP TCLP Volatiles	TCLP VOA
CLP Trace Volatiles	TVOA
CLP Volatiles	VOA
Pesticides	
CLP Pesticides	PEST
CLP SPLP Pesticides	SPLP PEST

To avoid issues with interpretation, ensure that Total Metals and Dissolved Metals are labeled correctly.

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6.0 CLP SAMPLE CONTAINERS

The analytical protocol(s) to be used for sample analysis often requires the use of a particular type of sample container. The type of container also may depend on the sample matrix and analysis.

It is recommended that samplers use borosilicate glass containers, which are inert to most materials, when sampling for pesticides and/or other organics. Conventional polyethylene is recommended when sampling for metals because of the lower cost and absorption rate of metal ions.

Have extra containers readily available for each sampling event in case of breakage, loss, or contamination.

Containers procured for a sampling event are usually pre-cleaned and shipped ready for use from the manufacturer to the sampling site. Regardless of the type of container used, samplers must ensure that the containers have been analyzed or certified clean to levels below concern for the project (certificates must be kept on record). These containers must meet the U.S. Environmental Protection Agency (EPA) container type specifications listed in Table 6-1.

Samplers should document the lot numbers for every lot of cleaned containers used for each project and maintain corresponding certificates of analysis on file and available upon request.

Table 6-1. Sample Container Type Specifications

Reference Number	Container Type	Specifications	
		Closure	Septum
1	40 mL amber glass vial, 24 mm neck finish.	Polypropylene or phenolic, open-top screw-cap, 15 cm opening, 24-400 size.	24 mm disc of 0.005 in. Polytetrafluoroethylene (PTFE) bonded to 0.120 in. silicone for a total thickness of 0.125 in.
2	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
3	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish.	Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	N/A
4	4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish.	Polypropylene or phenolic cap, 48-400 size; 0.015 in. PTFE liner.	N/A
5	1 L amber round glass bottle, 33 mm pour-out neck finish.	Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner.	N/A
6	Coring tool used as a transport device (e.g., 5 g Sampler).	Has built-in closing mechanism.	N/A
7	1 qt polymer zip-top bag	Has built-in closing mechanism.	N/A
8	Heavy duty aluminum foil	N/A	N/A

The information contained in this table is also cross-referenced in the sample collection parameters discussed in Appendix C. The container Reference Numbers are used in Tables C-1 to C-4 under the Container Type column. For example, samples collected for low-level soil VOA analysis may require the sampler to use pre-prepared, tared closed-system purge-and-trap vials with a preservative (refer to Appendix B). Refer to the Regional Quality Assurance Project Plan (QAPP) and Appendix D for additional references. Refer to Table B-2 for a cross reference between the analyses and the required sample container types.

7.0 CLP SAMPLE COLLECTION

Samplers should determine the types of samples or aliquots to be taken, the volumes required of each sample or aliquot, and the preservation requirements for each sample by referring to the Site Project Plan (SPP) and Contract Laboratory Program (CLP) sample requirements table in Appendix C. The following sections describe the types of samples that may be required to be collected.

7.1 Requesting the Scheduling of the Laboratory

The sampler must request that the Regional Sample Control Coordinator (RSCC) schedule the laboratory to be used for the analysis. This should be done as far in advance of the sampling event as possible.

- The sampler should specify the number of samples, analyses, etc., being shipped each week.
- When scheduling a sampling event that will last for more than one week, it is recommended that the sampler contact the RSCC (or designee) on a weekly basis to provide updates. This contact between the sampler, the RSCC (or designee), and Sample Management Office (SMO) is very important because it will ensure better availability of laboratory capacity.
- In the event that time frame or number of samples for a sampling event changes, the RSCC and SMO should be notified as soon as possible to maintain capacity at the CLP laboratory.

The CLP has the capability to schedule sampling on an emergency basis; however, the sampler must contact the RSCC (or designee) to obtain details regarding how to handle such a situation.

7.2 Preparing for the Shipping of Samples

Once the samples are collected, they will be shipped to the CLP laboratory for analysis. Samplers must have the necessary shipping supplies on site.

7.2.1 Procure Shipping Supplies

Samplers should refer to the appropriate project plans to determine the types of samples that will be taken during the sampling project to determine the necessary packaging materials to have at the site for all pertinent sample container types and sample matrices.

Samplers should also make sure to obtain the appropriate shipping paperwork (e.g., shipping forms required by the delivery service).

The CLP strongly discourages the use of vermiculite and cat litter as sources for packing material. These materials interfere with labeling and documentation and are difficult to remove from sample containers and shipping containers.

7.2.2 Laboratory Assignment Notification

The Laboratory Assignment Notification informs the sampler of the CLP laboratory(ies) that will be receiving the samples. Prior to beginning fieldwork, samplers should contact their RSCC (or designee) to obtain their Laboratory Assignment Notification(s), or they may be provided by SMO.

The Laboratory Assignment Notification applies only to work being performed under the CLP Statements of Work (SOWs).

7.2.3 Verify Laboratory Shipping Information

Samplers should make sure to have accurate laboratory contact information, including the following:

- Laboratory name
- Laboratory address
- Contact name
- Laboratory phone number

This information, which is provided on the Regional Laboratory Assignment Notification Form, is used for both Traffic Report (TR)/Chain of Custody (COC) records and shipping paperwork such as address labels and airbills. This form may be provided by SMO, or can be obtained through the RSCC prior to sampling.

7.2.4 Obtain Shipping Company Information

Samplers should also make sure to have accurate shipping company information, including the following:

- Company name
- Telephone number
- Account number
- Pickup schedule

Additional guidance will be provided by the U. S. Environmental Protection Agency (EPA) if samples are to be shipped internationally.

7.2.5 Prepare Sample Cooler Return Documentation

CLP laboratories must routinely return sample shipping coolers to the appropriate sampling office within 14 calendar days following receipt of shipment from the sampler. For sample coolers to be returned, the sampler must complete the appropriate cooler documentation and work with Regions and government agencies to provide a cost-effective mechanism for laboratories to return the empty coolers to the appropriate sampling office. The sampling cooler return documentation should be prepared in advance and provided to samplers before field activities begin.

The sampler (not the CLP laboratory) is responsible for paying for the disposition (return or disposal) of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address, to allow for cooler return.

To maintain consistency among cooler transportation programs, samplers should do the following:

- ☐ Minimize the use of multiple transportation carriers to avoid confusion.
- ☐ Use multiple-copy labels so the laboratory and the sampling team can each retain a copy for their records.
- ☐ Prepare labels in advance so that the laboratory can simply affix a completed shipping label on the cooler.
- ☐ Include third-party billing information (i.e., their shipping account number) on labels so the laboratory will not be billed by the transportation carrier.
- ☐ Confirm that the laboratory knows which transportation carrier to use.
- ☐ Include the SMO-assigned CLP Case Number on return information.

7.3 Collecting Samples

The CLP requirements for samples are defined by the applicable CLP Statement of Work (SOW), and outlined in the following tables/tables in Appendix C. This includes CLP submission requirements such as sample volumes, preservation, and holding times.

Observe the sample collection requirements for the following SOWs when collecting analytical samples:

- Organic (SOM02.X) – Tables C-1 and C-2
- Inorganic (ISM02.X) – Table C-3
- High Resolution (Dioxin/Furan and CBCs (HRSM01.X) – Table C-4

For an explanation of the various sample types and the requirements for collecting and submitting each particular type, refer to Table 7-1.

Table 7-1. Sample Types and CLP Submission Requirements

Sample Type	Purpose	Collection[1]	CLP Sample Number
Field Sample	To analyze for target compounds of interest	Collect from areas that are known or suspected to be contaminated. Collect at the frequency specified in the Quality Assurance Project Plan (QAPP) and Sampling Plan.	Assign CLP Sample Numbers to the sample.
Field Duplicate	To check reproducibility of laboratory and field procedures To indicate non-homogeneity	Collect from areas that are known or suspected to be contaminated. Collect at the frequency specified in the QAPP and Sampling Plan.	Assign two separate (unique) CLP Sample Numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory.
Field Blank	To check cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory Also to check sample containers and preservatives	Collect for each group of samples of similar matrix with the frequency specified in the QAPP and Sampling Plan. Organics - Use water (demonstrated to be free of the contaminants of concern). Inorganics - Use metal-free (deionized or distilled) water or a single clean wipe.	Assign separate CLP Sample Numbers to the field blanks.
Filter Blank	To check contamination of samples from filtering procedure	Collect when water samples are filtered by filtering blank water using the same procedure and filtering equipment that is used for samples. Use blank water (water	Assign separate CLP Sample Numbers to the filter blanks.

Sample Type	Purpose	Collection[1]	CLP Sample Number
		demonstrated to be organic-free, deionized or distilled for inorganics) and collect into sample containers.	
Temperature Blank	To provide an accurate measurement of field sample temperature upon arrival to the laboratory Also to establish whether the temperature range has been maintained while in transit	Collect for each shipping container with the frequency specified in the QAPP and Sampling Plan.	Ship together with samples from the field to the laboratory. A CLP Sample Number is not required.
Trip Blank [Volatile Organic Analysis (VOA) Only]	To check contamination of VOA samples during handling, storage, and shipment from field to laboratory	Prior to going into the field, prepare and seal one trip blank sample per shipment per matrix. Trip blanks should be matched with respect to matrix and volume of the preservatives used. Prepare trip blank samples with the same laboratory grade methanol and sodium bisulfate solution or reagent water used for field sampling. Carry each through the same sampling and handling protocols used for field samples. Aqueous trip blank samples should be prepared using water demonstrated to be free of the contaminants of concern (deionized water is appropriate). Place one trip blank sample for each matrix in each cooler used to ship VOA samples.	Assign separate CLP Sample Numbers to the trip blanks.
Equipment Blank or Rinsate Blank	To check field decontamination procedures	Collect when sampling equipment is decontaminated and reused in the field or when a sample collection vessel (bailer or beaker) will be used. Use blank water (water demonstrated to be organic-free, deionized or distilled for inorganics) and rinse water into the sample containers.	Assign separate CLP Sample Numbers to the equipment blanks/rinsate.
Matrix Spike (MS) and Matrix Spike Duplicate (MSD) (Organic Analysis Only)	To check accuracy and precision of organic analyses in specific sample matrices	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), MS/MSD additional volume should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Collect five additional vials for aqueous samples and five additional field core containers for soil VOA samples designated for MS/MSD analyses. An aqueous sample for Semivolatile Organic Analysis (SVOA) analysis would require the field sampler to collect at least 2 L of field samples and at least 2 L each for the MS and MSD samples for a total volume of 6 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 6 L must be collected for each analysis method. Collect double volume for soil samples for MS/MSD.	Assign the same CLP Sample Number to the field sample and the extra volume for MS/MSD. Identify the sample designated for MS/MSD on the TR/COC record.

Sample Type	Purpose	Collection[1]	CLP Sample Number
		See Table C-2 and Appendix E for VOA collection volumes.	
Matrix Spike (MS) and Duplicate (Inorganic Analysis Only)	To check accuracy and precision of inorganic analyses in specific sample matrices	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), Matrix Spike and Duplicates should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Additional sample volume may be required for inorganic analysis.[2]	Assign the same CLP Sample Number to the field sample and extra volume (if collected). Identify the sample(s) designated for Matrix Spike and Duplicates on the TR/COC record.
Performance Evaluation (PE) Samples	Specially-prepared Quality Control (QC) samples used to evaluate a laboratory's analytical proficiency	The PE samples contain analytes with concentrations unknown to the laboratory. Designated Regional or authorized personnel (depending on Regional policy) arrange for Case-specific CLP PE samples to be prepared and shipped by the Quality Assurance Technical Support (QATS) contractor. The PE samples can be shipped to the site, or shipped per Regional direction. QATS provides the appropriate preparation instructions and chain of custody materials.	Samplers must order PE samples and ship them to the laboratory if required by the Region.

[1] Consult Regional or Project Manager Guidance for field QC sample frequencies; laboratory QC sample frequencies are generally fixed in the laboratory subcontracts or specified in analytical methods.

[2] Double volume should be sent for inorganic aqueous MS and Duplicate samples to allow for sufficient volume for these analyses in the event that sample volume is lost as a result of samples breaking, leaking, re-extraction/redigestion, reanalysis, or laboratory accidents. Additional soil volume is not necessary for inorganic samples.

7.3.1 Field QC Samples

Field QC samples are designed to assess variability of the media being sampled and to detect contamination and sampling errors in the field. The types of field QC samples that are generally collected include the following:

- Field duplicates
- Field blanks (such as equipment, trip, or rinse blanks)

Unless otherwise instructed, field duplicate samples should remain "blind" to the laboratory (i.e., they should have separate CLP Sample Numbers).

7.3.2 Laboratory QC Samples

A laboratory QC sample is an additional analysis of a field sample, as required by the laboratory's contract. There are three types of laboratory QC samples:

- MS (for organic and inorganic samples)
- MSD (for organic samples only)
- Duplicates (for inorganic samples only)

Observe the following guidelines for collecting laboratory QC samples:

- ☐ Follow Regional guidance regarding the collection of laboratory QC samples.
- ☐ Wipes samples do not require laboratory QC samples.
- ☐ When laboratory QC is scheduled for CLP analytical work, laboratories expect one designated laboratory QC sample per Sample Delivery Group (SDG), which closes when 20 samples or more than one week is reached, whichever occurs first.
- ☐ Samplers should **select one sample per matrix per 20 samples** as a laboratory QC sample.

- Designated laboratory QC samples should be noted on the TR/COC record; the sample(s) designated for laboratory QC should be noted in "Sample Type" column.
- QC samples should be sent in the same cooler as the field samples when possible.

Field QC samples should not be designated as laboratory QC samples.

In the event of multiple sample shipments during a sampling event, it is recommended that the sampler submit laboratory QC samples in the first sample shipment, and as necessary in subsequent shipments to meet laboratory contract requirements.

7.4 Recording Samples

Samplers must use Scribe to record the samples that are collected. To record the samples:

- Access the Scribe **Sampling** tab to select the type of sampling (Air Sampling, Water Sampling, Soil/Sediment Sampling, Water Sampling).
- Enter the detailed information for the sample.
- When all information has been entered, click the **Close** button at the bottom of the page to save the entries and close the window.

Refer to Table 5-1 when referencing the CLP analysis codes.

Need more information?
Use this code to access the ERT User Manual for Scribe CLP Sampling or contact the ERT Software Support Help Desk at 800-999-6990.

For assistance while using the Scribe software, contact the ERT Software Support Help Desk at 800-999-6990 from 9:00 AM - 5:00 PM ET. Refer to the following Web site for information on the use and training of Scribe: http://www.epaosc.org/Scribe.

7.4.1 Hardcopy Recording

In the event the Scribe is unavailable, samplers must have backup hardcopy Scribe TR/COC records. For information regarding emergency backup procedures, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/trcoc.htm. This should be done only in cases of power/equipment failure, and not as a matter of routine during a sampling event.

7.5 Meeting Volume, Preservation, and Holding Time Requirements

Samplers should refer to their project plans to obtain the specific sample volumes to be collected, the preservation needed for those samples, and the technical holding times under which they must submit samples to the scheduled CLP laboratory. Sample collection parameters (including sample volumes, preservatives, and technical holding times) are listed in Tables C-1 through C-4.

7.5.1 Collect Required Sample Volumes

Ensure that a sufficient volume is collected for each sample. If the sample volume does not meet the requirement set by the project plan, the laboratory may not be able to analyze the sample correctly.

Refer to Appendix E for information regarding the collection of VOAs in water. When sampling for VOAs in soils, samplers must use SW-846 Method 5035A guidelines included in Appendix D.

If a modified analysis requesting tissue samples requires processing or homogenizing, it should be performed at a sample processing facility under clean room conditions to reduce potential contamination. Tissue samples should be packed and cooled on ice immediately. Tissue samples should never be sent on Friday for Monday delivery.

7.5.2 Preserve Samples

Without preservation, some samples (e.g., VOAs) may degrade to the point that they will not provide an accurate analysis. The sampler must chemically preserve some water samples for certain analytes before shipping them to the laboratory.

Observe the following regarding preservation of samples:

- ☐ Note any visible reaction between the sample and added chemical preservative in the field record.
- ☐ Preserve and immediately cool all organic and cyanide water samples to ≤6°C, but not frozen, upon collection.
- ☐ Keep samples cooled until the time of analysis (do not freeze water samples).
- ☐ Preservation techniques vary among Regions, so the sampler should obtain Region-specific instructions and review the appropriate project plans and Standard Operating Procedures (SOPs).
- ☐ Refer to Appendix E for information regarding the collection of VOA water samples.

7.5.3 Ship Samples within Holding Times

There are two types of holding times: technical and contractual.

- **Technical holding time** is the maximum time allowed between a sample collection and the completion of the sample extraction and/or analysis.
- **Contractual holding time** is the maximum length of time that the CLP laboratory can hold the sample prior to extraction and/or analysis. The contractual holding time is the elapsed time expressed in days from the date of receipt of the sample by the laboratory until the date of its extraction and/or analysis, as described in the appropriate CLP Statement of Work.

Contractual holding times are generally set to be two days less than the technical holding times to allow for sample packing and shipping.

Samplers should ship samples to scheduled CLP laboratories as soon as possible after collection.

- ☐ Ship samples daily to CLP laboratories whenever possible.
- ☐ If samples cannot be shipped on a daily basis, they must be properly preserved and maintained to meet CLP-specified temperatures, holding times, and custody requirements.
- ☐ Uploading the electronic COC is mandatory and should be done as soon as possible after shipping.

If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) and SMO by 8:00 AM ET on the following business day. When making a Saturday delivery, samplers must notify the RSCC (or designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

7.6 Completing the Documentation

The sample documentation required is defined by the project plan. It is highly recommended that samplers provide documentation, even if the Region does not require it.

In general, samplers must complete the following documentation for the samples collected:

- CLP Sample Number (on the sample container or bottle)
- Sample label
- Chain of custody seals (as appropriate)
- TR/COC record
- Field operations records (as necessary)

Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional EPA laboratory. The Region copy of the TR/COC record shall be sent to the EPA laboratory.

An example of a packaged sample is shown in Figure 7-1.

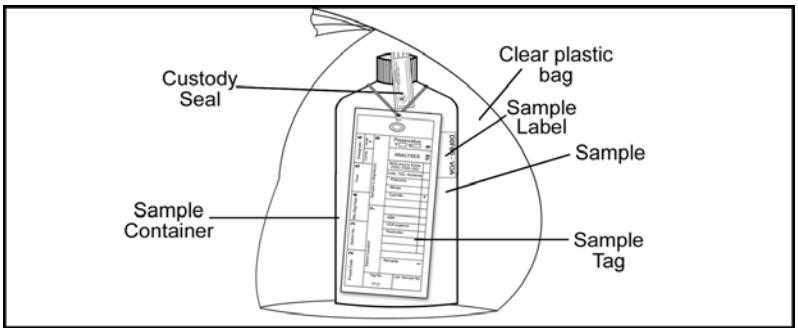

Figure 7-1. Packaged Sample with Identification and Chain of Custody Documentation (Excluding TR/COC Record)

7.6.1 Record and Label the Samples

The sample labels created in Scribe must be affixed to each sample container. A sample label contains the following information:

- Associated CLP Sample Number (either written or pre-printed)
- SMO-assigned CLP Case Number
- Preservative used
- Analysis
- Additional information such as the location or the date/time of collection

Record and label the samples collected as follows:

- ☐ Using Scribe, select the **Sampling** tab to select the type of matrix (e.g., Soil/Sediment, Water Sampling).
- ☐ Enter the Scribe **Sample Details** page to enter the analysis method, CLP Sample Number, and SMO-assigned CLP Case Number for each sample.
- ☐ Enter samples requested as a modified analysis (MA) by using the MA analysis previously created in Scribe. If the MA does not exist, refer to Section 5.1.2, Verify/Create Analysis Types to create the analysis type for the MA.
- ☐ Print two copies of the sample label and attach one to the sample container or bottle, and place the other on the sample tag that may be attached to the sample container or bottle.

- If handwriting a sample label, complete the label information using waterproof ink, place the label on the outside of the sample bottle or container, then cover the label with clear packaging tape to protect the label and maintain legibility.
- Avoid wrinkles in the tape and labels.
- Refer to Figure 7-1 to see how the sample labels are used.

If special conditions exist, use the following guidelines:

- **Water samples collected for total metal and filtered metal analyses from the same sampling location** - these samples must be assigned separate (unique) CLP Sample Numbers.
- **Tared VOA sample vials** - do not attach labels to tared VOA sample vials.

7.6.2 Complete the COC Records in Scribe

Complete the Scribe COC Record as follows:

Access the Scribe COC Page

- Select the **Chain of Custody** link under the **Sample Management** header. The ***Chain of Custody*** page displays.

Create the COC Record

- Click the **Add a Chain of Custody** button at the bottom of the page. The ***COC Details*** pop-up window displays.
- Enter the information for the COC, including selecting the **CLP format** (Inorganic, Organic, or High Resolution).

  Note: It is very important that the correct **COC Format** is selected when the COC Record is created. The user must choose the CLP format for the type of samples being submitted, as shown in Figure 7-2.

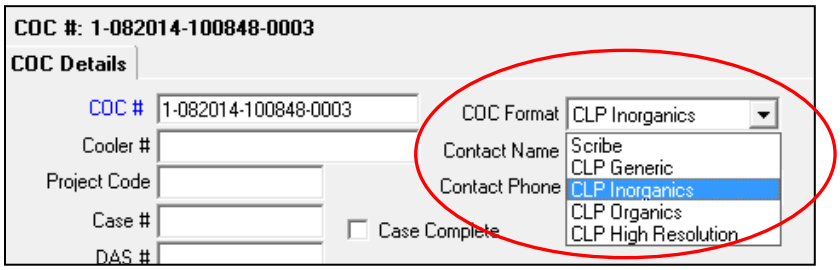

Figure 7-2. COC Details Pop-up Window

- Ensure that the **Case #** is also filled in. (If it was entered in the CLP/Tag Settings, it will automatically be filled in.)

