City of Seattle

LOWER DUWAMISH WATERWAY SLIP 4 EARLY ACTION AREA

LONG-TERM MONITORING AND REPORTING PLAN
APPENDIX A: QUALITY ASSURANCE PROJECT PLAN

Submitted to
U.S. Environmental Protection Agency
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March 21, 2013

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Integral Project Manager:	Kim Magruder Carlton	_____	Date:	_____
Integral Laboratory Coordinator and QA Manager:	Craig Hutchings	_____	Date:	_____
Analytical Resources, Inc. (ARI) Project Manager:	Sue Dunnihoo	_____	Date:	_____
ARI QA Manager:	Dave Mitchell	_____	Date:	_____

CONTENTS

LIST OF FIGURES ..... **v**

LIST OF TABLES ..... **v**

ACRONYMS AND ABBREVIATIONS ..... **vi**

1 PROJECT MANAGEMENT **1-1**

1.1 DISTRIBUTION LIST 1-1
1.2 INTRODUCTION 1-1
1.3 BACKGROUND AND PROBLEM DEFINITION 1-2
1.3.1 Background 1-2
1.3.2 Problem Definition 1-2
1.4 PROJECT TASK DESCRIPTION 1-3
1.5 DOCUMENT ORGANIZATION 1-3
1.6 PROJECT ORGANIZATION AND SCHEDULE 1-3
1.6.1 Project Organization 1-4
1.6.2 Schedule 1-8
1.7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA 1-8
1.7.1 Data Quality Objectives 1-8
1.7.2 Data Quality Indicators 1-9
1.8 SPECIAL TRAINING AND CERTIFICATION 1-11
1.9 DOCUMENTS AND RECORDS 1-12
1.9.1 Field Records 1-12
1.9.2 Laboratory Data Reports 1-15
1.9.3 Data Quality Documentation 1-16
1.9.4 Reports and Deliverables 1-16

2 DATA GENERATION AND ACQUISITION **2-1**

2.1 SAMPLING DESIGN AND METHODS 2-1
2.1.1 Station Locations 2-1
2.1.2 Field Survey and Sampling Methods 2-3
2.1.3 Field Quality Control Samples 2-8
2.1.4 Laboratory Quality Control Samples 2-9
2.1.5 Sample Packaging and Transport 2-10
2.1.6 Investigation-Derived Waste 2-10

2.2 SAMPLE HANDLING AND CUSTODY 2-10
2.3 LABORATORY ANALYTICAL METHODS 2-12
2.4 QUALITY CONTROL 2-12
2.4.1 Field Quality Control 2-12
2.4.2 Laboratory Quality Control 2-13
2.5 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE 2-14
2.6 INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES 2-14
2.7 NON-DIRECT MEASUREMENTS 2-14
2.8 DATA MANAGEMENT 2-15
2.8.1 Field Data 2-15
2.8.2 Laboratory Data 2-15

3 ASSESSMENT AND OVERSIGHT 3-1

3.1 ASSESSMENT AND RESPONSE ACTIONS 3-1
3.2 REPORTS TO MANAGEMENT 3-2

4 DATA VALIDATION AND USABILITY 4-1

4.1 CRITERIA FOR DATA REVIEW, VERIFICATION, AND VALIDATION 4-1
4.2 VERIFICATION AND VALIDATION METHODS 4-1
4.3 RECONCILIATION WITH USER REQUIREMENTS 4-2

5 REFERENCES 5-1

Attachment A1. Analytical Resources, Inc., Accreditation Certificates

Attachment A2. Analytical Resources, Inc., Quality Assurance Plan

Attachment A3. Standard Operating Procedures

Attachment A4. Field Forms

Attachment A5. Field Engineering Specifications

Attachment A6. Region 10 Checklist for the Assessment of Existing Information/Secondary Data for EPA's Use

Attachment A7. EPA Data Submission Requirements

LIST OF FIGURES

Figure A-1. Project Organization Chart

Figure A-2. Visual Monitoring Station Locations, Slip 4 Early Action Area

Figure A-3. Long-Term Monitoring Sampling Stations, Slip 4 Early Action Area

LIST OF TABLES

Table A-1. Target Analytes, Methods, and Reporting Limits for Sediment Samples

Table A-2. Criteria for Slip 4 EAA Cap Monitoring Samples

Table A-3. Measurement Quality Objectives

Table A-4. Slip 4 EAA Long-Term Monitoring Sample Matrix Example

Table A-5. Station Coordinates for Slip 4 EAA Long-Term Monitoring

Table A-6. Station Coordinates for Slip 4 EAA Visual Monitoring

Table A-7. Sample Containers, Preservation, Holding Times, and Sample Volume

ACRONYMS AND ABBREVIATIONS

ARI	Analytical Resources, Inc.
City	City of Seattle
CLP	contract laboratory program
COC	chain-of-custody
CSL	cleanup screening level
DGPS	differential global positioning system
DQO	data quality objective
EAA	early action area
EDD	electronic data deliverable
EIM	environmental information management
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
GPS	global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSP	health and safety plan
Integral	Integral Consulting Inc.
LTMRP	long-term monitoring and reporting plan
MDL	method detection limit
MLLW	mean lower low water
MRL	method reporting limit
NAD83	North American Datum of 1983
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
QA	quality assurance
QAPP	quality assurance project plan
QA/QC	quality assurance and quality control
QC	quality control
RACR	removal action completion report

RPD	relative percent difference
RTK	real-time kinematic
SDG	sample delivery group
SOP	standard operating procedure
SQS	sediment quality standard
SVOC	semivolatile organic compound
TOC	total organic carbon

1 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Title	Name
EPA Remedial Project Manager	Karen Keeley
EPA QA Manager	Ginna Grepo-Grove
City of Seattle Project Manager	Allison Crowley
Integral Principal in Charge	Reid Carscadden
Integral Project Manager	Kim Magruder Carlton
Integral Database Manager	Tom Schulz
Integral Laboratory Coordinator and QA Manager	Craig Hutchings
ARI Project Manager	Sue Dunnihoo
ARI QA Manager	Dave Mitchell

1.2 INTRODUCTION

This quality assurance project plan (QAPP), submitted on behalf of the City of Seattle (City), has been prepared as part of the long-term monitoring and