Assign Samples to the COC Record

- Assign samples to the **COC Record** (it will filter based on selected COC format SOW).
- Ensure that all sample information has been entered.
- Enter any additional information, such as sampler name, matrix, and preservation.
- Indicate any samples that will be analyzed using a MA.
- Scribe generates a laboratory and a Regional copy of the Chain of Custody Record (see Figures 7-3 through 7-4).

Print the COC Record

- Print the **COC Record** by selecting either the **Lab Copy** or **Region Copy**. There will be a QC check; ensure that all information is filled in.
- Print as many copies of the **COC Record** as is necessary.

- Sign and submit original copies of the **COC Record**.

Certain information will not appear on the electronic COC record (e.g., matrix and preservative descriptions).

Sampler information, etc., is not added when creating the COC; it is added when editing the sample itself.

Need more information?
Use this code to access the ERT User Manual for Scribe CLP Sampling or contact the ERT Software Support Help Desk at 800-999-6990.

7.6.3 Making Manual Edits to Printed Scribe COC Records

If a Scribe COC Record has been printed and deletions or edits need to be made by the sampler, the following procedures must be followed:

- If making a deletion, correct the deletion in Scribe and reprint the COC record. Discard the original.
- If making an addition, enter the new information in Scribe and reprint the COC record. Discard the original.
- If corrections occur after shipment, adhere to Region-specific procedures and guidelines on handling hard copy COC records.

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USEPA CLP COC (LAB COPY)
DateShipped: 1/3/2014
CarrierName: FedEx
AirbillNo: ABC12345

CHAIN OF CUSTODY RECORD

Case #: 21490
Cooler #:

No: 2-010614-124708-0001
Lab: EPA Labs
Lab Contact: John Smith
Lab Phone:

Sample Identifier	CLP Sample No.	Matrix/Sampler	Coll. Method	Analysis/Turnaround (Days)	Tag/Preservative/Bottles	Location	Collection Date/Time	For Lab Use Only
12345-0001	B0AA0	Soil/ EPA	Grab	SVOA(21)/PR, SVOA 1723.3(21)/PR, PEST(21), ARO(21), VOA(21), VOA MA(21)	1000 (0 C), 1001 (0 C), 1002 (0 C), 1003 (0 C), 1004 (0 C), 1005 (0 C) (6)	ABC	01/03/2014 08:00	
12345-0002	B0AA1	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1006 (0 C), 1007 (0 C), 1008 (0 C), 1009 (0 C) (4)	ABC	01/03/2014 08:00	
12345-0003	B0AA2	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1010 (0 C), 1011 (0 C), 1012 (0 C), 1013 (0 C) (4)	DEF	01/03/2014 09:00	
12345-0004	B0AA3	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1014 (0 C), 1015 (0 C), 1016 (0 C), 1017 (0 C) (4)	GHI	01/03/2014 10:00	
12345-0005	B0AA4	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1018 (0 C), 1019 (0 C), 1020 (0 C), 1021 (0 C) (4)	JKL	01/03/2014 11:00	
12345-0006	B0AA5	Soil/ EPA	Grab	SVOA(21), SVOA 1723.3(21), PEST(21), ARO(21), VOA MA(21)	1022 (0 C), 1023 (0 C), 1024 (0 C), 1025 (0 C), 1026 (0 C), 1027 (0 C) (6)	DEF	01/03/2014 09:00	
12345-0007	B0AA6	Soil/ EPA	Grab	SVOA(21), SVOA 1723.3(21), PEST(21), ARO(21), VOA MA(21)	1028 (0 C), 1029 (0 C), 1030 (0 C), 1031 (0 C), 1032 (0 C), 1033 (0 C) (6)	GHI	01/03/2014 10:00	
12345-0008	B0AA7	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1034 (0 C), 1035 (0 C), 1036 (0 C), 1037 (0 C) (4)	JKL	01/03/2014 11:00	

Sample(s) to be used for Lab QC: 12345-0001 Tag 1000, 12345-0001 Tag 1001, 12345-0001 Tag 1002, 12345-0001 Tag 1003, 12345-0001 Tag 1004, 12345-0001 Tag 1005	Shipment for Case Complete? Y Samples Transferred From Chain of Custody #

Analysis Key: SVOA=CLP Semivolatiles, SVOA 1723.3=CLP SVOA MA 1723.3, PEST=CLP Pesticides, ARO=CLP Aroclors, VOA=CLP Volatiles, VOA MA=CLP VOA (MA 1722.4)

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt

Figure 7-3. Scribe Chain of Custody Record (Laboratory Copy)

Page 1 of 1

USEPA CLP COC (REGION COPY)
DateShipped: 1/3/2014
CarrierName: FedEx
AirbillNo: ABC12345

CHAIN OF CUSTODY RECORD
Field Sampler's Guide
Case #: 21490
Cooler #:

No: 2-010614-124708-0001
Lab: EPA Labs
Lab Contact: John Smith
Lab Phone:

Sample Identifier	CLP Sample No.	Matrix/Sampler	Coll. Method	Analysis/Turnaround (Days)	Tag/Preservative/Bottles	Location	Collection Date/Time	Sample Type
12345-0001	B0AA0	Soil/ EPA	Grab	SVOA(21)/PR, SVOA 1723.3(21)/PR, PEST(21), ARO(21), VOA(21), VOA MA(21)	1000 (0 C), 1001 (0 C), 1002 (0 C), 1003 (0 C), 1004 (0 C), 1005 (0 C) (6)	ABC	01/03/2014 08:00	Lab QC
12345-0002	B0AA1	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1006 (0 C), 1007 (0 C), 1008 (0 C), 1009 (0 C) (4)	ABC	01/03/2014 08:00	Field Sample
12345-0003	B0AA2	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1010 (0 C), 1011 (0 C), 1012 (0 C), 1013 (0 C) (4)	DEF	01/03/2014 09:00	Field Sample
12345-0004	B0AA3	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1014 (0 C), 1015 (0 C), 1016 (0 C), 1017 (0 C) (4)	GHI	01/03/2014 10:00	Field Sample
12345-0005	B0AA4	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1018 (0 C), 1019 (0 C), 1020 (0 C), 1021 (0 C) (4)	JKL	01/03/2014 11:00	Field Sample
12345-0006	B0AA5	Soil/ EPA	Grab	SVOA(21), SVOA 1723.3(21), PEST(21), ARO(21), VOA MA(21)	1022 (0 C), 1023 (0 C), 1024 (0 C), 1025 (0 C), 1026 (0 C), 1027 (0 C) (6)	DEF	01/03/2014 09:00	Field Sample
12345-0007	B0AA6	Soil/ EPA	Grab	SVOA(21), SVOA 1723.3(21), PEST(21), ARO(21), VOA MA(21)	1028 (0 C), 1029 (0 C), 1030 (0 C), 1031 (0 C), 1032 (0 C), 1033 (0 C) (6)	GHI	01/03/2014 10:00	Field Sample
12345-0008	B0AA7	Soil/ EPA	Grab	ARO(21), PEST(21), SVOA(21)	1034 (0 C), 1035 (0 C), 1036 (0 C), 1037 (0 C) (4)	JKL	01/03/2014 11:00	Field Sample

Sample(s) to be used for Lab QC: 12345-0001 Tag 1000, 12345-0001 Tag 1001, 12345-0001 Tag 1002, 12345-0001 Tag 1003, 12345-0001 Tag 1004, 12345-0001 Tag 1005	**Shipment for Case Complete? Y** **Samples Transferred From Chain of Custody #**
Analysis Key: SVOA=CLP Semivolatiles, SVOA 1723.3=CLP SVOA MA 1723.3, PEST=CLP Pesticides, ARO=CLP Aroclors, VOA=CLP Volatiles, VOA MA=CLP VOA (MA 1722.4)	

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt

Figure 7-4. Scribe Chain of Custody Record (Region Copy)

7.6.4 Complete and Attach Custody Seals

Custody seals are usually pre-printed stickers that are signed (or initialed) and dated by the sampler after sample collection and placed on sample bottles or containers and/or shipping containers (see Figure 7-5).

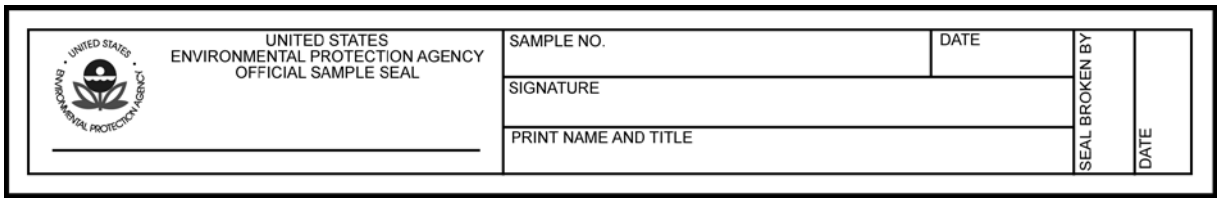

Figure 7-5. Custody Seal

The custody seal documents the person who sealed the sample container and verifies that the sample has not been tampered with. Custody seals can also be used to maintain custody of other items such as envelopes.

The use and type of custody seals can vary by Region or collecting organization. Samplers should obtain the appropriate custody seals and specific instructions for correctly attaching them from the RSCC. Note that some Regions require the sampling team to provide their own custody seals.

- Place the seals such that they will break if the sample bottle or container, or the shipping cooler or container is tampered with or opened after leaving custody of samplers.
- Custody seals should never be placed directly onto a coring tool used as a transport device (e.g., 5 g Sampler) or tared, 40 mL closed-system vials. The seals must be placed on the bag for the coring tool used as a transport device, or on the bag used to enclose the vials. Refer to Table 8-1 for details.

Instructions for completing and attaching a custody seal are included in Table 7-2.

Table 7-2. Completing and Attaching a Custody Seal

Step	Action	Important Notes
1	Record the CLP Sample Number.	The space for the CLP Sample Number does not need to be completed on custody seals being placed on the opening of a cooler, only on those being placed on the opening of sample bottles or containers.
2	Record the month, day, and year of sample collection.	
3	Sign the seal in the signature field.	
4	Print your name and title in the "Print Name and Title" field.	
5	Place the custody seal over the edge of the sample bottle or container such that it will break if tampered with.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared VOA bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
6	If possible, cover the custody seal with clear plastic tape to protect it.	Take special care to not place the protective tape over the seal in such a way that it can be removed and then re-attached without signs of tampering.

7.6.5 Complete and Attach Sample Tags

To support use of sample data in potential enforcement actions, sample characteristics other than on-site measurements (e.g., pH, temperature, conductivity) can be identified with a sample tag. Typically, site-specific information is written on the tags using waterproof ink.

Sample tags are not a CLP requirement. Please consult with specific RSCC as to Regional requirement. Not all EPA Regions require the use of sample tags, and field samplers should refer to their site specific project plans or contact their RSCC for Regional sample tag requirements.

An example of a completed sample tag is included in Figure 7-6 below:

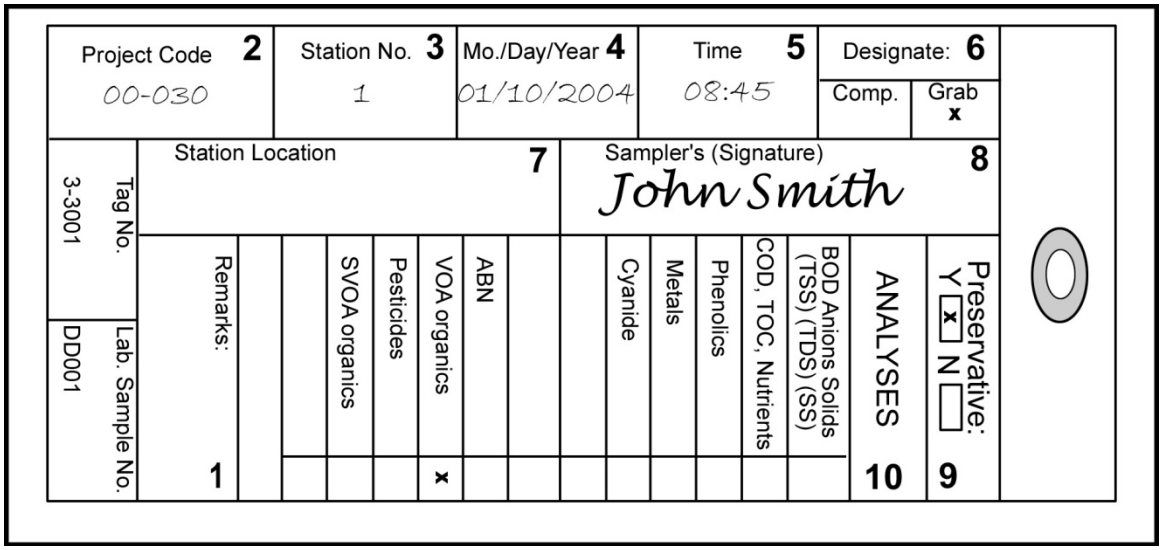

Figure 7-6. Completed Sample Tag

Complete the sample tag as follows:

- Use Scribe to create and print out multiple sample labels, one of which can be attached to the sample tag and then covered with clear packaging tape to protect the label and maintain legibility.
- If Scribe-created sample labels are not available, use the instructions for completing and attaching a handwritten sample tag in Table 7-3.
- Use waterproof ink when filling out the sample tag.
- Strike out, initial, and date any corrections.

Table 7-3. Completing and Attaching a Handwritten Sample Tag

Step	Action
1	Under the "Remarks" heading, record the CLP Sample Number and SMO-assigned CLP Case number in a legible manner.
2	Record the project code (e.g., Contract number, Work Assignment number, Interagency Agreement number, etc.) assigned by EPA.
3	Enter the location number assigned by the sampling team coordinator.
4	Record the month, day, and year of sample collection.
5	Enter the military time of sample collection (e.g., 13:01 for 1:01 PM).
6	Identify the designate and place an "X" in either the composite (Comp.) or grab (Grab) sample box.
7	Record the location.
8	Sign the sample tag in the signature area.

Step	Action
9	Place an "X" in the box next to Yes or No to indicate if a preservative was added to the sample.
10	Under "Analyses," place an "X" in the box next to the parameters for which the sample is to be analyzed.
11	Leave the box for "Laboratory Sample Number" blank.
12	It is recommended that the sample tag be attached to the neck of the sample bottle or container using regular string, stretch string, or wire.

7.7 Providing a Sample Receipt

After samples have been taken from private property, the sampler should prepare a receipt for these samples and provide this receipt to the property owner. This is especially important when sampling on private property since these samples could be used during future litigation and the receipt will verify that the owner granted approval for the removal of the samples from the property. An example of a sample receipt created using Scribe is shown in Figure 7-7.

Page 1 of 1

Receipt for Samples
Samples Residential Sampling

Project No. 045RD20 | Project Name: Scribe Demo | WA: 123
Samples Transferred: | Signature: | Sampler's Signature:
Samples Received By: | Signature: | John Q. Sampler

Sample #	SS-0004	SS-0004	SS-0019	SS-0019	SS-0024
Sample Date	6/9/2013	6/9/2013	6/9/2013	6/9/2013	6/25/2013
EventID	Front Yard Soil Sampling	Front Yard Soil Sampling	Back Yard Soil Sampling	Back Yard Soil Sampling	High Res Sampling
Location	H004-F	H004-F	H004-R	H004-R	H004-F
Matrix	Soil	Soil	Soil	Soil	Soil
Collection Method	Grab	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Analyses	CLP TCLP Volatiles	CLP TCLP Semivolatiles	CLP TCLP Volatiles	CLP TCLP Semivolatiles	CLP 209 Congeners
CLP Sample #	Y0002	Y0002	Y0007	Y0007	PY0013
Tag	1007	1006	1017	1016	1034
Container	40 ml Vial	4oz Glass	40 ml Vial	4oz Glass	32oz Amber Jar
COC	9-060913-133741-0004	9-060113-084802-0001	9-060913-133741-0004	9-060113-084802-0001	9-070913-170237-0006
Remarks					

Sample #	SS-0024	SS-0024			
Sample Date	6/25/2013	6/25/2013			
EventID	High Res Sampling	High Res Sampling			
Location	H004-F	H004-F			
Matrix	Soil	Soil			
Collection Method	Grab	Grab			
Sample Type	Field Sample	Field Sample			
Analyses	CLP 12 Toxic Congeners	CLP Dioxins/Furans			
CLP Sample #	PY0013	PY0013			
Tag	1033	1032			
Container	32oz Amber Jar	32oz Amber Jar			
COC	9-070913-170237-0006	9-070913-170237-0006			
Remarks					

Figure 7-7. Sample Receipt Created Using the Scribe Software

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8.0 CLP SAMPLE TRANSPORTATION AND SHIPPING

The sampling organization is responsible for the transportation and shipping of the Contract Laboratory (CLP) samples to the CLP laboratory that will be performing the analysis. The sampling organization is responsible for being in compliance with applicable packaging, labeling, and shipping requirements. Samplers are expected to review the applicable project plans to be aware of all State, Federal, Department of Transportation (DOT), and International Air Transport Association (IATA) regulations governing environmental and hazardous sample packaging.

8.1 Providing Shipment Notification

Some Regions require that samplers notify their Regional Sample Control Coordinator (RSCC) (or designee) when samples are shipped, and some Regions allow samplers to contact the Sample Management Office (SMO) directly to provide shipment notification. It is mandatory that the electronic Chain of Custody (COC) through the Contract Laboratory Program Support System (CLPSS) (aka "the SMO Portal") be submitted as soon as possible after shipping. Submitting the COC electronically sends a notification to SMO and to the laboratory that the samples have been shipped. It is recommended that samplers contact the RSCC to verify if such notification is necessary. If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) and SMO by 8:00 AM ET on the following business day.

It is strongly recommended that samplers provide shipping notification to the RSCC even if they have approval to directly notify SMO. This will assure that the Region is aware early on of any changes in the final number and timing or samples delivered.

8.2 Packing and Shipping Samples

Once the samples have been collected, it is very important that the sampler properly package the samples for shipment and ensure that the samples are sent to the appropriate laboratory as quickly as possible. Prompt and proper packaging of samples will achieve the following:

- Protect the integrity of samples from changes in composition or concentration caused by bacterial growth or degradation from increased temperatures.
- Reduce the chance of leaking or breaking of sample containers that would result in loss of sample volume, loss of sample integrity, and exposure of personnel to toxic substances.
- Help ensure compliance with shipping regulations.

One CLP sample may be contained in several bottles and vials. For example, one water sample may consist of all containers needed for three of the analytical analyses available under this service (i.e., Semivolatile Organic Analysis (SVOA) analysis, Pesticide analysis, and Aroclor analysis), even though the analyses are collected in separate containers. Therefore, the analysis to be performed and the matrix type will determine the type of container(s) that will be used, as well as the volume that must be collected for that particular sample analysis.

8.2.1 Inventory of Samples and Documentation

Inventory the contents of the shipping container against the corresponding Traffic Report (TR/COC) record when packing for shipment to laboratories. Check for the following conditions:

- Ensure that the correct number of containers have been collected for each analysis of the samples.
- Ensure that the required Performance Evaluation (PE) and Quality Control (QC) samples and cooler temperature blanks are included.
- Verify that the correct sample numbers and analyses have been assigned to each sample.

8.2.2 Shipping Regulations

Sample shipping personnel are legally responsible for ensuring that the sample shipment will comply with all applicable shipping regulations. Ensure that the following shipping regulations are adhered to if any of the following conditions apply to the samples:

- ☐ **Domestic and foreign soil movement** - follow Unites States Department of Agriculture (USDA) soil quarantine and shipping requirements.
- ☐ **Chlorinated Dibenzo-p-Dioxin (CDD) and Chlorinated Dibenzofuran (CDF)** - follow the High Resolution Superfund Method (HRSM) Statement of Work (SOW) for specific information on safety and handling of samples potentially containing CDD/CDF.
- ☐ **Radiological** - samples suspected to be radioactive must be screened; follow instructions from the Analytical Services Branch (ASB) Project Manager.
- ☐ **Dry ice** - if dry ice is used for shipping tissue samples, follow DOT and IATA regulations. Refer to the Code of Federal Regulations (49CFR 173.217) classifying dry ice as Hazard Class 9 *UN 1845* (Hazardous Material) and IATA Dangerous Goods regulations or DOT regulations and U.S. Environmental Protection Agency (EPA) guidelines. Refer to Appendix D for detailed shipping guidelines when using SW-846 Method 5035A to preserve and ship samples.

When shipping from remote locations, dry ice may used with the regular ice for the purpose of keeping the ice from melting. Wrap the dry ice in newspaper and place above any regular ice. Never place dry ice in a sealed bag or cooler.

Access more transportation and shipping information using the following Web sites:

Dangerous goods regulations
IATA Web site
http://www.iata.org/whatwedo/cargo/Pages/index.aspx

DOT/Pipeline and Hazardous Materials Safety Administration (PHMSA)
http://phmsa.dot.gov/regulations

The type of samples collected determines the type of shipping materials to be used.

- ☐ Refer to the project plan to determine which type of shipping container should be used for each type of sample being taken during the sampling event.

8.2.3 Shipping Temperature

Samples must be stored in conditions that maintain sample integrity.

- All samples should be placed in shipping containers or other suitable containers with ice to reduce the temperature as soon as possible after collection.
- Ideally, all samples should be shipped the day of collection for overnight delivery to the laboratory.
- If samples cannot be shipped on the day of collection, the sample temperature should be maintained at ≤6°C, but not frozen, until they are shipped to the laboratory.

8.2.4 Pack Shipping Containers

Packing shipping containers correctly will prevent sample containers from breaking and leaking. Pack shipping containers according to the instructions outlined in Table 8-1 to prevent shipping and leaking.

Table 8-1. Packing Samples for Shipment

Step	Action	Important Notes
1	Seal all drain holes in the shipping container, both inside and out, to prevent leakage in the event of sample breakage.	
2	Check all lids/caps to make sure the samples are tightly sealed and will not leak.	
3	Wipe loose soil residue from containers.	
4	Seal samples within a clear plastic bag.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared Volatile Organic Analysis (VOA) bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
5	Fully chill those samples requiring chilling to ≤6°C, but not frozen prior to placement within suitable packing materials.	
6	Prior to placing samples within the shipping cooler, it is recommended that samplers line shipping containers with non-combustible, absorbent packing material.	The CLP strongly discourages the use of vermiculite and cat litter as sources for packing material. These materials interfere with labeling and documentation and are difficult to remove from sample containers and shipping containers.
7	Place samples in CLEAN, sealed, watertight shipping containers (metal or hard plastic coolers).	All soil/sediment samples known to contain dioxin should be securely enclosed in metal cans (e.g., paint cans) with the lids sealed.
8	Conduct an inventory of the contents of the shipping cooler/container against the corresponding TR/COC record.	
9	Cover samples in double-bagged ice to prevent water damage to packing materials.	Do NOT pour loose ice directly into the sample cooler. The ice is used to maintain the temperature of the samples within the shipping cooler.
10	It is recommended that a temperature blank be included in an area within each shipping container which will allow for easy access by the laboratory upon opening the shipping container.	The temperature blank is generally a 40 mL vial filled with water and labeled "temperature blank" but does not have a CLP Sample Number.
11	Ensure that the site name or other site-identifying information does not appear on any documentation being sent to the laboratory.	

Step	Action	Important Notes
12	Label the outside of the shipping container with any instructions for handling, such as, "This end up," "Do not Tamper With," or "Environmental Laboratory Samples."	
13	If shipping samples containing methanol as a preservative (e.g., samples to be analyzed by SW-846 Method 5035A), use a label to indicate methanol, the United Nations (UN) identification number for methanol (UN 1230), and Limited Quantity.	

8.2.5 Include Required Paperwork

☐ Attach the necessary paperwork to the shipping cooler or acceptable container. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping container lid (Figure 8-1).

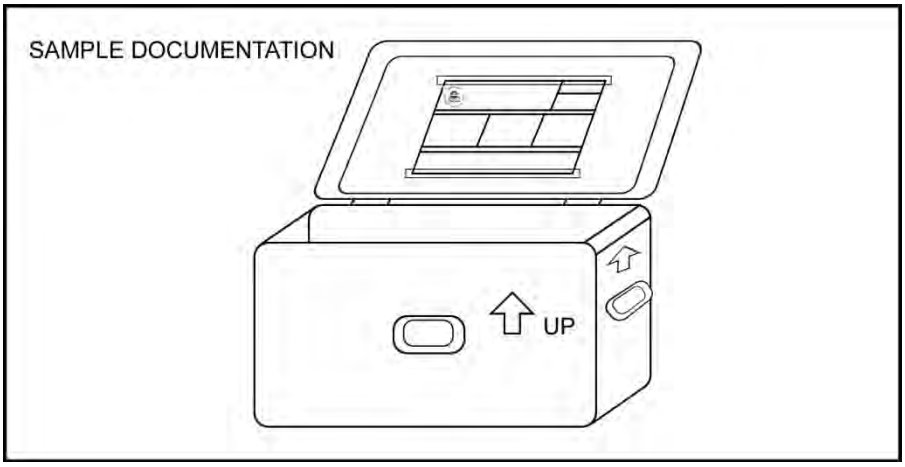


Figure 8-1. Sample Cooler with Attached TR/COC Record, PE Sample Instructions (if applicable), and Cooler Return Documentation

Required paperwork includes:

- TR/COC records
- Sample weight logs (Figure 4-1), if required for VOA samples.
- PE instruction sheets if PE samples are included in the cooler.

Contact the RSCC (or designee) for specific paperwork requirements.

8.2.6 Label and Seal Sample Shipping Coolers

After samples are packaged within shipping containers, samplers must carefully secure the top and bottom of the coolers with tape, place return address labels clearly on the outside of the container, and attach the required chain of custody seals (Figure 8-2).

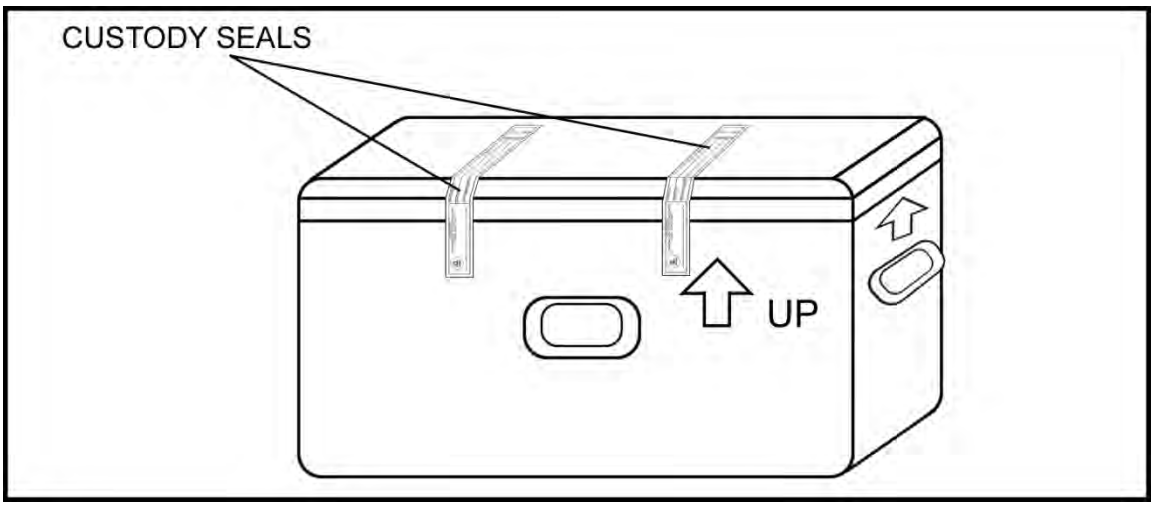


Figure 8-2. Shipping Cooler with Custody Seals

Use the following guidelines when labeling shipping containers:

- If more than one container is being delivered to a laboratory, samplers should mark each cooler as "1 of 2," "2 of 2," etc.
- An airbill, addressed to the Sample Custodian of the receiving laboratory, must be completed for each cooler shipped. Samplers should receive the correct name, address, and telephone number of the laboratory to which they must ship samples from the RSCC or SMO.
- To avoid delays in analytical testing, samplers should make sure they are sending the correct types of samples to the correct laboratory when collecting samples for multiple types of analysis. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory.
- Be aware of the shipping company's hours of operation, shipping schedule, and pick-up/drop-off requirements.

8.2.7 Overnight Delivery

It is imperative that samples be sent via overnight delivery. Delays due to longer shipment times may cause technical holding times to expire, or the temperature to rise above the preservation limit, which in turn may destroy sample integrity or require the recollection of samples for analysis.

8.2.8 Saturday Delivery

For shipping samples for Saturday delivery, the sampler MUST notify the RSCC (or their designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

8.2.9 Shipment Notification

When samples are shipped to CLP Laboratories, samplers **must immediately** report all sample shipments to the RSCC (or designee) or to SMO. **Under no circumstances should the sampler contact the laboratory directly.** If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) or SMO by 8:00 AM ET on the following business day. Samplers should receive the name and phone number of the appropriate SMO coordinator to contact from the Region/RSCC. Samplers should be aware if their Region requires them to notify the RSCC (or designee) and/or SMO of sample shipment.

Samplers must provide the following information to the RSCC (or designee) or to SMO:

- Name and phone number at which they can easily be reached (preferably closest on-site phone number if still in the field)
- SMO-assigned Case number
- Number, matrix and analysis of samples being shipped, and MA number (if required)
- Name of laboratory (or laboratories) to which the samples were shipped
- Airbill number(s)
- Date of shipment
- Case status (i.e., whether or not the Case is complete)
- Problems encountered, special comments, or any unanticipated issues
- When to expect the next anticipated shipment

For Saturday delivery, samplers MUST notify the RSCC (or designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

8.2.10 Uploading the Electronic COC

The electronic COC record must be uploaded to SMO as soon as possible after sample shipment. The following is an overview of the steps used to upload the electronic COC:

- ☐ Using **Scribe**:
  - Under **Sample Management**, click on **Chain of Custody** link.
  - Click the **Export** button on the top of the menu bar.
  - Select the **COC XML File (.xml)** option.
  - Select the **COC(s)** to be exported.
  - Make sure that the **CLP Region Copy COC XML Template** is checked.
  - Click **OK**.
  - Provide a **filename** for the exported XML file. Per CLP guidance, the XML file name must reference the Region #; Case Number and today's date.
  - Click the **Save** button.
- ☐ Using the **Contract Laboratory Program Support System (CLPSS)**:
  - Select the **Submit Chain of Custody** task from the SMO Portal.
  - Select the **COC** file to upload.
  - Enter any **comments** associated with the COC file.
  - **Submit the file**; CLPSS provides a confirmation page.
  - **Print or download** a copy of the submission summary to keep as a record of the submission.

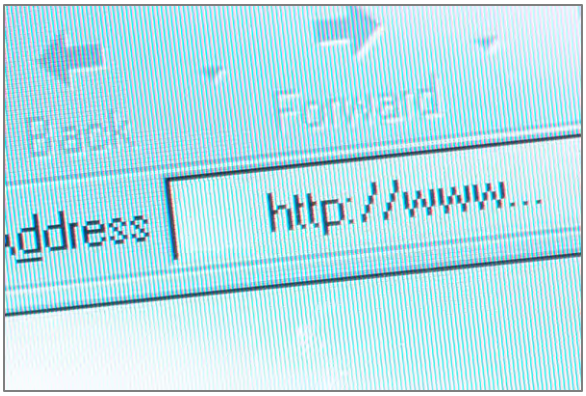
For a detailed description of how to create and upload electronic COC files using Scribe and CLPSS, refer to each system's user documentation.

8.2.11 Return Sample Shipping Coolers

CLP laboratories must routinely return sample shipping coolers within 14 calendar days following shipment receipt. Therefore, the sampler should also include cooler return instructions with each shipment. The **sampler** (not the CLP laboratory) is responsible for paying for the disposition (return or disposal) of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address to allow for cooler return. **Samplers should use the least expensive return shipping option possible.**

9.0 SAMPLER RESOURCES

This Guide provides a summary of many of the resources used to define and manage the sampling process. The sampler may need to refer to the original source documents or Web sites for further information or clarification. The resources cited in this Guide are listed in this section.



9.1 List of Resources

Table 9-1 provides a list of resources available to samplers. These resources are referenced throughout this Guide.

Table 9-1. Resources for Samplers

Resource	Location
United States Environmental Protection Agency (EPA) Statements of Work	http://www.epa.gov/superfund/programs/clp/analytic.htm
Scribe Software Support	http://www.ertsupport.org/scribe_home.htm
Contract Laboratory Program Support System (CLPSS)	https://epasmoweb.fedcsc.com/smoportal
EPA Environmental Response Team (ERT) User Manual for Scribe Contract Laboratory Program (CLP) Sampling	http://www.epaosc.org/sites/ScribeGIS/files/Scribe%20CLP%20User%20Guide.pdf
CLP Guidance Documents	http://www.epa.gov/superfund/programs/clp/guidance.htm
Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) regulations	http://phmsa.dot.gov/hazmat
Use of Dry Ice - Federal Regulations (49CFR 173.217) classified dry ice as Hazard Class 9 *UN 1845* (Hazardous Material).	http://www.gpo.gov/fdsys/pkg/CFR-2004-title49-vol2/xml/CFR-2004-title49-vol2-sec173-217.xml
International Air Transport Association (IATA) transportation regulations	http://www.iata.org
United States Department of Agriculture (USDA) Regulated Organisms and Soil Permits	http://www.aphis.usda.gov/plant_health/permits/organism/soil/
Common Ground Alliance - marking for underground utilities	http://www.call811.com

Resource	Location
Water Sampling Requirements of Dissolved Metals determinators	***EPA Method SW-3005A – Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, Section 2.2:*** Dissolved metals - The sample is filtered through a 0.45-µm filter at the time of collection and the liquid phase is then acidified at the time of collection with nitric acid. Samples for dissolved metals do not need to be digested as long as the acid concentrations have been adjusted to the same concentration as in the standards. http://www.epa.gov/osw/hazard/testmethods/sw846/online/3_series.htm
	Clean Water Act (CWA), §136.3 Identification of test procedures. Table II—Required Containers, Preservation Techniques, and Holding Times [7]For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically. http://www.ecfr.gov/cgi-bin/text-idx?SID=ed1ce4541f86f730e11600ca39e3926b&node=40:24.0.1.1.1&rgn=div5#40:24.0.1.1.1.0.1.3
EPA Method SW-846 5035A - Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples	http://www.epa.gov/osw/hazard/testmethods/pdfs/5035a_r1.pdf
NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities	http://www.osha.gov/Publications/complinks/OSHG-HazWaste/all-in-one.pdf
The Roles of Project Managers and Laboratories in Maintaining the Representativeness of Incremental and Composite Soil Samples, EPA/OSWER 9200.1-117FS	http://www.clu-in.org/download/char/RolesofPMsandLabsinSubsampling.pdf

9.2 For More Information

For more information regarding the CLP or this Guide, refer to the Superfund Analytical Services/Contract Laboratory Program Web site at:
http://www.epa.gov/superfund/programs/clp/contacts.htm#contacts

APPENDIX A FUNCTIONS WITHIN A SAMPLING PROJECT

The following table describes Quality Assurance Project Plan (QAPP) requirements taken from *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5).

Table A-1. QAPP Requirements

Functions Within a Sampling Project	Elements of that Function
Project Management	
Project/Task Organization	Identifies the individuals or organizations participating in the project and defines their specific roles and responsibilities.
Problem Definition/Background	States the specific problem to be solved or decision to be made and includes sufficient background information to provide a historical and scientific perspective for each particular project.
Project/Task Description	Describes the work to be performed and the schedule for implementation to include: • Measurements to be made during the course of the project • Applicable technical, regulatory, or program-specific quality standards, criteria, or objectives • Any special personnel and equipment requirements; assessment tools needed • A work schedule and any required project and quality records, including types of reports needed
Quality Objectives and Criteria	Describes the project quality objectives and measurement performance criteria.
Special Training/Certification	Ensures that any specialized training for modified field sampling techniques, field analyses, laboratory analyses, or data validation should be specified.
Documents and Records	• Itemizes the information and records that must be included in the data report package and specifies the desired reporting format for hard copy and electronic forms, when used. • Identifies any other records and/or documents applicable to the project such as audit reports, interim progress reports, and final reports that will be produced. • Specifies or references all applicable requirements for the final disposition of records and documents, including location and length of retention period.
Data Generation and Acquisition	
Sampling Process Design (Experimental Design)	• Describes the experimental design or data collection design for the project. • Classifies all measurements as critical or non-critical.
Sampling Methods	• Describes the procedures for collecting samples and identifies sampling methods and equipment. Includes any implementation requirements, support facilities, sample preservation requirements, and materials needed. • Describes the process for preparing and decontaminating sampling equipment to include the disposal of decontamination by-products, selection and preparation of sample containers, sample volumes, preservation methods, and maximum holding times for sampling, preparation, and/or analysis. • Describes specific performance requirements for the method. • Addresses what to do when a failure in sampling occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented.
Sample Handling and Custody	• Describes the requirements and provisions for sample handling and custody in the field, laboratory, and transport, taking into account the nature of the samples, the maximum allowable sample holding times before extraction and analysis, and the available shipping options and schedules. • Includes examples of sample labels, custody forms, and sample custody logs.

Functions Within a Sampling Project	Elements of that Function
Analytical Methods	• Identifies the analytical methods and equipment required, including sub-sampling or extraction methods, waste disposal requirements (if any), and specific method performance requirements. • Identifies analytical methods by number, date, and regulatory citation (as appropriate). If a method allows the user to select from various options, the method citations should state exactly which options are being selected. • Addresses what to do when a failure in the analytical system occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented. • Specifies the laboratory turnaround time needed, if important to the project schedule. • Specifies whether a field sampling and/or laboratory analysis Case Narrative is required to provide a complete description of any difficulties encountered during sampling or analysis.
Quality Control (QC)	• Identifies required measurement QC checks for both the field and laboratory. • States the frequency of analysis for each type of QC check, and the spike compounds sources and levels. • States or references the required control limits for each QC check and corrective action required when control limits are exceeded and how the effectiveness of the corrective action shall be determined and documented. • Describes or references the procedures to be used to calculate each of the QC statistics.
Instrument/Equipment Testing, Inspection, and Maintenance	• Describes how inspections and acceptance testing of environmental sampling and measurement systems and their components will be performed and documented. Identifies and discusses the procedure by which final acceptance will be performed by independent personnel. • Describes how deficiencies are to be resolved and when re-inspection will be performed. • Describes or references how periodic preventative and corrective maintenance of measurement or test equipment shall be performed. • Identifies the equipment and/or system requiring periodic maintenance. • Discusses how the availability of spare parts identified in the operating guidance and/or design specifications of the systems will be assured and maintained.
Instrument/Equipment Calibration and Frequency	• Identifies all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled, and at specific times, calibrated to maintain performance within specified limits. • Identifies the certified equipment and/or standards used for calibration. • Describes or references how calibration will be conducted using certified equipment and/or standards with known valid relationships to nationally recognized performance standards. If no such standards exist, documents the basis for calibration. • Indicates how records of calibration shall be maintained and traced to the instrument.
Inspection/Acceptance of Supplies and Consumables	• Describes how and by whom supplies and consumables shall be inspected and accepted for use in the project. • States acceptance criteria for such supplies and consumables.
Non-direct Measurements	• Identifies any types of data needed for project implementation or decision-making that are obtained from non-measurement sources (e.g., computer databases, programs, literature files, historical databases). • Describes the intended use of data. • Defines the acceptance criteria for the use of such data in the project. • Specifies any limitations on the use of the data.
Data Management	• Describes the project data management scheme, tracing the data path from generation in the field or laboratory to their final use or storage. • Describes or references the standard record-keeping procedures, document control system, and the approach used for data storage and retrieval on electronic media.

APPENDIX B SAMPLE CONTAINER TYPE SPECIFICATIONS

Table B-1. Sample Container Type Specifications

Reference Number	Container Type	Specifications	
		Closure	Septum
1	40 mL amber glass vial, 24 mm neck finish.	Polypropylene or phenolic, open-top screw-cap, 15 cm opening, 24-400 size.	24 mm disc of 0.005 in. Polytetrafluoroethylene (PTFE) bonded to 0.120 in. silicone for a total thickness of 0.125 in.
2	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
3	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish.	Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	N/A
4	4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish.	Polypropylene or phenolic cap, 48-400 size; 0.015 in. PTFE liner.	N/A
5	1 L amber round glass bottle, 33 mm pour-out neck finish.	Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner.	N/A
6	Coring tool used as a transport device (e.g., 5 g Sampler).	Has built-in closing mechanism.	N/A
7	1 qt polymer zip-top bag	Has built-in closing mechanism.	N/A
8	Heavy duty aluminum foil	N/A	N/A

Table B-2. Sample Container Type Specifications with Analysis

Reference Number	Analysis	Matrix	Sample Type	Container Type[2]	Specifications	
					Closure	Septum
1	VOA	Water	Samples Only	40 mL amber glass vial, 24 mm neck finish.	Polypropylene or phenolic, open-top screw-cap, 15 cm opening, 24-400 size.	24 mm disc of 0.005 in. Polytetrafluoroethylene (PTFE) bonded to 0.120 in. silicone for a total thickness of 0.125 in.
			Samples with SIM[1]			
			Samples with MS/MSD			
	VOA	Soil/Sediment[2]	**(Option 1)** Samples Only			
			(Option 1) Samples with MS/MSD			
	VOA	Soil/Sediment[2]	**(Option 2)** Samples Only			
			(Option 2) Samples with MS/MSD			
	VOA	Soil/Sediment[2]	**(Option 4)** Samples for TCLP/SPLP Only			
2	Metals/ICP-AES, Metals/ICP-MS, and/or Mercury by CVAA	Water	Samples Only	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
			Samples with MS/Duplicate			
	Cyanide/ Spectrophotometric Determination	Water	Samples Only			
			Sample with MS/Duplicate			
3	SVOA	Soil/Sediment[3]	Samples Only	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish.	Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	N/A
			Samples for TCLP/SPLP			
			Samples with MS/MSD			
	SVOA SIM	Soil/Sediment[3]	Samples Only			
			Samples with MS/MSD			

Reference Number	Analysis	Matrix	Sample Type	Container Type[2]	Specifications	
					Closure	Septum
	Pesticides	Soil/Sediment[3]	Samples Only			
			Samples for TCLP/SPLP			
			Samples with MS/MSD			
	Aroclors	Soil/Sediment[3]	Samples Only			
			Samples with MS/MSD			
	Metals/ICP-AES, Metals/ICP-MS, and/or Mercury by CVAA	Soil/Sediment[4]	Samples Only			
			Samples for TCLP/SPLP			
			Samples with MS/Duplicate			
	Cyanide/ Spectrophotometric Determination	Soil/Sediment[4]	Samples Only			
			Samples for SPLP			
			Samples with MS/Duplicate			
	CDD/CDF and CBC	Soil/Sediment/Oil/ Ash/Biosolid	----------			
	CDD/CDF and CBC	Tissue	----------			
4	SVOA	Soil/Sediment[3]	Samples Only	4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish.	Polypropylene or phenolic cap, 48-400 size; 0.015 in. PTFE liner.	N/A
			Samples for TCLP/SPLP			
			Samples with MS/MSD			
	SVOA SIM	Soil/Sediment[3]	Samples Only			
			Samples with MS/MSD			
	Pesticides	Soil/Sediment	Samples Only			
			Samples for TCLP/SPLP			
			Samples with MS/MSD			
	Aroclors	Soil/Sediment	Samples Only			

Reference Number	Analysis	Matrix	Sample Type	Container Type[2]	Specifications	
					Closure	Septum
			Samples with MS/MSD			
	CDD/CDF and CBC	Soil/Sediment/Oil/ Ash/Biosolid	----------			
	CDD/CDF and CBC	Tissue	----------			
5	SVOAs	Water[5]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish.	Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner.	N/A
			Samples with MS/MSD			
	SVOA SIM	Water[5]	Samples Only			
			Samples with MS/MSD			
	Pesticides	Water[5]	Samples Only			
			Samples with MS/MSD			
	Aroclors	Water[5]	Samples Only			
			Samples with MS/MSD			
	CDD/CDF and CBC	Water	----------			
6	VOA	Soil/Sediment	**(Option 3)** Samples Only	Coring tool used as a transport device (e.g., 5 g Sampler).	Has built-in closing mechanism.	N/A
			(Option 3) Samples with MS/MSD			
7	Metals/ICP-AES	Wipe	Samples Only	1 qt polymer zip-top bag	Has built-in closing mechanism.	N/A
8	CDD/CDF and CBC	Tissue	----------	Heavy duty aluminum foil	N/A	N/A

1 Available through Modified Analysis (MA) only.
2 Vials for soil analysis are typically pre-labeled and tared. Vials for water analysis are not pre-labeled or tared.
3 If one or two extractable analyses are required for soil/sediment, only a single 8 oz. jar is required. If three extractable analyses are required, two 8 oz. jars are required. The number of jars should be doubled if MS/MSD is required
4 Only one 8 oz. jar is needed for soil/sediment when all metals (including mercury) and cyanide analyses are required for soil/sediment samples. Collect more than one jar when TCLP or SPLP are scheduled.
5 An aqueous sample for SVOA analysis would require the field sampler to collect at least 2 L of field samples and at least 2 L each for the MS and MSD samples for a total volume of 6 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 6 L must be collected for each analysis method. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

APPENDIX C CLP SAMPLE COLLECTION REQUIREMENTS BY ANALYSIS TYPE

Table C-1. Sample Collection Requirements for CLP SOW SOM02.X (Volatile Organic Analysis Only)

Analysis	Matrix	Sample Type	Container Type[1]	Minimum Number of Containers Needed				Minimum Volume/Mass[2]	Important Notes	Preservative[3]	Technical Holding Time[4]
				with Water	Dry	% Moisture	TOTAL				
VOA	Water	Samples Only	40 mL amber glass vial, 24 mm neck finish. See Table B-1, Reference Number 1.	-	-	-	**3**	Fill to capacity	Containers/vials must be filled to capacity with no headspace or air bubbles. Refer to Appendix E for samples requiring QC analyses. If amber containers are not available, the samples should be protected from light.	Preserve to a pH of 2 with HCl and cool to ≤ 6°C, but not frozen, immediately after collection. DO NOT FREEZE water samples.	14 days
		Samples with SIM[5]		-	-	-	**5**				
		Samples with MS/MSD									
	Soil/ Sediment	Samples Only	**OPTION 1** Closed-system 40 mL amber glass vial containing magnetic stirrer, 24 mm neck finish. See Table B-1, Reference Number 1.	-	3	1	**4**	5g (at least 50 g for TCLP or SPLP)	Place samples on side prior to being iced.[7] Refer to Appendix E for samples requiring QC analyses.	Frozen to < -7°C **OR** Iced to ≤ 6°C, but not frozen.	14 days **OR** 48 hours (unpreserved)[6]
		Samples with MS/MSD		-	9	3	**12**				
		Samples Only	**OPTION 2** Closed-system 40 mL amber glass vial containing magnetic stirrer, 24 mm neck finish and 5 mL water. See Table B-1, Reference Number 1.	3	-	1	**4**	5 g	Place samples on side prior to being iced.[7] Refer to Appendix E for samples requiring QC analyses.	Frozen to < -7°C **OR** Iced to ≤ 6°C, but not frozen.	14 days **OR** 48 hours (unpreserved)[6]
		Samples with MS/MSD		9	-	3	**12**				
		Samples Only	**OPTION 3** Coring tool used as a transport device. See Table B-1, Reference Number 6.	-	3	1	**4**	5 g	Refer to Appendix E for samples requiring QC analysis. Place samples on side prior to being iced.[7]	Frozen to < -7°C. **OR** Iced to ≤ 6°C, but not frozen.	14 days **OR** 48 hours (unpreserved)[6]
		Samples with MS/MSD		-	9	3	**12**				

Analysis	Matrix	Sample Type	Container Type[1]	Minimum Number of Containers Needed				Minimum Volume/Mass[2]	Important Notes	Preservative[3]	Technical Holding Time[4]
				with Water	Dry	% Moisture	TOTAL				
		Samples for TCLP/SPLP Only	**OPTION 4** Closed-system 40 mL amber glass vial 24 mm neck finish. See Table B-1, Reference Number 1.	-	4	-	**4**	25 g	Place samples on side prior to being iced.[7]	Iced to ≤ 6°C but not frozen.	14 days

Notes

1 Vials for soil analysis are typically pre-labeled and tared. Vials for water analysis are not pre-labeled or tared.

2 Minimum volume/mass to be collected in order to ensure sample analysis can be performed. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

3 Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.

4 Technical holding time is calculated from the time of sample collection to sample extraction, and determined as 14 days for preserved (frozen or iced) samples and 48 hours for non-preserved (iced) samples.

5 Available through Modified Analysis (MA) only.

6 Unpreserved soil samples can be frozen or iced at the time of receipt by the laboratory to increase holding time.

7 Vials are place on their side so that the septum is wet on the inside, thereby preventing vapor leaks around it, in case any bubbles form. Also, in case they freeze, you want the water to expand into the flexible septum rather than breaking the vial.

Table C-2. Sample Collection Requirements for CLP SOW SOM02.X (SVOAs, Pesticides and Aroclors)

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/Mass[1]	Important Notes	Preservative/ Collection	Technical Holding Time[2]
SVOAs	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	2 L (per Test)	If amber containers are not available, the samples should be protected from light.	Cool all samples to ≤ 6°C, but not frozen, immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or two 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	150 g (at least 500 g for TCLP or SPLP)		Cool all samples to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Samples for TCLP/SPLP	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			
SVOA SIM	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to ≤6°C, but not frozen, immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or two 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	150 g		Cool all samples to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			

Table C-2. (Continued) Sample Collection Requirements for CLP SOW SOM02.X (SVOAs, Pesticides and Aroclors)

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/Mass[1]	Important Notes	Preservative/ Collection	Technical Holding Time[2]
Pesticides	Water[3, 5]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to ≤ 6°C), but not frozen, immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	150 g		Cool all samples to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Samples for TCLP/SPLP	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			
Aroclors	Water[3, 5]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to ≤ 6°C, but not frozen, immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	150 g		Cool all samples to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	300 g			

Notes

1 Minimum volume/mass to be collected in order to ensure sample analysis can be performed.

2 This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.

3 An aqueous sample for SVOA analysis would require the field sampler to collect at least 2 L of field samples and at least 2 L each for the MS and MSD samples for a total volume of 6 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 6 L must be collected for each analysis method. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

4 If one or two extractable analyses are required for soil/sediment, only a single 8 oz. jar is required. If three extractable analyses are required, two 8 oz. jars are required. The number of jars should be doubled if MS/MSD is required.

5 Samplers must test for chlorine in aqueous samples in the field upon collection. Refer to the SAP and Appendix E for guidance.

Table C-3. Sample Collection Requirements for CLP SOW ISM02.X

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/ Mass[1]	Important Notes	Preservative/ Collection[2]	Technical Holding Time[3]
Metals/ICP-AES, Metals/ICP-MS, and/or Mercury by CVAA	Water	Samples Only	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish. See Table B-1, Reference Number 2.	1L	DO NOT FREEZE water samples.	Acidify to pH < 2 with HNO_3 immediately after collection.[4]	6 months for all metals except Mercury (28 days)
		Samples with MS/Duplicate		2L			
	Soil/ Sediment[5]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish. See Table B-1, Reference Number 3.	Fill to capacity		Cool to ≤ 6°C, but not frozen, immediately after collection.	6 months
		Samples for TCLP/SPLP					
		Samples with MS/Duplicate					
Metals/ICP-AES[6]	Wipe	Samples Only	1 qt polymer zip-top bag. See Table B-1, Reference Number 7.	N/A		Store at room temperature.	6 months
Cyanide/ Spectrophotometric Determination	Water	Samples Only	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish. See Table B-1, Reference Number 2.	1L	DO NOT FREEZE water samples.	To neutralize residual chlorine, add 0.6 g ascorbic acid for each liter of sample collected, immediately upon collection.[7] Add NaOH until pH > 10 and cool to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Sample with MS/Duplicate		2L			
	Soil/ Sediment[5]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish. See Table B-1, Reference Number 3.	Fill to capacity		Cool to ≤ 6°C, but not frozen, immediately after collection.	14 days
		Samples for SPLP					
		Samples with MS/Duplicate					

Notes

1 Minimum volume/mass to be collected in order to ensure sample analysis can be performed.
2 Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.
3 This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction.
4 Water samples collected for total metal and filtered metal analyses from the same sampling location must be assigned separate (unique) CLP Sample Numbers.
5 Only one 8 oz. jar is needed for soil/sediment when all metals (including mercury) and cyanide analyses are required for soil/sediment samples. Collect more than one jar when TCLP or SPLP are scheduled.
6 Wipe materials have varied from laboratory tissues (e.g., Kimwipes®) to pre-moistened "baby wipes" from the nearest store.
7 Samplers must test for sulfide and oxidizing agents (e.g., chlorine) in aqueous samples in the field upon collection. Refer to the SAP and Appendix E for guidance. Sulfides adversely affect the analytical procedure. The following can be done to test for and neutralize sulfides. Place a drop of the sample on lead acetate test paper to detect the presence of sulfides. If sulfides are present, treat 25 mL more of the sample than that required for the cyanide determination with powdered cadmium carbonate or lead carbonate. Yellow cadmium sulfide or black lead sulfide precipitates if the sample contains sulfide. Repeat this operation until a drop of the treated sample solution does not darken the lead acetate test paper. Filter the solution through a dry filter paper into a dry beaker, and from the filtrate measure the sample to be used for analysis. Avoid a large excess of cadmium carbonate and a long contact time in order to minimize a loss by complication or occlusion of cyanide on the precipitated material. Sulfide removal should be performed in the field, if practical, prior to pH adjustment with NaOH.

Table C-4. Sample Collection Requirements for CLP SOW HRSM01.X [CDDs, CDFs, and CBCs]

Analysis	Matrix	Container Types	Minimum Volume/Mass[1]	Important Notes	Preservative	Technical Holding Time[2]
CDD/CDF and CBC	Water[3]	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table B-1, Reference Number 5.	2L	If amber containers are not available, the samples should be protected from light.	Cool all samples to ≤ 6°C, but not frozen, immediately after collection. DO NOT FREEZE water samples. If residual chlorine is present, add 80 mg sodium thiosulfate/L of water.	1 year
	Soil/Sediment/Oil/ Ash/Biosolid	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or 4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table B-1, Reference Numbers 3 and 4.	Fill to capacity		Cool all samples to ≤ 6°C, but not frozen, immediately after collection.	
	Tissue	Heavy duty aluminum foil as transport device. See Table B-1, Reference Number 8. 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or 4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. Reference Number 3 and 4 for homogenates tissue.	Fill to capacity		Cool all samples to ≤ 6°C, or freeze immediately after collection.	

Notes

1 Minimum volume/mass to be collected in order to ensure sample analysis can be performed.

2 This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.

3 Samplers must test for chlorine in aqueous samples in the field upon collection. Refer to the SAP and Appendix E for guidance.

APPENDIX D CLP SAMPLE COLLECTION GUIDELINES FOR SOIL VOA SAMPLES BY SW-846 METHOD 5035A AND TCLP EXTRACTION – EPA SW 846 1311, SPLP EXTRACTION EPA SW 846 1312

A. Preferred Options for the Contract Laboratory Program (CLP) are Options 1, 2, 3, and 4:

This method employs sample vials that are filled and weighed in the field and never opened during the analytical process. As a result, sampling personnel should be equipped with a portable balance capable of weighing to 0.01g.

Soil samples must be placed on their sides prior to being frozen or placed on ice. Vials are place on their side so that the septum is wet on the inside, thereby preventing vapor leaks around it, in case any bubbles form. Also, in case they freeze, you want the water to expand into the flexible septum rather than breaking the vial. Dry ice or field freezers are the only options.

Option 1.

Closed-system Vials:

Container - tared or preweighed 40 mL Volatile Organic Analysis (VOA) vial containing a magnetic stir bar.

Collect 5 g of soil per vial (iced or frozen in the field). Check the pre-tared weight of the (dry) VOA vials prior to departure for the sampling event under controlled conditions. Weigh vials and soil samples to the nearest 0.01 g. This check is to ensure that the original weight was properly recorded.

Regular Samples	3 Vials - Dry (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials
Regular Samples Requiring QC Analysis	9Vials - Dry (5 g soil per vial) 3 Vial - Dry (filled with soil, no headspace) 12 Total Vials

Option 2.

Closed-system Vials Containing Water:

Container - tared or pre-weighed 40 mL VOA vial containing a magnetic stir bar and 5 mL water.

Collect 5 g of soil per vial (iced or frozen in the field). Weigh vials and soil samples to the nearest 0.01 g.

Regular Samples	3 Vials with water added (5 g soil and 5 mL water per vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials (3 with water and 1 dry)
Regular Samples Requiring QC Analysis	9 Vials with water added (5 g soil and 5 mL water per vial) 3 Vial - Dry (filled with soil, no headspace) 12 Total Vials (9 with water and 3 dry)

Option 3.

Container - 5 g Samplers or equivalent and coring tool used as a transport device.

All samples should be iced or frozen in the field and bagged individually.

Regular Samples	3 Samplers (5 g soil per Sampler) 1 Vial - Dry (filled with soil, no headspace) 4 Total (3 Samplers and 1 Vial)
Regular Samples Requiring QC Analysis	9 Samplers (5 g soil per Sampler) 3 Vial - Dry (filled with soil, no headspace) 12 Total (9 Samplers and 3 Vial)

Option 4.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA vial.

Collect 25 g of soil per vial (iced or frozen in the field). Check the pre-tared weight of the (dry) VOA vials prior to departure for the sampling event under controlled conditions. Weigh vials and soil samples to the nearest 0.01 g. This check is to ensure that the original weight was properly recorded.

Regular Samples	4 Vials - Dry (25 g soil per vial)

B. Options 5, 6, and 7 are NOT preferred options for the CLP:

Option 5.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA vial containing a magnetic stir bar and preservative.

Collect 5 g of soil per vial and add Sodium bisulfate ($NaHSO_4$) preservative (5 mL water + 1 g $NaHSO_4$) - iced in the field.

Caution: **This option is NOT a Preferred Option for the CLP because:**

$NaHSO_4$ preservation creates low pH conditions that will cause the destruction of certain CLP target analytes (e.g., vinyl chloride, trichloroethene, trichlorofluoromethane, cis- and trans-1,3-dichloropropene). Projects requiring the quantitation of these analytes should consider alternative sample preservation methods. $NaHSO_4$ also cannot be used on carbonaceous soils. Check the soil before using this method of collection! Soil can be checked by placing a test sample in a clean vial, then adding several drops of $NaHSO_4$ solution. If the soil bubbles, use Option 5b and note this issue on the TR/COC record.

Option 5a. Samples preserved in the field

Regular Samples	3 Vials with $NaHSO_4$ preservative added (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials (3 with $NaHSO_4$ preservative and 1 without)

Regular Samples Requiring QC Analyses	6 Vials with $NaHSO_4$ preservative added (5 g soil per vial) 2 Vial - Dry (filled with soil, no headspace) 8 Total Vials (6 with $NaHSO_4$ and 2 without)

Option 5b. Samples are preserved by the laboratory (No $NaHSO_4$ preservative is added to these samples in the field).

Regular Samples	3 Vials - Dry (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials
Regular Samples Requiring QC Analyses	6 Vials - Dry (5 g soil per vial) 2 Vial - Dry (filled with soil, no headspace) 8 Total Vials

Option 6.

Methanol Preservation (medium-level analysis only):

Container - tared or pre-weighed 40 mL VOA vials containing 5 mL methanol.

Collect 5 g of soil per vial (iced in the field).

Caution: This is NOT a preferred option for the CLP because:

Samples preserved with methanol can only be analyzed by the medium-level method. Low-level Contract Required Quantitation Limit (CRQLs) cannot be achieved when samples are preserved this way. If this soil option is used, then samples for low-level analysis by one of the other options should also be collected and accompany the medium-level soil.

Additional problems associated with use of methanol as a preservative in the field include:

- Possible contamination of the methanol by sampling-related activities (e.g., absorption of diesel fumes from sampling equipment);
- Leakage of methanol from the sample vials during shipping, resulting in loss of VOAs prior to analysis.

Regular Samples	2 Vials (5 g soil and 5 mL methanol per vial) 1 Vial - Dry (filled with soil, no headspace) 3 Total Vials (1 with methanol and 1 dry)
Regular Samples Requiring QC Analyses	6 Vials (5 g soil and 5 mL methanol per vial) 1 Vial -Dry (filled with soil, no headspace) 7 Total Vials (6 with methanol and 1 dry)

If shipping samples contain methanol as a preservative, a shipping label must be used to indicate methanol. This label must also contain the United Nations (UN) identification number for methanol (UN 1230), and indicate Limited Quantity. Refer to http://www.phmsa.dot.gov for more information about the safe shipping of methanol.

Option 7.

Glass Containers filled with sample - No Headspace:

Container - 4 oz Glass Jars.

Glass container filled with soil with no headspace and iced.

Caution: This is NOT a preferred option for the CLP because:

Samples collected in this manner lose most of their volatile analytes prior to analysis when the sample containers are opened and sub-sampled in the laboratory. This option is only available due to Regional requirements.

Regular Samples	2 Glass Jars (4 oz) filled with sample, no headspace 1 Vial - Dry (filled with soil, no headspace)
	3 Total Containers
Regular Samples Requiring QC Analyses	2 Glass Jars (4 oz) filled with sample, no headspace 1 Vial - Dry (filled with soil, no headspace)
	3 Total Containers

C. Caution:

1. Extreme care must be taken to ensure that frozen or iced samples do not break during shipment.
2. Before adding soil to pre-weighed vials containing a stir bar, weigh the vials to confirm the tared weight. If the weight varies by more than 0.1 g, record the new weight on the label and the sample documentation. Do NOT add labels to these vials once the tared weight has been determined or confirmed.

D. Dry Samples:

All options include taking a sample in a dry 40 mL VOA vial (or a 4 oz wide mouth jar) with no headspace. No water, $NaHSO_4$, or methanol is added to this sample. This sample is taken to determine moisture content; therefore, it does not need to be tared or have a stir bar.

E. Iced or Frozen Samples:

1. Iced means cooled to ≤6°C, but not frozen, immediately after collection.
2. Frozen means cooled to ≤ -7°C immediately after collection.
3. Dry ice is not a long-term freezing agent and may contaminate samples.

F. Sample Delivery:

CLP strongly recommends that all samples reach the laboratory by COB the next day after sample collection.

G. Notes:

1. For Options 2, 5, and 6, check the weight of the pre-tared VOA vials plus liquid in the field due to the possibility that liquid leaked out during packing, transit, or deployment in the field just prior to sampling. This check is to ensure that the original weight is properly recorded.
2. For Option 5, samples can be preserved with $NaHSO_4$ either:
   - In the field; or
   - In the laboratory upon receipt. In this case, the sampler should put the following information in the Preservation Column of the TR/COC record - "To be preserved at lab with $NaHSO_4$." This Regional request should also be communicated to SMO so that the laboratory can be notified.
3. Regional QAPPs may require the use of Option 6. Note that this option is for medium-level analysis ONLY.
4. If water, methanol, or $NaHSO_4$ preservative is added to the vials in the field, a field blank containing the appropriate liquid used in the vials should be sent to the laboratory for analysis.

APPENDIX E GENERAL CLP SAMPLE COLLECTION GUIDELINES VOAs IN WATER

Regional guidance and/or specific Project Plan requirements will supersede the guidelines listed below.

Collect the following:

- At least three 40 mL glass containers with polytetrafluoroethylene (PTFE)-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to ≤6°C, but not frozen, immediately after collection. DO NOT FREEZE THE SAMPLES.

Regular Samples	3 vials (40 ml filled to capacity with no headspace or air bubbles)
Regular Samples Requiring QC Analysis	3 vials for Sample (40 ml filled to capacity with no headspace or air bubbles) 1 vials for MS (40 ml filled to capacity with no headspace or air bubbles) 1 vials for MSD (40 ml filled to capacity with no headspace or air bubbles)

- If Selected Ion Monitoring (SIM) analysis is requested, at least two additional 40 mL glass containers with PTFE-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to ≤6°C, but not frozen, immediately after collection.

Regular Samples With SIM Analysis	3 vials for Sample (40 ml filled to capacity with no headspace or air bubbles) 2 vials (40 ml filled to capacity with no headspace or air bubbles)

Volatile Organic Analysis (VOA) Selected Ion Monitoring (SIM) analysis is only available through Modified Analysis (MA).

Test for Carbonates, Residual Chlorine, Oxidants, and Sulfides:

- It is very important that samplers obtain Regional guidance when testing and ameliorating for:
  - Carbonates;
  - Residual chlorine (e.g., municipal waters or industrial waste waters that are treated with chlorine prior to use or discharge); or
  - Oxidants.
- VOA samples containing carbonates react with the acid preservative causing effervescence (due to formation of carbon dioxide), which can cause loss of volatile analytes.
- Residual chlorine present in VOA samples can continue to react with dissolved organic matter. This continuous reaction may lead to inaccurate quantitation of certain analytes present in the sample at the time of collection.
- Residual chlorine and oxidants present in VOA samples can cause degradation of certain volatile analytes (e.g., styrene).

Perform the following for *Pre-Preserved* Vials:

1. Pour the sample slowly down the edge of the sample vial to avoid excess aeration or agitation of the sample during filling.
2. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).

3. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
4. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
5. While holding the vial upright, gently tap the sample to check for air bubbles (either in the body or especially at the top of the vial).
6. If air bubbles are present, discard the sample and select a new vial in which to recollect a new sample. Repeat Steps 1 to 5 above.
7. Do NOT mix or composite samples for VOAs.
8. Cool sample to a temperature of ≤ 6°C, but not frozen. Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. DO NOT FREEZE WATER SAMPLES.
9. Immediately transfer the vial to the sample shuttle (device that contains a "set" of VOA vials) once it has been collected. Do NOT allow ice to touch the vials.

Perform the Following for *Empty* Vials:

1. Rinse the vial with sample water prior to actual sample collection and preservation.

Regions vary in their approach to pre-rinsing and/or re-using sample vials (e.g., some Regions do not recommend pre-rinsing and/or re-use of pre-cleaned containers using sample water). Be sure to follow Regional guidance.

2. Add 1-2 mL of acid preservative to the vial. Check to ensure that the sample you are collecting requires a preservative (follow Regional guidance).
3. Pour the sample slowly down the edge of the sample vial to avoid excess aeration and agitation of the sample.
4. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).
5. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
6. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
7. While holding the vial upright, gently tap the vial to check for air bubbles (either in the body or especially at the top of the vial).
8. If air bubbles are present, discard the sample and recollect a new sample using the same sample vial. Repeat Steps 1 - 7 above.
9. Check the re-collected sample for air bubbles. If air bubbles are present, additional sample water may be added to the vial to eliminate air bubbles. If there are air bubbles after three consecutive attempts to eliminate air bubbles by the addition of sample water, the entire sample and sample vial should be discarded and a new sample collected.
10. Do NOT mix or composite samples for VOAs.
11. Cool sample to a temperature of ≤ 6°C, but not frozen. Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. DO NOT FREEZE WATER SAMPLES.
12. Immediately transfer the vial to the sample shuttle (device which contains a "set" of VOA vials) once it has been collected. Do NOT allow ice to touch the vials.

Things to Remember:

- Samples must be shipped as soon as possible, preferably on the same day as sample collection to avoid exceeding sample holding times. If overnight transit is not possible, samples should be maintained at ≤ 6°C, but not frozen, until they are shipped to the laboratory.
- If samples are not preserved (a requirement for certain analytes), the technical holding time is shortened to 7 days.

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APPENDIX F SAMPLING TECHNIQUES AND CONSIDERATIONS

During a sampling event, the sampler is expected to follow prescribed sampling techniques. The sampler should also be aware of any special sampling considerations, contaminant issues, and sample compositing and mixing methods that could affect their sampling efforts.

Regional guidance will take precedence over any of the techniques and considerations listed below.

F.1 General Sampling Techniques

Information regarding surface water, sediment, soil, and groundwater sampling can be found in many documents including, but not limited to, the following sources:

- *Compendium of ERT Surface Water and Sediment Sampling Procedures*, EPA/540/P-91/005
- *Compendium of ERT Soil Sampling and Surface Geophysics Procedures*, EPA/540/P-91/006
- *Compendium of ERT Groundwater Sampling Procedures*, EPA/540/P-91/007
- *The Roles of Project Managers and Laboratories in Maintaining the Representativeness of Incremental and Composite Soil Samples,* EPA/OSWER 9200.1-117FS
- *Lead in Surface Wipe Samples*, NIOSH Method 9100, August 15, 1994
- *Elements on Wipes*, NIOSH Method 9102, March 15, 2003
- *Surface Wipe Sampling Procedure*, IH75190, Brookhaven National Laboratory, Industrial Hygiene Group, May 10, 2011
- Quality Assurance Sampling Plan for Environmental Response (QASPER) software, Version 4.1

When working with potentially hazardous materials, samplers should follow United States Environmental Protection Agency (EPA) and Occupational Health and Safety Administration (OSHA) requirements, specific health and safety procedures, and Department of Transportation (DOT) requirements.

F.2 Special Sampling Considerations

Samplers should refer to Regionally-developed standard operating procedures (SOPs) to obtain specific procedures for properly collecting and preserving samples in the field. For additional guidance regarding sampling for Volatile Organic Analyses (VOAs) in soil and water, see Appendixes D and E. Samplers should obtain Regional guidance when testing and ameliorating for:

- Carbonates in VOA soil and water
- Residual chlorine in VOA soil and water, or cyanide water
- Oxidants in VOA soil and water
- Sulfides and oxidizing agents in cyanide

F.3 Contaminant Sampling

Certain compounds can be detected in the parts-per-billion (ppb) and/or parts-per-trillion (ppt) range. Extreme care MUST be taken to prevent cross-contamination of these samples. The following precautions should be taken when trace contaminants are a concern:

- Disposable gloves should be worn each time a different location is sampled.

- When collecting both surface water and sediments, surface water samples should be collected first. This reduces the chance of sediment dispersal into surface water, and the resulting loss of surface water sample integrity.
- Sampling should occur in a progression from the least to the most contaminated area, if this information is known to the sampling team.
- Samplers should use equipment constructed of polytetrafluoroethylene (PTFE), stainless steel, or glass that has been properly pre-cleaned for the collection of samples for trace organic and/or inorganic analyses. Equipment constructed of plastic or polyvinyl chloride (PVC) should NOT be used to collect samples for trace organic compound analyses.
- Equipment constructed of stainless steel should NOT be used to collect samples for trace metals analyses.

F.4 Sample Compositing

Sample compositing is a site-specific activity that must be conducted according to the Site Activity Plan (SAP). Compositing is typically used for large sites under investigation to improve the precision (i.e., lower the variance) of the estimated average contaminant concentrations. **Samples for VOA analysis should NOT be composited to minimize loss of VOAs/analytes.**

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples are usually of equal volume, but may be weighted to reflect an increased flow or volume. Regardless, all discrete samples must be collected in an identical manner and the number of grab samples forming a composite should be consistent. There are several compositing techniques that may be required such as:

- Flow-proportioned - Collected proportional to the flow rate during the compositing period by either a time-varying/constant volume or a time-constant/varying volume method. This technique is usually associated with wastewater or storm water runoff sampling.
- Time - Composed of a varying number of discrete samples collected at equal time intervals during the compositing period. This technique is typically used to sample wastewater and streams, and in some air sampling applications.
- Areal - Collected from individual grab samples collected in an area or on a cross-sectional basis. Areal composites are comprised of equal volumes of grab samples where all grabs are collected in an identical manner. This technique is typically used for estimating average contaminant concentrations in soils or sediments. This technique is useful when contaminants are present in nugget form (i.e., TNT chunks, lead shot, etc.), thus exhibiting large differences in concentration over a small sample area.
- Vertical - Collected from individual grab samples but taken from a vertical cross section. Vertical composites are comprised of equal volumes of grab samples where all grab samples are collected in an identical manner. Examples would include vertical profiles of a soil borehole or sediment columns.
- Volume - Collected from discrete samples whose aliquot volumes are proportional to the volume of sampled material. Volume composites are usually associated with hazardous waste bulking operations where the sample represents combined or bulked waste.

When compositing solid or tissue samples (i.e., sediment, soil, or sludge) for analysis of compounds present in trace quantities, use a stainless steel or PTFE bowl and spatula.

F.5 Sample Mixing and Homogenizing

Mixing of the sample for the remaining parameters is necessary to create a representative sample media. It is extremely important that solid samples be mixed as thoroughly as possible to ensure that the sample is as representative as possible of the sample location. Refer to the project-specific SAP regarding instructions on removal of any extraneous materials (e.g., leaves, sticks, rocks, etc.). The mixing technique will depend on the physical characteristics of the solid material (e.g., particle size, moisture content, etc.). (Grinding and homogenization of tissue is easier when it is partially

frozen.) The mixing container should be large enough to hold the sample volume and accommodate the procedures without spilling. Both the mixing container (generally a bowl or tray) and the mixing implement should be properly decontaminated before use. Samples should be homogenized according to procedures listed in the project-specific SAP. Table F-1 provides a short procedure for mixing a soil sample with a small particle size (less than 1/4 in) and filling sample containers in the field.

Table F-1. Mixing a Sample and Filling Sample Containers

Step	Action
1	Roll the contents of the compositing container to the middle of the container and mix.
2	Quarter the sample and move to the sides of the container.
3	Mix each quarter individually, then combine and mix OPPOSITE quarters, then roll to the middle of the container.
4	Mix the sample once more, and then quarter the sample again.
5	Mix each quarter individually, then combine and mix ADJACENT corners, then roll to the middle of the container. The goal is to achieve a consistent physical appearance before sample containers are filled.
6	Flatten piled material into an oblong shape.
7	Using a flat-bottomed scoop, collect a strip of soil across the entire width of the short axis and place it into a sample container.
8	Repeat Step 7 at evenly-spaced intervals until the sample containers are filled.
9	Record the approximate quantity of each subsample in the field log book.

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APPENDIX G INTERNATIONAL SHIPPING

The following section provides information on shipping Contract Laboratory Program (CLP) samples to laboratories outside the United States.

G.1 United Parcel Service (UPS) Procedure for Shipping to Canada

1. Introduction

The Standard Operating Plan (SOP) defines the responsibilities and procedures for shipping to Canada labs. This document covers the export shipping process.

2. Overview

UPS will provide pick-up and delivery service for small package (weighing less than 150 lbs. each) shipments to labs in Canada. This document outlines the requirements and processes with regards to these export shipments.

3. Contact Information

UPS Strategic Support for Government Accounts	1.800.877.1497/ www.strategicsupport.com
UPS International Customer Service	1.800.782.7892/ www.ups.com/international
Shelly O'Leary, UPS Account Manager for EPA	404.402.9827/ shellyoleary@ups.com

4. Product Profile

Service Level – Under WWX5, EPA receives government pricing for shipments via UPS *Worldwide Express Saver* service. This service provides guaranteed delivery within 1 – 3 business days, by end of day, to Canada. The maximum weight per package is 150 lbs. (70 kg.), maximum length is 108 in. (270 cm.) per package and the maximum dimensions are 165.0 in. (419.10 cm) per package, length and girth combined.

5. Commercial Invoice

A commercial invoice form is used for all shipments containing non-documents. The commercial invoice is the primary document used for importation control, valuation, and duty determination. This document identifies the products being shipped.

The form should include:

- Complete name and address information for both shipper and consignee
- **Phone numbers** for both shipper and consignee
- Terms of Sale (Incoterm)
- Reason for export
- A complete description of the item
- What is the item?
- What is the item used for?
- Harmonized Tariff Codes, if known
- Country of origin (where manufactured) for each commodity
- Number of units, unit value, and total value (purchase price) of each item
- Number of packages and total weight
- Shipper's signature and date

- A nominal or fair market value must be stated for items of no commercial value

Commercial Invoice Template –

Invoice

Page 1

From

Tax ID/VAT No.:

Contact Name:

Company Name:

Address:

City State/Province:

Postal Code Country/Territory:

Phone:

Waybill Number: Shipment ID:

Date:

Invoice Number (Reference 1):

Purchase Order Number (Reference 2):

Terms of Sale (Incoterm):

Reason for Export:

Ship To

Tax ID/VAT No.:

Contact Name:

Company Name:

Address:

City State/Province:

Postal Code Country/Territory:

Phone:

Sold To

Tax ID/VAT Number:

Contact Name:

Company Name:

Address:

City State/Province:

Postal Code Country/Territory:

Phone:

Units	UM	Description of Goods/Part Number	Harmonized Code	C/O	Unit Value	Total Value	Currency

Additional Comments:

Declaration Statement:

Invoice Line total: _____

Discount/Rebate:

Invoice Sub-Total: _____

Freight:

Insurance:

Other: _____

_____ Currency

Total Invoice amount:

Shipper's Signature / Title Date

Total Number of Packages:

Total Weight:

These commodities, technology, or software were exported from the United States in accordance with the Export Administration Regulation.Diversion contrary to U.S. law is prohibited.

Figure G-1. Commercial Invoice Template

6. Packing with Coolants and Refrigerants (Dry Ice)

Coolants and refrigerants are used to keep temperature-sensitive products cold or frozen while in transit. Dry ice (frozen carbon dioxide) and gel packs are the most common types of coolant / refrigerants used for transportation.

International Air Shipments Containing Dry Ice

International **Air** shipments containing dry ice require the shipper to have a UPS International Special Commodities contract. For more information, please contact the UPS Hazardous Materials Support Center at 1-800-554-9964, or visit our online UPS Guide for Shipping International Dangerous Goods.

View UPS Guide for Shipping International Dangerous Goods

International Dry Ice Packages Shipped via Air Service Require the Following Under IATA:

- Process through WorldShip 2008 version 10.0 (or higher), CampusShip or compliant software
- An acceptance audit is performed
- Mark the outer carton with:
  - The words "Dry Ice" of "Carbon Dioxide, Solid" and "UN1845"
  - The amount of dry ice contained in the package in KG
  - Class 9 Diamond label

Requirements for Preparing Your Dry Ice Shipments:

- Fill any empty space in your package with appropriate packing material to prevent product movement in transit.
- Wrap temperature-sensitive products in two watertight plastic bags or use absorbent material along with a plastic liner.
- Avoid shipping temperature-sensitive products over the weekend.
- Wrap the refrigerant in paper or another carton to slow the melting rate and prevent excess space when using dry ice.
- Do not place the refrigerant at the bottom of the package because cold air will not circulate.
- Do not seal the inner insulated container when using dry ice. Venting is required to allow some carbon dioxide gas to escape the package.

* UPS CampusShip is a web-based, UPS-hosted shipping solution that helps to increase efficiency and reduce costs. See QuickStart Guide, July 2010, links following below.

7. Additional Information

Common items that may be hazardous and require the shipper to have a UPS International Special Commodities contract. For more information, please contact the UPS Hazardous Materials Support Center at 1-800-554-9964, or visit our online UPS Guide for Shipping International Dangerous Goods.

Descriptions that Indicate Dangerous Goods – watch for any of the following descriptions that could indicate Dangerous Goods or Hazardous Materials:

- Acidic
- Caustic
- Combustible Communicable
- Compressed Gas
- Corrosive
- Explosive
- Flammable
- Infectious
- Inflammable
- Poison
- Radioactive
- Refrigerated

- Toxic
- Volatile

Note: This is only a sampling of trigger terms which should prompt further questions about a shipment. There are many more, and it is hoped that seeing these will lead you to think about other general terms that may warrant further investigation.

8. Tools and Resources

UPS Global - http://global.ups.com/international-shipping-cost/

Access UPS Global website to get up-to-date information on everything international, including information on how to prepare an international shipment, track your package, import/export country regulations and international forms.

How to Process International Package using UPS CampusShip

http://www.ups.com/media/en/CampusShip_admin_QuickStart_Guide.pdf
http://www.ups.com/media/en/CampusShip_shipping_QuickStart_Guide.pdf

Step-by-Step Instructions for International Shipping

Step 1. Verify That Your Commodity Can Be Shipped

Determine if service restrictions apply to either your country of origin or country of destination.

Check for Embargoed/Suspended Service

Verify that your commodity can be shipped to or from the United States and a specific country.

Check List of UPS Export Prohibited Articles

Step 2. Select an International Service If price and time are your primary considerations in selecting an international service, use the Service Comparison tool on UPS CampusShip to find the guaranteed delivery time and price of every service available to and from the United States and a specific country.

Step 3. Choose an International Billing Option

UPS international billing options give you the flexibility to bill charges in a way that best suits your business model. Whichever option you select, you can be assured that UPS will accurately bill your international charges.

Learn More About International Billing Options

Step 4. Create Required Documentation

Find out what export documentation is required for your shipments and how to complete each form.

Learn How to Create Documentation

Step 5. Prepare Your Shipment

Use the following resources to learn more about preparing your shipment.

Learn How to Prepare Your International Shipment
Learn What Packing Materials to Use for Your International Shipment
Identify Specific Weight and Size Limitations
Convert the Weight, Length, Area, and Volume of Your Shipment

Decide whether to declare a value for high value items. UPS's liability is limited to US$100.00 for loss or damage on domestic or international packages with no declared value. If the value of your goods exceeds US$100.00, you can declare a higher value, up to US$50,000.00 per package. For packages that exceed the maximum declared value, a waiver must be obtained. Refer to the applicable terms and conditions of service for additional limits and restrictions.

Learn More About Declared Value

Step 6. Ship Your Package

Use UPS CampusShip or Internet Shipping on ups.com to prepare your international shipping label and the international forms required for certain shipments.

Step 7. Get Your Shipment to UPS

If you don't have an automatic scheduled pickup, UPS On-Call Pickup® gives you the convenience of having shipments picked up at your location. With one pickup request, UPS will pick up all ground, air, and international shipments. UPS On-Call Pickup can be scheduled at ups.com or by calling 1-800-PICK-UPS®. A pickup may be scheduled for the same day or a future day. Or you can conveniently ship your UPS package at one of our thousands of locations including The UPS Store® and UPS Drop Boxes.

Find Locations

Step 8. Check Your Shipment Status

Since every UPS package is assigned a unique tracking number, you can access information about your shipments whenever you like, and as often as you like. Tracking information about your shipments is always available at ups.com, by e-mail, and through optional services.

Track Your Shipment
Learn About More Ways to Track

G.2 Completed Customs Forms Example

Shipping samples to an international laboratory requires the completion of a customs form. The following is an example of a correctly completed customs form for shipment to a laboratory in Canada.

DEPARTMENT OF HOMELAND SECURITY
U.S. Customs and Border Protection

OMB No. 1651-0098
Exp. 08-31-2014

NORTH AMERICAN FREE TRADE AGREEMENT
CERTIFICATE OF ORIGIN

19 CFR 181.11, 181.22 Bill of Lading / Air Waybill No: A99F99VKRSL

1. EXPORTER NAME AND ADDRESS	2. BLANKET PERIOD
US EPA 980 COLLEGE STATION RD ATHENS, GA 30605 United States TAX IDENTIFICATION NUMBER: 11-1111111	FROM 12/MAY/2014 TO 13/MAY/2014
3. PRODUCER NAME AND ADDRESS XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada TAX IDENTIFICATION NUMBER: 99-9999999	4. IMPORTER NAME AND ADDRESS XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada TAX IDENTIFICATION NUMBER: 99-9999999

5. DESCRIPTION OF GOOD(S)	6. HS TARIFF CLASSIFICATION NUMBER	7. PREFERENCE CRITERION	8. PRODUCER	9. NET COST	10. COUNTRY OF ORIGIN
Infiltrex Water Sampler Stainless Steel Columns w 250g XAD resin (adsorbent)Scientific Testing Only	HS Code 9015.90	A	NO(1)	NO	CA
Wound Glass fiber filter catridges with samples for Scientific Testing Only. Not for resale, no com value	HS Code 9015.90	A	NO(1)	NO	CA

I CERTIFY THAT:

- THE INFORMATION ON THIS DOCUMENT IS TRUE AND ACCURATE AND I ASSUME THE RESPONSIBILITY FOR PROVIDING SUCH REPRESENTATIONS. I UNDERSTAND THAT I AM LIABLE FOR ANY FALSE STATEMENTS OR MATERIAL OMISSIONS MADE ON OR IN CONNECTION WITH THIS DOCUMENT;
- I AGREE TO MAINTAIN AND PRESENT UPON REQUEST, DOCUMENTATION NECESSARY TO SUPPORT THIS CERTIFICATE, AND TO INFORM, IN WRITING, ALL PERSONS TO WHOM THE CERTIFICATE WAS GIVEN OF ANY CHANGES THAT COULD AFFECT THE ACCURACY OR VALIDITY OF THIS CERTIFICATE;
- THE GOODS ORIGINATED IN THE TERRITORY OF ONE OR MORE OF THE PARTIES, AND COMPLY WITH THE ORIGIN REQUIREMENTS SPECIFIED FOR THOSE GOODS IN THE NORTH AMERICAN FREE TRADE AGREEMENT AND UNLESS SPECIFICALLY EXEMPTED IN ARTICLE 411 OR ANNEX 401, THERE HAS BEEN NO FURTHER PRODUCTION OR ANY OTHER OPERATION OUTSIDE THE TERRITORIES OF THE PARTIES; AND
- THIS CERTIFICATE CONSISTS OF 2 PAGES, INCLUDING ALL ATTACHMENTS.

11.			
11a. AUTHORIZED SIGNATURE		11b. COMPANY	
11c. NAME		11d. TITLE	
11e. DATE	11f. TELEPHONE NUMBER ▶	*(Voice)*	*(Facsimile)*

CBP Form 434 (04/11)

Figure G-2. International Shipping Form (1 of 6)

PAPERWORK REDUCTION ACT STATEMENT: An agency may not conduct or sponsor an information collection and a person is not required to respond to this information unless it displays a current valid OMB control number and an expiration date. The control number for this collection is 1651-0098. The estimated average time to complete this application is 15 minutes. If you have any comments regarding the burden estimate you can write to U.S. Customs and Border Protection, Office of Regulations and Rulings, 799 9th Street, NW., Washington DC 20229.

NORTH AMERICAN FREE TRADE AGREEMENT CERTIFICATE OF ORIGIN INSTRUCTIONS

For purposes of obtaining preferential tariff treatment, this document must be completed legibly and in full by the exporter and be in the possession of the importer at the time the declaration is made. This document may also be completed voluntarily by the producer for use by the exporter. Please print or type:

FIELD 1: State the full legal name, address (including country) and legal tax identification number of the exporter. Legal taxation number is: in Canada, employer number or importer/exporter number assigned by Revenue Canada; in Mexico, federal taxpayer's registry number (RFC); and in the United States, employer's identification number or Social Security Number.

FIELD 2: Complete field if the Certificate covers multiple shipments of identical goods as described in Field #5 that are imported into a NAFTA country for a specified period of up to one year (the blanket period). "FROM" is the date upon which Certificate becomes applicable to the good covered by the blanket Certificate (it may be prior to the date of signing this Certificate). "TO" is the date upon which the blanket period expires. The importation of a good for which preferential treatment is claimed based on this Certificate must occur between these dates.

FIELD 3: State the full legal name, address (including country) and legal tax identification number, as defined in Field #1, of the producer. If more than one producer's good is included on the Certificate, attach a list of additional producers, including the legal name, address (including country) and legal tax identification number, cross-referenced to the good described in Field #5. If you wish this information to be confidential, it is acceptable to state "Available to CBP upon request". If the producer and the exporter are the same, complete field with "SAME". If the producer is unknown, it is acceptable to state "UNKNOWN".

FIELD 4: State the full legal name, address (including country) and legal tax identification number, as defined in Field #1, of the importer. If the importer is not known, state "UNKNOWN"; if multiple importers, state "VARIOUS".

FIELD 5: Provide a full description of each good. The description should be sufficient to relate it to the invoice description and to the Harmonized System (H.S.) description of the good. If the Certificate covers a single shipment of a good, include the invoice number as shown on the commercial invoice. If not known, indicate another unique reference number, such as the shipping order number.

FIELD 6: For each good described in Field #5, identify the H.S. tariff classification to six digits. If the good is subject to a specific rule of origin in Annex 401 that requires eight digits, identify to eight digits, using the H.S. tariff classification of the country into whose territory the good is imported.

FIELD 7: For each good described in Field #5, state which criterion (A through F) is applicable. The rules of origin are contained in Chapter Four and Annex 401. Additional rules are described in Annex 703.2 (certain agricultural goods), Annex 300-B, Appendix 6 (certain textile goods) and Annex 308.1 (certain automatic data processing goods and their parts). NOTE: In order to be entitled to preferential tariff treatment, each good must meet at least one of the criteria below.

Preference Criteria

A The good is "wholly obtained or produced entirely" in the territory of one or more of the NAFTA countries as referenced in Article 415. Note: The purchase of a good in the territory does not necessarily render it "wholly obtained or produced". If the good is an agricultural good, see also criterion F and Annex 703.2. *(Reference: Article 401(a) and 415)*

B The good is produced entirely in the territory of one or more of the NAFTA countries and satisfies the specific rule of origin, set out in Annex 401, that applies to its tariff classification. The rule may include a tariff classification change, regional value-content requirement, or a combination thereof. The good must also satisfy all other applicable requirements of Chapter Four. If the good is an agricultural good, see also criterion F and Annex 703.2. *(Reference: Article 401(b))*

C The good is produced entirely in the territory of one or more of the NAFTA countries exclusively from originating materials. Under this criterion, one or more of the materials may not fall within the definition of "wholly produced or obtained", as set out in article 415. All materials used in the production of the good must qualify as "originating" by meeting the rules of Article 401(a) through (d). If the good is an agricultural good, see also criterion F and Annex 703.2. *Reference: Article 401(c).*

D Goods are produced in the territory of one or more of the NAFTA countries but do not meet the applicable rule of origin, set out in Annex 401, because certain non-originating materials do not undergo the required change in tariff classification. The goods do nonetheless meet the regional value-content requirement specified in Article 401(d). This criterion is limited to the following two circumstances:

1. The good was imported into the territory of a NAFTA country in an unassembled or disassembled form but was classified as an assembled good, pursuant to H.S. General Rule of Interpretation 2(a), or
2. The good incorporated one or more non-originating materials, provided for as parts under the H.S., which could not undergo a change in tariff classification because the heading provided for both the good and its parts and was not further subdivided into subheadings, or the subheading provided for both the good and its parts and was not further subdivided.

NOTE: This criterion does not apply to Chapters 61 through 63 of H.S. (Reference: Article 401(d))

E Certain automatic data processing goods and their parts, specified in Annex 308.1, that do not originate in the territory are considered originating upon importation into the territory of a NAFTA country from the territory of another NAFTA country when the most-favored-nation tariff rate of the good conforms to the rate established in Annex 308.1 and is common to all NAFTA countries. *(Reference: Annex 308.1)*

F The good is an originating agricultural good under preference criterion A, B, or C above and is not subject to a quantitative restriction in the importing NAFTA country because it is a "qualifying good" as defined in Annex 703.2, Section A or B (please specify). A good listed in Appendix 703.2B.7 is also exempt from quantitative restrictions and is eligible for NAFTA preferential tariff treatment if it meets the definition of "qualifying good" in Section A of Annex 703.2. NOTE 1: This criterion does not apply to goods that wholly originate in Canada or the United States and are imported into either country. NOTE 2: A tariff rate quota is not a quantitative restriction.

FIELD 8: For each good described in Field #5, state "YES" if you are the producer of the good. If you are not the producer of the good, state "NO" followed by (1), (2), or (3), depending on whether this certificate was based upon: (1) your knowledge of whether the good qualifies as an originating good; (2) your reliance on the producer's written representation (other than a Certificate of Origin) that the good qualifies as an originating good; or (3) a completed and signed Certificate for the good, voluntarily provided to the exporter by the producer.

FIELD 9: For each good described in field #5, where the good is subject to a regional value content (RVC) requirement, indicate "NC" if the RVC is calculated according to the net cost method; otherwise, indicate "NO". If the RVC is calculated over a period of time, further identify the beginning and ending dates (MM/DD/YYYY) of that period. *(Reference: Article 402.1, 402.5).*

FIELD 10: Identify the name of the country ("MX" or "US" for agricultural and textile goods exported to Canada; "US" or "CA" for all goods exported to Mexico; or "CA" or "MX" for all goods exported to the United States) to which the preferential rate of CBP duty applies, as set out in Annex 302.2, in accordance with the Marking Rules or in each party's schedule of tariff elimination.
For all other originating goods exported to Canada, indicate appropriately "MX" or "US" if the goods originate in that NAFTA country, within the meaning of the NAFTA Rules of Origin Regulations, and any subsequent processing in the other NAFTA country does not increase the transaction value of the goods by more than seven percent; otherwise indicate "JNT" for joint production. *(Reference: Annex 302.2)*

FIELD 11: This field must be completed, signed, and dated by the exporter. When the Certificate is completed by the producer for use by the exporter, it must be completed, signed, and dated by the producer. The date must be the date the Certificate was completed and signed.

CBP Form 434 (04/11)

Figure G-3. International Shipping Form (2 of 6)

UPS EEI DATA

1a. U.S. PRINCIPAL PARTY IN INTEREST (USPPI) (Complete name and address)
US EPA
980 COLLEGE STATION RD
ATHENS, GA, United States
ZIP CODE 30605

Shipper Number:

2. DATE OF EXPORTATION: 30/Jul/2014

3. TRANSPORTATION REFERENCE NO.: A99F99VKR9L

b. USPPI'S EIN (IRS) OR ID NO.: 11-1111111

c. PARTIES TO TRANSACTION: [ ] Related [X] Non-related

4a. ULTIMATE CONSIGNEE (Complete name and address)
XYZ Laboratory
530 St. Clair Ave W
TORONTO, ON, M6C0A2, Canada
ULTIMATE CONSIGNEE TYPE: O

b. INTERMEDIATE CONSIGNEE (Complete name and address)
Same as Ultimate Consignee

5a. FORWARDING AGENT (Complete name and address)
UPS
99 UPS Parkway NE
Atlanta, GA, 30328, United States

5b. FORWARDING AGENT'S EIN (IRS) NO.: 33-3333333

6. POINT (STATE) OF ORIGIN OR FTZ LOCATION ID: GA

7. COUNTRY OF ULTIMATE DESTINATION: Canada

8. LOADING PIER (Ocean only):

9. METHOD OF TRANSPORTATION (Specify): Air

14. CARRIER IDENTIFICATION CODE: 5X

15. SHIPMENT REFERENCE NO.: A99F99VKR9L

10. EXPORTING CARRIER: UPS

11. PORT OF EXPORT: 0901

16. IN BOND NUMBER:

17. HAZARDOUS MATERIALS: [ ] Yes [X] No

12. PORT OF UNLOADING (Ocean and Air only):

13. CONTAINERIZED (Ocean only): [ ] Yes [X] No

18. IN BOND NUMBER TYPE: 70

19. ROUTED EXPORT TRANSACTION: [ ] Yes [X] No

20. SCHEDULE B DESCRIPTION OF COMMODITIES (Use columns 22-24)

D O T C	Export Information Code	D/F (21)	SCHEDULE B NUMBER (22)	QUANTITY - SCHEDULE B UNIT(S)/2nd UOM (23)	SHIPPING WEIGHT IN KILOS (24)	VIN/PRODUCT NUMBER/ VEHICLE TITLE NUMBER (25)	VALUE IN U.S. DOLLARS (26)
	GP	F	Infiltrex Water Sampler Stainless Steel Columns w 250g XAD resin (adsorbent) Scientific Testing Only Schedule B: 9015900000 License/Exception/Exemption Number: NLR	10 / NO	34.93		8,700
	GP	F	Wound Glass fiber filter cartridges with samples for Scientific Testing Only. Not for resale, no com value Schedule B: 9015900000 License/Exception/Exemption Number: NLR	5 / NO	11.11		41

27. I certify that all statements made and all information contained herein are true and correct and that I have read and understand the instructions for preparation of this document, set forth in the "Foreign Trade Regulations (15CRF30)." I understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements herein, failing to provide the requested informations or for violation of U.S. laws on exportation (13 U.S.C. Sec. 305; 22 U.S.C. Sec. 401; 18 U.S.C. Sec. 1001; 50 U.S.C. App. 2410).

Signature

Title

Date

Telephone No. (Include area code)

Confidential - For use solely for official purposes authorized by the Secretary of Commerce (13 U.S.C., 301 (g)).

Export shipments are subject to inspection by U.S. Customs and Border Protection and/or Office of Export Enforcement.

The USPPI authorizes the forwarder named above to act as a forwarding agent for export control and customs purposes.

E-mail address

Page 1

Figure G-4. International Shipping Form (3 of 6)

Invoice

Page 1

FROM	
Tax ID/EIN/VAT No.: 11-1111111 Contact Name: Bob Smith US EPA 980 COLLEGE STATION RD ATHENS, GA 30605 United States Phone: 7065551212	Waybill Number:A99F99VKR9L Shipment ID: A99F99VKR9L Date: 30/JUL/2014 Invoice No: PO No: Terms of Sale (Incoterm): Reason for Export: Point of Origin: GA UPS to File AES: Y Other Government Agency License or Permit: C33
SHIP TO	SOLD TO INFORMATION
Tax ID/VAT No.: 99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone: 4165551212	Tax ID/VAT No.:99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone:4165551212

Units	U/M	Description of Goods/Part No. Exception	Harm. Code	C/O	Unit Value	Total Value
10	NMB	Infiltrex Water Sampler Stainless Steel Columns w 250g XAD resin (adsorbent)Scientific Testing Only NLR	HS Code 9015.90	CA	870.00	8,700.00
5	NMB	Wound Glass fiber filter catridges with samples for Scientific Testing Only. Not for resale, no com value NLR	HS Code 9015.90	CA	8.25	41.25

Additional Comments:

Declaration Statement:
Canadian Goods returned. Nor for Resale, No Commercial Value, Scientific Testing Only. These commodities are licensed for the ultimate destination shown. Diversion contrary to United Staes Law is Prohibited. I Declare all the information contained in this invoice to be true and correct.

Shipper Date

Invoice Line Total:	8,741.25
Discount/Rebate:	0.00
Invoice Sub-Total:	8,741.25
Freight:	0.00
Insurance:	0.00
Other:	0.00
Total Invoice Amount:	8,741.25

Total Number of Packages: 3 Currency: USD
Total Weight: 101.5 LBS

These commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited.

Figure G-5. International Shipping Form (4 of 6)

Invoice

Page 1

FROM	
Tax ID/EIN/VAT No.: 11-1111111 Contact Name: Bob Smith US EPA 980 COLLEGE STATION RD ATHENS, GA 30605 United States Phone: 7065551212	Waybill Number:A99F99VKR9L Shipment ID: A99F99VKR9L Date: 30/JUL/2014 Invoice No: PO No: Terms of Sale (Incoterm): Reason for Export: Point of Origin: GA UPS to File AES: Y Other Government Agency License or Permit: C33
SHIP TO	SOLD TO INFORMATION
Tax ID/VAT No.: 99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone: 4165551212	Tax ID/VAT No.:99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone:4165551212

Units	U/M	Description of Goods/Part No. Exception	Harm. Code	C/O	Unit Value	Total Value
10	NMB	Infiltrex Water Sampler Stainless Steel Columns w 250g XAD resin (adsorbent)Scientific Testing Only NLR	HS Code 9015.90	CA	870.00	8,700.00
5	NMB	Wound Glass fiber filter catridges with samples for Scientific Testing Only. Not for resale, no com value NLR	HS Code 9015.90	CA	8.25	41.25

Additional Comments:

Declaration Statement:
Canadian Goods returned. Nor for Resale, No Commercial Value, Scientific Testing Only. These commodities are licensed for the ultimate destination shown. Diversion contrary to United Staes Law is Prohibited. I Declare all the information contained in this invoice to be true and correct.

Shipper Date

Invoice Line Total:	8,741.25
Discount/Rebate:	0.00
Invoice Sub-Total:	8,741.25
Freight:	0.00
Insurance:	0.00
Other:	0.00
Total Invoice Amount:	8,741.25

Total Number of Packages: 3 Currency: USD
Total Weight: 101.5 LBS

These commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited.

Figure G-6. International Shipping Form (5 of 6)

Invoice

Page 1

FROM	
Tax ID/EIN/VAT No.: 11-111111 Contact Name: Bob Smith US EPA 980 COLLEGE STATION RD ATHENS, GA 30605 United States Phone: 7065551212	Waybill Number:A99F99VKR9L Shipment ID: A99F99VKR9L Date: 30/JUL/2014 Invoice No: PO No: Terms of Sale (Incoterm): Reason for Export: Point of Origin: GA UPS to File AES: Y Other Government Agency License or Permit: C33
SHIP TO	SOLD TO INFORMATION
Tax ID/VAT No.: 99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone: 4165551212	Tax ID/VAT No.:99-9999999 Contact Name:Sample Receiving XYZ Laboratory 530 St. Clair Ave W TORONTO, ON M6C0A2 Canada Phone:4165551212

Units	U/M	Description of Goods/Part No. Exception	Harm. Code	C/O	Unit Value	Total Value
10	NMB	Infiltrex Water Sampler Stainless Steel Columns w 250g XAD resin (adsorbent)Scientific Testing Only NLR	HS Code 9015.90	CA	870.00	8,700.00
5	NMB	Wound Glass fiber filter catridges with samples for Scientific Testing Only. Not for resale, no com value NLR	HS Code 9015.90	CA	8.25	41.25

Additional Comments:

Declaration Statement:
Canadian Goods returned. Nor for Resale, No Commercial Value, Scientific Testing Only. These commodities are licensed for the ultimate destination shown. Diversion contrary to United Staes Law is Prohibited. I Declare all the information contained in this invoice to be true and correct.

Shipper Date

Invoice Line Total:	8,741.25
Discount/Rebate:	0.00
Invoice Sub-Total:	8,741.25
Freight:	0.00
Insurance:	0.00
Other:	0.00
Total Invoice Amount:	8,741.25

Total Number of Packages: 3 Currency: USD
Total Weight: 101.5 LBS

These commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited.

Figure G-7. International Shipping Form (6 of 6)

APPENDIX H SAMPLING CHECKLISTS

Table H-1: Personnel Preparation Checklist

(Page 1 of 1)

Personnel Briefing	Yes	No	Comments
1. Did you review sampling team responsibilities and identify individual(s) responsible for corrective actions?			
2. Did you ensure that you have met the appropriate personal safety and protection requirements?			
3. Did you identify sampling locations and receive permission to access them, as appropriate?			
4. Did you contact the appropriate utility companies PRIOR to the start of sampling? By law, utility companies must be contacted prior to the start of digging/sampling so that any underground utilities (gas lines, water lines, electrical lines, etc.) can be marked. A list of one-call centers for each state may be found at: http://www.call811.com.			
5. If sampling on private property, do you have sample receipts to provide to the property owner for all samples taken and removed from the property?			
6. Have you determined the number and type of samples to be collected?			
7. Did you review sample collection methods?			
8. Have you reviewed sample container requirements?			
9. Did you review decontamination requirements, procedures, and locations?			
10. Did you determine holding times and conditions?			
11. Did you determine Performance Evaluation (PE) and Quality Control (QC) sample requirements?			
12. Have you obtained shipping cooler temperature blanks, if required?			
13. Did you review sample label and tag requirements?			
14. Did you review Traffic Report/Chain of Custody (TR/COC) record and custody seal requirements?			
15. Have you obtained the laboratory name, shipping addresses, and telephone number?			
16. Did you review cooler return instructions?			
17. Have you obtained shipping company information (name, telephone number, account number, pickup schedule)?			
18. Have you obtained shipping schedules?			
19. Did you review shipment reporting requirements and the appropriate contact names and telephone numbers for reporting?			

Personnel Briefing	Yes	No	Comments
20. Have you included any sampler comments regarding sampling issues (e.g., low volumes, matrix, suspected concentrations based on field measurements)?			

Table H-2: General Sample Collection Checklist

(Page 1 of 1)

General Sample Collection	Yes	No	Comments
1. Did you identify and mark the sampling location with buoys, flags, or stakes according to the sampling plans, maps, and grids?			
2. If the sampling location is inaccessible, did you contact the appropriate field or Regional personnel for instructions?			
3. Did you use the correct sampling equipment?			
4. Did you follow the correct decontamination procedures?			
5. Did you follow the correct collection procedures?			
6. Did you use the correct sample containers for each sample collected?			
7. Did you use certified clean containers for all samples? Are certificates kept on record?			
8. Did you use certified clean water for all field, trip, equipment and rinsate blanks? Are certificates kept on record?			
9. Did you collect the correct volume for each sample?			
10. Did you collect the correct type of sample, including primary samples and Quality Control (QC) samples?			
11. Did you properly preserve each sample collected?			
12. Did you correctly document and label each sample with all necessary information? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional U.S. Environmental Protection Agency (EPA) laboratory. Then the Region copy of the TR/COC record shall be sent to the EPA laboratory.			
13. If sampling on private property, did you provide a sample receipt to the owner of the property for all samples taken and removed from the property?			

Table H-3: Completing Field Logbook Checklist

(Page 1 of 1)

Completing Field Logbook	Yes	No	Comments
1. Did you use waterproof ink when writing in the field logbook?			
2. Did you document sampling project information such as: • Project name, ID, and location • Names of samplers • Geological observations, including maps • Atmospheric conditions • Field measurements • Sampling dates, times, and locations? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional EPA laboratory. Then the Region copy of the TR/COC record shall be sent to the EPA laboratory.			
3. Did you record sampling activity information such as: • Sampling dates and times • Sample identifications • Sample matrices • Sample descriptions (e.g., odors and/or colors) • Number of samples taken • Sampling methods/equipment • Description of QC samples?			
4. Did you document any and all deviations from the sampling plan?			
5. Did you document any and all difficulties in sampling and/or any unusual circumstances?			
6. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Table H-4: Completing Handwritten Sample Labels Checklist

(Page 1 of 1)

Completing Handwritten Sample Labels	Yes	No	Comments
1. Did the Regional Sample Control Coordinator (RSCC) provide Contract Laboratory Program (CLP) Sample Numbers and Sample Management Office (SMO)-assigned CLP Case Numbers?			
2. If additional CLP Sample Numbers were needed, did you contact the appropriate Regional personnel?			
3. Were the CLP Sample Numbers and SMO-assigned CLP Case Numbers on the labels correct? Organic CLP Sample Numbers begin with the Regional letter code, followed by letters and numbers. Inorganic CLP Sample Numbers begin with "M," followed by the Regional letter code, and then letters and numbers.			
4. Were samples uniquely numbered and designated to only one sample? Samples collected for total metal and filtered metal analyses must receive separate, unique, CLP Sample Numbers.			
5. Were QC samples numbered accordingly?			
6. Were the specific requirements followed for total and filtered metals analysis, QC and Performance Evaluation (PE) samples, and SW-846 Method 5035A?			
7. Were all temperature blanks labeled with "TEMPERATURE BLANK"?			
8. Was a sample label containing the CLP Sample Number, SMO-assigned CLP Case Number, location, concentration, preservative, and the analysis, attached to each sample bottle or container as the sample was collected? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional EPA laboratory. Then, the Region copy of the TR/COC record shall be sent to the EPA laboratory.			
9. Was clear tape placed over the sample labels to protect the labels from moisture and to help the labels adhere to the sample bottle? Use only CLEAR tape over the sample labels and avoid wrinkles in the tape and the sample labels.			
10. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Table H-5: Completing Handwritten Sample Tags & Custody Seals Checklists

(Page 1 of 1)

Completing Handwritten Sample Tags	Yes	No	Comments
1. Was waterproof ink used on the sample tags?			
2. If Regionally required for individual sample containers, was the project code on the sample tag completed?			
3. Was the location number on the sample tag completed?			
4 Was the date filled in using the format MM/DD/YYYY?			
5. Was the time of sample collection indicated in military time format HH:MM?			
6. Was the box checked indicating composite or grab sample?			
7. Was the location on the sample tag completed?			
8. Did you indicate whether or not the sample was preserved by checking "yes" or "no"?			
9. Was the appropriate analysis indicated on the sample tag?			
10. Were the appropriate CLP Sample Number and SMO-assigned CLP Case Number indicated and cross-referenced with the numbers on the sample label?			
11. Did you sign the sample tags?			
12 Did you attach the sample tag to the neck of the sample bottle with string, stretch string, or wire? Do **NOT** use wire to attach a sample tag to a metal sample.			
13. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			
Completing Custody Seals	**Yes**	**No**	**Comments:**
1. Did you sign and date the custody seal?			
2. Did you attach a completed custody seal to the sample bottle, container, or plastic bag, placing the seal over the cap or lid of each sample bottle or container or on the bag opening such that it will be broken if the sample bottle, container, or bag is opened or tampered with?			
3. As appropriate, did you attach the completed custody seal to the sample shipping container or cooler, placing the seal such that it will be broken if the container or cooler is opened or tampered with?			
4. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Table H-6: Packing Sample Container Checklist

(Page 1 of 1)

Packing Sample Container	Yes	No	Comments
1. Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the packaging of environmental and hazardous samples? If samples contain methanol preservation (e.g., samples to be analyzed by SW-846 Method 5035A), refer to the packaging instructions in Appendix D.			
2. Were all CLP Sample Numbers, SMO-assigned CLP Case Numbers, analyses, labels, tags, and custody seals attached to the correct sample containers?			
3. Is modified analysis indicated if requested?			
4. Was an inventory conducted of CLP Sample Numbers, SMO-assigned CLP Case Numbers, analyses, and containers, and verified against the TR/COC records?			
5. Were the correct number and type of Performance Evaluation (PE) and Quality Control (QC) samples collected?			
6. Were all sample containers sealed in clear plastic bags with the sample label and tag visible through the packaging?			
7. Were all soil/sediment samples known or suspected to contain dioxin securely enclosed in metal cans (e.g., paint cans) with the lids sealed?			
8. Was suitable absorbent packing material placed around the sample bottles or containers?			
9. Were the outsides of metal containers labeled properly with the CLP Sample Number, SMO-assigned CLP Case number, and the analysis of the sample inside?			

Table H-7: Packing Shipping Container Checklist

(Page 1 of 1)

Packing Shipping Container	Yes	No	Comments
1. Were you shipping samples in a clean waterproof metal or hard plastic ice chest or cooler in good condition?			
2. Were all non-applicable labels from previous shipments removed from the container?			
3. Were all inside and outside drain plugs closed and covered with suitable tape (e.g., duct tape)?			
4. Was the inside of the cooler lined with plastic (e.g., large heavy-duty garbage bag)?			
5. Was the lined shipping cooler packed with noncombustible absorbent packing material?			
6. Were sample containers placed in the cooler in an upright position not touching one another?			
7. Was a sample shipping cooler temperature blank included in the cooler?			
8. Did the documentation in the cooler only address the samples in that cooler?			
9. Was the site name absent from all documentation? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional EPA laboratory. Then the Region copy of the TR/COC record shall be sent to the EPA laboratory.			
10. Was there sufficient packing material around and in between the sample bottles and cans to avoid breakage during transport?			
11. If required, was double-bagged ice placed on top and around sample bottles to keep the samples cold at ≤ 6°C? Do not pack loose ice into the cooler.			
12. Was the top of the plastic liner fastened and secured with tape?			
13. Was a completed custody seal placed around the top of the fastened plastic liner (if required by the Region)?			
14. Were all sample documents enclosed within the cooler (e.g., TR/COC record, PE instructions, and cooler return instructions) in a waterproof plastic bag?			
15. Was the plastic bag, containing the documentation, taped to the underside of the cooler lid?			
16. Were cooler return instructions and airbills taped to the underside of the cooler lid?			
17. Was the return address of the cooler written with permanent ink on the underside of the cooler lid?			
18. Was tape placed around the outside of the entire cooler and over the hinges?			
19. Were the completed custody seals placed over the top edge of the cooler so the cooler cannot be opened without breaking the seals?			
20. Was the return address label attached to the top left corner of the cooler lid?			
21. Were instructional labels attached to the top of the cooler, as necessary (e.g., "This End Up," "Do Not Tamper With," or "Environmental Laboratory Samples")?			

Packing Shipping Container	Yes	No	Comments
22. Have all US DOT regulations been met for the shipment when shipping hazardous samples?			
23. If shipping samples containing methanol as a preservative (e.g., samples to be analyzed by SW-846 Method 5035A), was a label used to indicate methanol, the United Nations (UN) identification number for methanol (UN 1230), and Limited Quantity?			

Table H-8: Shipping & Reporting CLP Samples Checklist

(Page 1 of 1)

Shipping CLP Samples	Yes	No	Comments:
1. Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the shipment of environmental and hazardous samples?			
2. Was a separate airbill filled out for each cooler being shipped?			
3. Was the airbill filled out completely, including correct laboratory name, address, and telephone number, identification of recipient as "Sample Custodian," and appropriate delivery option (e.g., overnight or Saturday)?			
4. Was the completed airbill attached to the top of the cooler with the correct laboratory address?			
5. If more than one cooler was being shipped to the same laboratory, were they marked as "1 of 2," "2 of 2," etc.?			
6. Were the samples being shipped "overnight" through a qualified commercial carrier?			
7. Did you export the electronic COC XML file from Scribe?			
8. Did you upload the electronic COC XML file using the Submit Chain of Custody task in CLPSS?			
Reporting CLP Samples	**Yes**	**No**	**Comments:**
1. Did you contact the RSCC (or designee) or the Contract Laboratory Program Sample Management Office (SMO) on the same day samples were shipped?			
2. If the samples were shipped after 5:00 PM Eastern Time (ET), were they reported to the RSCC (or designee) or to SMO by 8:00 AM ET the following business day?			
3. Did you notify the RSCC (or designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on Friday for sample shipments that will be delivered to the laboratory on Saturday?			
4. Did you provide the RSCC (or designee) or SMO with: • Your name, phone number, and Region number; • Case Number of the project; • Modified Analysis Number, if requested; • Exact number of samples, matrix(ces), and type of analysis; • Laboratory(ies) to which the samples were shipped; • Carrier name and airbill number; • Date of shipment; • Date of next shipment; and • Any other information pertinent to the shipment?			

APPENDIX I GLOSSARY

Analyte -- The element, compound, or ion that is determined in an analytical procedure; the substance or chemical constituent of interest.

Analytical Services Branch (ASB) -- Directs the Contract Laboratory Program (CLP) from within the United States Environmental Protection Agency's (EPA's) Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER).

Aroclor -- Polychlorinated biphenyls (PCBs) or a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl and a general chemical formula of $C_{12}H_{10-x}Cl_x$. PCBs, commercially produced as complex mixtures containing multiple isomers at different degrees of chlorination, were marketed in North America under the trade name Aroclor.

Case -- A finite, usually predetermined, number of samples collected over a given time period from a particular site. Case numbers are assigned by the Sample Management Office (SMO). A Case consists of one or more Sample Delivery Groups (SDGs).

Chlorinated Dibenzo-p-Dioxin/Chlorinated Dibezofuran (CDD/CDF) -- A group of organic compounds of tetra- through octa-chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) -- First authorized by Congress in December 1980, and amended in 1986, CERCLA provided broad Federal authority to respond directly to the release or possible release or hazardous substances that may endanger human health or the environment. CERCLA also established a Trust Fund to provide for cleanup when no responsible party could be identified; hence, CERCLA is commonly referred to as "Superfund."

Congener -- The chlorinated congeners of biphenyl.

Contract Laboratory Program (CLP) -- A national program of commercial laboratories under contract to support the EPA's nationwide efforts to clean up designated hazardous waste sites by providing a range of chemical analytical services to produce environmental data of known and documented quality. This program is directed by EPA's Analytical Services Branch (ASB).

Contract Laboratory Program Contracting Officer's Representative (CLP COR) -- Monitors technical performance of the contract laboratories in each Region.

Contract Laboratory Program Sample Management Office (CLP SMO) -- A contractor-operated facility operated under the CLP, awarded and administered by the EPA, which provides necessary management, operations, and administrative support to the CLP. SMO coordinates and schedules sample analyses, tracks sample shipments and analyses, receives and tracks data for completeness and compliance, and processes laboratory invoices.

Custody Seal -- An adhesive label or tape that is used to seal a sample bottle or container that maintains chain of custody and that will break if the sample bottle or container is opened or tampered with.

Cyanide (Total) -- Cyanide ion and complex cyanides converted to hydrocyanic acid (HCN) by reaction in a reflux system of a mineral acid in the presence of magnesium ion.

Data Quality Objective (DQO) -- The requirements established to maintain the quality of the data being collected.

Data Validation -- Data validation is based on Region-defined criteria and limits, professional judgment of the data validator, and (if available) the Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP).

Duplicate -- Sample required by the laboratory's contract to check the accuracy and precision of inorganic analyses. It is a second aliquot of the same sample to determine the precision of the method.

Equipment Blank -- A sample used to check field decontamination procedures. See Field Blank.

Field Blank -- Any blank sample that is submitted from the field. Each field blank is assigned its own unique EPA sample number. A field blank checks for cross-contamination during sample collection, sample shipment, and in the laboratory. A field blank includes trip blanks, rinse blanks, equipment blanks, etc.

Field Duplicate -- Checks reproducibility of laboratory and field procedures and indicates non-homogeneity.

Field QC Sample -- Used to detect for contamination or error in the field.

Field Sample -- Primary sample material taken out in the field from which other samples, such as duplicates or split samples are derived. A field sample can be prepared in the field and sent for analysis in one or multiple containers, and is identified by a unique EPA sample number.

Field Sampling Plan (FSP) -- Developed to outline the actual steps and requirements pertaining to a particular sampling event, and explains, in detail, each component of the event to all involved samplers.

Holding Time -- The elapsed time expressed in hours, days, or months from the date of collection of the sample until the date of its analysis.

> **Contractual** -- The maximum length of time that the CLP laboratory can hold samples prior to extraction and/or analysis, and are described in the CLP analytical services Statements of Work (SOWs).
>
> **Technical** -- The maximum length of time that samples may be held from time of collection to time of preparation and/or analysis and still be considered valid.

Laboratory Blank -- See Method Blank.

Laboratory Duplicate -- A sample required by the laboratory's contract to check the precision of inorganic analyses.

Laboratory QC Sample -- An additional volume of an existing sample, as required by the laboratory's contract, used to detect contamination or error in the laboratory's practices.

Matrix -- The predominant material of which a sample to be analyzed is composed.

Matrix Spike (MS) -- Sample required by the laboratory's contract to check the accuracy of organic and inorganic analyses. It is an aliquot of a sample (water or soil) that is fortified (spiked) with known quantities of a specific compound and subjected to the entire analytical procedure. See Matrix Spike Duplicate.

Matrix Spike Duplicate (MSD) -- Sample required by the laboratory's contract to check the accuracy and precision of organic analyses. It is a second aliquot of the same matrix as the Matrix Spike (MS) that is spiked to determine the precision of the method. See Matrix Spike.

Method Blank -- An analytical control consisting of all reagents, internal standards and surrogate standards [or System Monitoring Compounds (SMCs) for volatile organic analysis], that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background, and reagent contamination, also referred to as laboratory blank when defining the level of laboratory contamination.

Modified Analysis (MA) -- A change in the technical requirements that fall outside the scope of the Statement of Work (SOW).

Performance Evaluation (PE) Sample -- A sample of known composition provided by the EPA Region for contractor analysis. Used by EPA to evaluate contractor performance.

Pesticides -- Substances intended to repel, kill, or control any species designated a "pest," including weeds, insects, rodents, fungi, bacteria, and other organisms. Under the CLP, only organochlorine pesticides are analyzed (e.g., DDT, Dieldrin, Endrin, etc.).

Polychlorinated Biphenyls (PCBs) -- A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant. The sale and new use of PCBs were banned by law in 1979.

Quality Assurance (QA) -- An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

Quality Assurance Project Plan (QAPP) -- Document written to meet requirements outlined in the document *EPA Guidance for Quality Assurance Project Plans* (EPA QA/R-5). Prepared in advance of field activities and used by samplers to develop any subsequent plans such as the Sampling Analysis Plan (SAP) or the Field Sampling Plan (FSP).

Quality Control (QC) -- 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.

Regional Sample Control (RSCC) Coordinator -- In most Regions, coordinates sampling efforts and serves as the central point of contact for sampling questions and problems. Also assists in coordinating the level of Regional sampling activities to correspond with the monthly projected demand for analytical services.

Regional Site Manager -- Coordinates the development of data quality objectives and oversees project-specific remedial or removal contractors, State officials, or private parties conducting site sampling efforts.

Rinsate Blank -- A sample used to check decontamination procedures. Also see Field Blank.

Routine Analytical Service (RAS) -- The standard inorganic and organic analyses available through the CLP.

Sample -- A discrete portion of material to be analyzed that is contained in single or multiple containers, and identified by a unique sample number.

Sample Delivery Group (SDG) -- A unit within a sample Case that is used to identify a group of samples for delivery. An SDG is defined by the following, whichever is most frequent:

- Each Case of field samples received; or
- Each 20 field samples (excluding PE samples) within a Case; or
- Each 7 calendar day period (3 calendar day period for 7-day turnaround) during which field samples in a Case are received (said period beginning with the receipt of the first sample in the SDG).

In addition, all samples and/or sample analyses assigned to an SDG must have been scheduled under the same contractual turnaround time. Preliminary Results have no impact on defining the SDG. Sample may be assigned to SDGs by matrix (e.g., all soil samples in one SDG, all water samples in another) at the discretion of the laboratory.

Sample Label -- An identification label attached to a sample bottle or container to identify the sample.

Sample Number -- A unique number used to identify and track a sample. This number can be recorded on a sample label or written on the sample bottle or container using indelible ink.

Sample Tag -- A tag attached to a sample that identifies the sample and maintains chain of custody.

Sampling Analysis Plan (SAP) -- A document that explains how samples are to be collected and analyzed for a particular sampling event.

Scribe -- A stand-alone Windows-based desktop application that samplers can use to automatically create and generate sample documentation prior to and during sampling events.

Semivolatile Organic Analyte (SVOA) -- A compound amenable to analysis by extraction of the sample using an organic solvent.

Standard Operating Procedure (SOP) -- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the methods for performing certain routine or repetitive tasks.

Statement of Work (SOW) -- A document that specifies how laboratories analyze samples under a particular Contract Laboratory Program (CLP) analytical program.

Superfund -- The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA), that funds and carries out EPA removal and remedial activities at hazardous waste sites. These activities include establishing the National Priorities List (NPL), investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Superfund Amendments and Reauthorization Act (SARA) -- The 1986 amendment to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Traffic Report/Chain of Custody (TR/COC) Record -- A record that is functionally similar to a packing slip that accompanies a shipment of goods. Used as physical evidence of sample custody and functions as a permanent record for each sample collected.

Trip Blank -- A sample used to check for contamination during sample handling and shipment from field to laboratory. Also see Field Blank.

Volatile Organic Analyte (VOA) -- A compound amenable to analysis by the purge-and-trap technique. Used synonymously with the term purgeable compound.

Appendix B

General Laboratory and Data Package Deliverable Requirements

ATTACHMENT B
GENERAL ANALYTICAL SERVICES STATEMENT OF WORK

Analytical services (laboratory analyses) are needed to support investigations, studies, and various projects to collect environmental data. These analytical services are required to gather data which are needed to make decisions about extent of contamination, threats to human health and the environment, or to develop baseline information. In order for the analytical data to support the intended use of the data, the Subcontractor shall adhere to the required analytical methods and quality control procedures detailed in this Statement of Work (SOW).

The Subcontractor shall furnish the necessary personnel, material, equipment, services and facilities to perform the analyses of environmental samples utilizing approved analytical methods, following strict quality assurance (QA)/quality control (QC) procedures, and submitting analytical results in a standardized format, as described in this SOW or applicable attachments.

1. FACILITIES (EQUIPMENT/PERSONNEL/MATERIALS SPECIFICATION)

The Subcontractor shall have personnel experienced in the preparation and analysis of environmental samples, and shall be experienced in the timely, accurate, and precise analysis of environmental samples as demonstrated by documentation for sample handling, logistics and preparation, methods, procedures, extractions and/or digestions, concentration, standards preparation, instrument repair, automated and/or manual report generation, and QA/QC.

The Subcontractor shall have installed and operating, at a minimum, the specified type and number of instruments and apparatus required to perform analyses as specified. The Subcontractor shall be responsible for the maintenance of this equipment.

The Subcontractor shall provide personnel, facilities and equipment for performance of sample analyses and data reporting. The sample preparation specialist(s) and analysts assigned to each project shall have experience in the specified preparation technique(s) and analytical procedures. Analysts shall also be experienced in the interpretation of analytical results from environmental samples by the instrumentation required to perform analyses as stated in the attached methods.

The Subcontractor shall furnish the necessary calibration standards for each project and must have them in-house at the time of sample receipt.

2. SAMPLE DOCUMENTATION

Because of the nature of the data being collected, the custody of the samples must be traceable from the time of collection until the time of sample disposal. A sample is physical evidence collected from a facility or the environment. Controlling evidence is an essential part of the hazardous waste investigation effort. To accomplish this, the following sample identification, chain of custody (COC), sample receiving, and sample tracking procedures have been established. These procedures shall be followed in the laboratory where client's samples are prepared and analyzed.

2.1 SAMPLE DELIVERY GROUP AND IDENTIFICATION

A Sample Delivery Group (SDG) is a unit within a single sampling event that is used to identify a group of samples upon delivery. An SDG is a group of 20 or fewer field samples within a shipment, received over a period of up to 7 calendar days. The data from the samples in an SDG are due concurrently. An SDG is defined by one of the following, whichever occurs first:

- Samples within a single sampling event; or
- Every set of 20 field samples within a sampling event; or
- Samples received within a 7 day calendar period.

Samples may be assigned to SDGs by matrix (i.e., soil samples in one SDG, and water samples in another), at the discretion of the laboratory.

The Subcontractor shall have a specified method for maintaining identification of samples throughout the laboratory to assure the traceability of samples while in possession of the Subcontractor. Each sample and sample preparation container shall be labeled with a unique laboratory identifier. The unique laboratory identifier shall be cross-referenced to the sample identification information provided by the sampling organization.

The Subcontractor shall prepare and follow written standard operating procedures (SOPs) for receiving and logging in samples as well as the assignment of unique laboratory identifiers, including a description of the method used to assign the unique laboratory identifier and cross reference of the field sample identifier.

The Subcontractor shall have and follow written SOPs on the assigning of prefixes or suffixes in addition to sample identification numbers (if this procedure is used by the laboratory).

2.2 CHAIN-OF-CUSTODY PROCEDURES

The Subcontractor shall have procedures ensuring that sample custody is maintained and documented. A sample is under custody if the following applies:

1. It is in your possession, or
2. It is in your view after being in your possession, or
3. It was in your possession and you locked it up, or
4. It is in a designated secure area (accessible to authorized personnel only).

The Subcontractor shall have and follow written SOPs for maintaining identification of samples throughout the laboratory.

The Subcontractor shall have and follow written SOPs describing the method by which the laboratory maintains samples under custody.

2.3 SAMPLE RECEIVING PROCEDURES

The Subcontractor shall designate a sample custodian responsible for receiving project samples.

The Subcontractor shall designate a representative to receive samples in the event that the sample custodian is not available.

The Subcontractor shall have the sample custodian or designated representative inspect the condition of the sample bottles on receipt by the laboratory.

The Subcontractor shall have the sample custodian or designated representative check for the presence or absence of shipping documents accompanying the sample shipment.

The Subcontractor shall require that the sample custodian or designated representative to sign and date all shipping documents accompanying the samples.

The Subcontractor shall require the sample custodian or designated representative to note and document problems such as absent documents, conflicting information, broken custody seals, and unsatisfactory sample condition (e.g. leaking sample bottles).

The Subcontractor shall have and follow written SOPs for sample receipt. The SOP shall address, but are not limited to, the following information:

- Presence or absence of COC records.
- Presence or absence of airbills.
- Presence or absence of traffic reports or packing lists.
- Presence or absence of custody seals on shipping and/or sample containers and their condition.
- Presence or absence of sample tags.
- Sample tag identification numbers.
- Type and condition of shipping container and sample bottles.
- Verification of agreement of or non-agreement of information on shipping documents and/or COC with sample containers.
- Resolution of problems or discrepancies with the sampling organization.
- An explanation of any terms used to describe sample conditions upon receipt (e.g. good, fine, okay, etc.).

2.4 SAMPLE STORAGE

The Subcontractor shall have written SOPs describing management of storage areas for samples in the laboratory. The SOPs shall include a list of authorized personnel who have access or keys to secure storage areas. The SOPs shall include instructions for monitoring temperatures in temperature

controlled sample storage areas, as well as provide appropriate corrective actions if temperature tolerances are exceeded.

2.5 TRACKING OF SAMPLE ANALYSIS

The Subcontractor shall have written SOPs for tracking work performed on project samples. The tracking SOP shall include:

- A description of the documents used to record sample receipt, sample storage, sample transfers, sample analysis and sample disposal.
- A description of the documents used to record calibration and QA/QC laboratory work.
- Examples of document formats and laboratory documents used in the sample receipt, sample storage, sample transfer, and sample analysis.
- A narrative step-by-step description of how documents are used to track samples.

3. ANALYTICAL METHODS

The Subcontractor shall utilize the methods specified in the order.

3.1 DELIVERABLES

Documents produced by the Subcontractor related to the receipt, preparation, and analysis of the samples are considered as deliverables. These records shall be submitted to the client as originals; however, copies will be acceptable where the document is part of a bound laboratory logbook or notebook.

The following are included to specify and emphasize general documentation requirements and are not intended to supersede or change the requirements of the referenced methods. The sample data package shall include:

- Case narrative describing the analyses and any unusual problems with the project.
- Final tabulated results of sample analyses showing analytes, methods used, analyte concentrations, units of quantitation, dates of analysis, sample receipt date, client sample number, laboratory sample number, type of matrix.
- Instrument raw data and analyst bench records describing dilutions, weighing, sample size prepared, and final volumes such that an independent data reviewer may recreate the calculations.
- Example calculations of sample results and quantitation limits.

- Calibration records pertaining to the project analysis dates for all instruments used for the project samples or for associated quality control samples.

- Blank and reanalysis results.

- A Complete SDG File (CSF) will consist of the following documents in addition to the documents in the SDG. The contents of the CSF will be consecutively numbered. No copies will be placed in the CSF unless the originals are bound in a logbook that is maintained by Subcontractor.

  — Subcontractor shall supply one CSF to the client within the number of calendar days designated.

  — The contents of the CSF are:

    - Sample Data Package

    - Shipping documents, including, but not limited to, the following documents: COC record(s) and airbills sealed in plastic bags.

    - Receiving documents, including, but not limited to, the following documents: sample log-in sheet and other receiving forms or copies of receiving logbooks, cover sheets, etc.

    - Laboratory records, not submitted elsewhere in the Sample Data Package, of sample transfer, preparation and analysis, including, but not limited to, the following documents:

      - Preparation and analysis forms or copies of preparation and analysis logbook pages.

      - Internal sample and sample extract transfer COC records.

      - Screening records.

      - Instrument output, including strip charts from screening activities.

      - Other request-specific documents in the possession of the Subcontractor, including, but not limited to, the following documents: telephone contact logs, copies of personal logbook pages, handwritten request-specific notes, and other request-specific documents not covered by the above.

Submit contract deliverables to the address specified in the request for proposal.

4. QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

The Subcontractor shall follow the QC requirements described in each project specific method, SOW, and COC record request for analytical services.

In addition, the project **may** include blind QC samples. These may consist of blanks and/or spikes. Successful performance on the spike shall be defined as proper identification and quantitation of the target analyte(s) within the established quantitative acceptance windows. Successful performance for the blank shall be defined as no contaminants present that interfere with the analytical integrity of the target analytes.

In the event of unacceptable performance, client shall have the option of rejecting all or part of a data package. Performance as specified by the contract will serve as a basis of acceptance. EA shall have 30 days from the receipt of the data package for review and inspection. No payment shall be made for rejected data.

The Subcontractor shall establish and implement a comprehensive QA program in order to define the reliability of the analytical results for analyses performed under this SOW. This program shall incorporate the QC procedures, any necessary corrective action, and the documentation required during data collection as well as the quality assessment measures performed by management to ensure reliable data production. This program shall include the use of standard reference materials. The QA program shall be documented in a written Quality Manual.

The Subcontractor's written Quality Manual shall present the policies, organization, objectives, functional guidelines, and specific QA/QC activities designed to achieve the data quality requirements in this SOW or other request for proposal attachments. Where applicable, the SOPs pertaining to each element listed below shall be included or referenced as part of this Quality Manual. The Subcontractor's written Quality Manual must be available to the client during any on-site audits and shall be submitted to the client upon request.

The Subcontractor's Quality Manual must describe the procedures which have been implemented to achieve the following:

- Maintain data integrity, validity and usability.
- Ensure that analytical measurement systems are maintained in an acceptable state of accuracy, stability and reproducibility.
- Detect problems through quality control indicators and establish corrective action procedures which keep all analytical processes reliable.
- Document all aspect of the measurement process in order to provide data that are technically sound and legally defensible.

The Subcontractor's Quality Manual must address the following elements:

A) Organization and Personnel
   1) QA Policy and Objectives
   2) QA Management
      a) Organization
      b) Assignment of QA and QC Responsibilities
      c) Reporting Relationship between QA and Management
      d) QA Document Control Procedures
      e) QA Program Assessment Procedures
   2) Personnel
      a) Resumes
      b) Education and Experience
      c) Training Goals
B) Facilities and Equipment
   1) Instrumentation and Backup Alternatives
   2) Maintenance Activities and Schedules
C) Document Control
   1) Laboratory Notebook Policy
   2) Sample Tracking/Custody Procedures
   3) Logbook Maintenance and Archiving Procedures
   4) Project File Organization, Preparation and Review Process
   5) Procedures for Preparation, Review, Revision and Distribution of SOPs
   6) Process for Revision of Technical or Documentation Procedures
D) Analytical Methodology
   1) Receipt and Review of Analysis Request
   2) Calibration Procedure and Frequency
   3) Sample Preparation/Extraction Procedures
   4) Sample Analysis Procedures
   5) Standards Preparation Procedures
   6) Decision Processes, Procedures, and Responsibility for Initiation of Corrective Action
E) Data Generation
   1) Data Collection Procedures
   2) Data Reduction Procedures
   3) Data Validation Procedures
   4) Data Reporting and Authorization Procedures
F) Quality Control
   1) Solvent, Reagent, and Adsorbent Check Analysis
   2) Reference Material Analysis
   3) Internal Quality Control Checks
   4) Determination of QC Acceptance Limit Procedures
   5) Determination of Corrective Action Procedures
   6) Responsibility Designation
G) Quality Assurance
   1) Data Quality Assurance
   2) Systems/Internal Audits
   3) Performance/External Audits
   4) Corrective Action Procedures

5) Quality Assurance Reporting Procedures
6) Responsibility Designation.

5. DOCUMENT CONTROL PROCEDURES

The Subcontractor shall provide reports and other deliverables as specified. In addition, the laboratory shall follow document control procedures. The goal of the laboratory document control program is to assure that the documents for a specified project will be accounted for when the project is complete. Accountable documents used by the Subcontractor shall include, but are not limited to, logbooks, COC records, sample work sheets, sample run logs, instrument raw data, bench sheets, sample preparation records and other documents relating to the sample analysis.

Because the Subcontractor may be required to provide copies of sample analysis documents to the client, the Subcontractor may exercise the option of using only laboratory identification numbers in the documents rather than clients names to preserve the confidentiality of other clients. The existence of client names in the documents does not excuse the laboratory from providing the required documents to the client. The Subcontractor shall provide a cross-reference for internal sample identification versus sampling organization's sample identification.

Original documentation not provided to the client with the data package related to the preparation and analysis of the samples shall be kept on file for a minimum of ten years. If at the end of the period, the Subcontractor desires to dispose of the original documents, the Subcontractor should first contact the client for permission to dispose of the documents. If directed by the client, the laboratory shall ship the project documents to the client rather than disposing of the documents.

6. SAMPLE HANDLING/DISPOSAL

The Subcontractor shall be responsible for the handling or processing required for receipt of samples.

Because of the potential hazards associated with the handling and analyses of these samples, the Subcontractor shall be responsible for taking the necessary measures to ensure the health and safety of its employees.

The Subcontractor shall dispose of unused sample volume and used sample bottles/containers no earlier than 18 months following complete submission of analytical data, unless otherwise instructed by the client. Sample/extract disposal and disposal of unused sample bottles/containers shall be done pursuant to all applicable laws and regulations governing disposal of such materials. The Subcontractor shall be responsible for long-term sample storage regardless of disposal capacity/availability.

7. STANDARD OPERATING PROCEDURES

The Subcontractor shall have and follow written SOPs for laboratory operations. These procedures are necessary to ensure that the analytical data produced under this SOW are of known quality and are

defensible. Copies of the Subcontractor's written SOPs shall be provided to EA upon request. An SOP is defined as a written step-by-step description of the laboratory's operating procedures, including examples of laboratory documents. The SOPs shall accurately describe the actual procedures used by the laboratory, and copies of the written SOPs shall be available to the appropriate laboratory personnel.

The Subcontractor shall have and follow written SOPs that describe how the following operations are conducted in the laboratory:

- Preventing sample contamination.
- Security for laboratory and samples.
- Standards purity/preparation.
- Maintaining instrument records and logbooks.
- Sample analysis and data control systems, i.e., laboratory information management systems (computerized or manual).
- Glassware cleaning.
- Technical and managerial review of laboratory operation and data report/data package generation.
- Internal review of contractually required QA/QC data for each project.
- Sample analysis, data handling and reporting.
- Laboratory data validation/laboratory self-inspection system.
    - Data flow and chain of command for data review.
    - Procedures for measuring precision and accuracy.
    - Evaluation parameters for identifying systematic errors.
    - Demonstration of internal QA inspection procedures (demonstrated by supervisory sign-off on personal notebooks, internal proficiency testing samples, etc.).
    - Frequency and type of internal audits (e.g. random, quarterly, spot checks, perceived trouble areas).
    - Demonstration of problem identification/corrective action and resumption of analytical processing.
    - Documentation of audit reports (internal and external), response, corrective action, etc.

- Data Management and Handing
  - Procedures for controlling and estimating data entry errors.
  - Procedures for reviewing changes to data and deliverables. Procedures for ensuring traceability of updates.
  - Procedures for testing, modifying, and implementing changes to existing computing systems including hardware, software, and installing new systems.
  - Database security, backup, and archival procedures including recovery from system failures.
  - Data system maintenance procedures and response time.
  - Individuals responsible for data system operation, maintenance, data integrity and security.
  - Specification for staff training procedures.
  - List of signatures, initials and typed name of laboratory personnel.

ATTACHMENT C
DATA PACKAGE DELIVERABLES

The data package deliverable requests are categorized into three levels as follows:

Level IV	Comprehensive validation-ready fully documented package including raw data
Level III	Summary data with quality control (QC) forms, excludes raw data
Level II	Data verification summary package, excludes forms and raw data.

The laboratory is responsible for ensuring that the electronic and complete laboratory report deliverables are consistent and accurate, including but not limited to significant figures, analyte names, and data qualifiers and/or footnotes used. The analytical method used shall be clearly defined consistently throughout the data package. The entire report shall be sequentially paginated. If revisions are made to the data packages, complete updated electronic and hard copies shall be resubmitted.

The elements to be included in the Level IV, Level III, and Level II reports are presented in Table 1. The elements to be included in a data package are further described below, as applicable to the analytical method:

1) Cover Sheet:

a) Title of report (i.e., test report, test certificate).

b) Name and location of laboratory (including a point of contact, phone and facsimile numbers) and name and location of subcontract laboratories, and test method performed if applicable.

c) Prime Contract Number (will be provided by EA Engineering, Science, and Technology, Inc., PBC [EA]).

d) Unique identification of the report (report identification number or other identifier).

e) Client name and address (will be provided by EA).

f) Project name and site location (will be provided by EA).

g) Statement of data authenticity and official signature and title of person authorizing report release.

h) Amendments to previously released reports that clearly identify the number for the previous report and revision number as well as stated reason(s) for reissuance of the report, if necessary.

i) Total number of pages.

2) **Table of Contents:** The data package shall be organized in a format that facilitates retrieval of information. The table of contents will be provided to allow navigation throughout information provided.

3) **Case Narrative:** The cover sheet and case narrative may be combined if preferred. The case narrative shall include the following information:

   a) A table that summarizes samples received, including field sample numbers and laboratory sample numbers, and identifying the analytical test methods performed and if multiple laboratories performed the analyses, the name and location of each laboratory associated with each sample.

   b) A list of samples that were received but not analyzed.

   c) Reference to preparation and analytical methods performed.

   d) A description of extractions or analyses performed outside holding times.

   e) Definition of data qualifiers or flags used.

   f) Identification of deviations of any calibration standards or QC sample results from appropriate acceptance limits and a discussion of the associated corrective actions taken by the laboratory.

   g) Identification of samples and analytes for which manual integration was necessary.

   h) Appropriate notation of any other factors that could affect the sample results (e.g., air bubbles in VOC sample vials, excess headspace in soil volatile organic analyte containers, the presence of multiple phases, sample temperature and sample pH excursions, container type or volume, etc.).

4) **Chain-of-Custody (COC) Records:** Both field and internal laboratory COC records shall be included.

5) **Sample Receipt Documentation:** The internal laboratory checklist or other form used to document the condition of samples at laboratory receipt shall be included as well as shipping documentation, and documentation (i.e., telephone logs or emails) of conversations associated with actions taken or quality issues.

6) Corrective Action Report(s)

7) **Data Report:** The analytical results for each sample and blank (Contract Laboratory Program Form I or equivalent), which must include the following information:

   a) Project name and site location

   b) Field and laboratory sample IDs

   c) Matrix

d) Date and time of sample collection

e) Date of sample receipt at the laboratory

f) Dates extracted, digested, and analyzed

g) Method numbers for preparation, cleanup, and analysis procedures employed

h) Analyte or parameter and CAS number

i) Reporting levels including limits of quantitation (LOQ) and limits of detection (LOD) and detection limits (DLs)

j) Analytical results with appropriate number of significant figures

k) Notation if manual integration occurred, including the cause and justification

l) Data qualifiers assigned

m) Concentration units

n) Dilution factors

o) Final extract volume

p) Any dilutions or concentrations for all reported data, and if neat or less diluted results are available, recorded and reported data from all runs

q) Percent moisture or percent solids (soil and sediment results are to be reported on a dry weight basis)

8) Surrogate recovery forms including acceptance criteria

9) Blank spike (laboratory control sample [LCS]) forms including acceptance criteria, amount spiked, percent recoveries, and relative percent difference (RPD), if blank spike duplicates are reported.

10) Matrix spike (MS), matrix spike duplicate (MSD), and laboratory duplicate results forms including acceptance criteria, original sample results, amounts spiked, percent recoveries, and RPD

11) Method blank results and association

12) Confirmatory results for high performance liquid chromatography (HPLC) or gas chromatography (GC) methods and retention time windows and shift results and acceptance criteria

13) Performance standard results including instrument performance check (tuning) report, degradation check standards, etc.

14) Initial calibration results including acceptance criteria

15) Second source or initial and continuing calibration standard results including acceptance criteria

16) Initial and continuing calibration blank results

17) Internal standard areas and retention time reports, including limits and out-of-control flags

18) Post-digestion spike recovery reports including acceptance criteria, original sample results, amounts spiked, and percent recoveries

19) Inductively-coupled plasma (ICP) interference check sample report

20) Serial dilution percent difference results

21) Contract required detection limit (CRDL) standard report

22) ICP interelement correction factor report

23) Sample preparation/extraction logs

24) Gel permeation cleanup logs (GPC cleanup logs)

25) Analysis run logs

26) Standard preparation logs

27) Associated raw data for each sample, blank, spike, duplicates, and standards (*i.e.*, quantitation reports, chromatograms, mass spectra, instrument printouts, bench sheets).

Table 1. Data Package Deliverable Requirements

Required Documentation	Data Package Deliverables		
	Level II	Level III	Level IV
Cover sheet	✓	✓	✓
Table of contents	✓	✓	✓
Case narrative	✓	✓	✓
COC records (field and internal laboratory)	✓	✓	✓
Corrective action reports	✓	✓	✓
Sample receipt documentation	✓	✓	✓
Data report	✓	✓	✓
Surrogate recovery forms	✓	✓	✓
Method blank results	✓	✓	✓
MS/MSD and LCS forms	✓	✓	✓
Confirmatory results for HPLC or GC	✓	✓	✓
Performance standard results		✓	✓
Initial calibration		✓	✓
Second source and continuing calibration standard results		✓	✓
Initial and continuing calibration blank results		✓	✓
Internal standard areas and retention time reports	✓	✓	✓
Post-digestion spike recovery reports	✓	✓	✓
ICP interference check sample report		✓	✓
Detection limit standard report	✓	✓	✓
ICP interelement correction factor report	✓	✓	✓
Sample preparation/extraction logs		✓	✓
GPC cleanup logs		✓	✓
Sample bench sheets			✓
Analysis run logs		✓	✓
Standard preparation logs			✓
Raw data			✓

Appendix C

Field Forms

Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Ground Water Collection Field Form

Well ID: _____ **Sample ID:** _____ **Sample Date/Time:** _____

Casing diameter/type: Well location: Weather:

Screened interval(s): Sampling personnel:

Total depth: Sampling method:

Initial depth to water (w/o pump): Water level indicator:

Final depth to water (w/o pump): Water quality meter: YSI

Measuring point: **North side of casing** Pump depth setting: Pump type/model:

	Δ < 1º C	Δ < 3%	Δ <10%	Δ <10%	Δ < 0.1 pH	Δ < 10 mV	Δ < 0.3 ft	< 1L/min	Δ < 10 NTU		Parameter Stabilization Limits (3 consecutive readings)
Time	**Temp (^oC)**	**Conductivity (mS/cm)** or **(µS/cm)**	**DO (%)**	**DO (mg/L)**	**pH**	**ORP (mV)**	**Water Level (feet btoc)**	**Flow Rate (L/min)** or **(mL/min)**	**Turbidity (NTU)**	**Purge Volume (L)** or **(mL)**	**Additional Comments**

Note:
Parameter Stabilization Limits:
(3 consecutive readings) for percent difference type parameters
Percent difference formula =
ABS[((first reading - second reading)/first reading) x 100]
Ex: Readings 12, 16, 15, 13
((12-16)/12)*100 = 33% ((16-15)/16)*100 = 6%
((15-13)/15)*100 = 13% In example, stabilization has not occurred.

Analyses: (circle those collected and indicate the number of containers)

VOCs	Metals	Dioxins and Furans
SVOCS	Dissolved Metals	PCBs as Aroclors

Sediment and Surface Water Collection Field Form

Sampling Location:_____ **Sample Date/Time(s):**_____

Sediment Sample ID(s):_____ **GPS Coordinates: Latitude:**_____

Surface Water Sample ID(s):_____ **Longitude:**_____

Sediment Description: (soil type, color, density/consistency, plasticity, moisture, grain size, angularity/mineralogy, other)

Location Map:

Analyses:
(circle and indicate number of containers)
VOCs
SVOCS
Metals
PCBs as Aroclors
Dioxins and Furans
AVS/SEM
TOC

Sampling Method:
Scoop
Core Sampler
Other

Surface Water Field Parameters:

Temperature (°C): _____

pH: _____

Conductivity (ms/cm): _____

TDS (ppm): _____

ORP (mv): _____

Turbidity (ntu): _____

Dissolved Oxygen (percent): _____

Dissolved Oxygen (mg/l): _____

Flow Rate: _____

Sampling Personnel: _____

Notes:

GEOTECHNICAL BOREHOLE LOG

Borehole ID:	Latitude:
Drilling Company:	Longitude:
Drilling Rig/Bit:	Start Time/Date:
Driller:	Completion Time/Date:
Logged by:	Final Depth:

Sample Interval	Recovery (inch)	PID Reading	USCS Soil Type	Depth, ft bgs	Soil Description (soil type, color, density/consistency, plasticity, moisture, grain size, angularity/mineralogy, odor, other)	Boring Completion Details
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
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				15		
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				27		
				28		
				29		
				30		
				31		
				32		
				33		
				34		
				35		

Soil Collection Field Form

Sampling Location:_____ **Sample Date/Time:**_____

Sample ID(s):_____ **GPS Coordinates: Latitude:**_____

Longitude:_____

Depth (bgs): **Description:** (soil type, color, density/consistency, plasticity, moisture, grain size, angularity/mineralogy, other)

Location Map:

Sampling Method:
Slide Hammer Probe
Scoop
Core Sampler
Other

Analyses:
(circle and indicate number of containers)
VOCs
SVOCS
Metals
PCBs as Aroclors
Dioxins and Furans

Notes:

Sampling Personnel: _____

Colonial Creosote
Bogalusa, Washington Parish, Louisiana

Tap Water Collection Field Form

Well ID: _____ **Sample ID:** _____ **Sample Date/Time:** _____

Well owner/location/residence: _____

Street address: _____

Filtration system? (circle one) Y N	Sampling personnel:
Start purge time:	Weather:
End purge time:	Purge Rate (gal/min):

Sample collected at (circle as appropriate): Wellhead tap In-line House tap

Field Parameters:

Time:					Within	Circle One:	
Specific Conductance:					**10%**	us/cm	ms/cm
pH:					**+/- 0.5**		
Temperature:					**+/- 1 C**	F°	C°
ORP:						mV	

Notes/Comments: _____

Analyses: (circle those collected and indicate the number of containers)

VOCs	Metals	Dioxins and Furans
SVOCS		PCBs as Aroclors

Well Configuration

Recorded By: _____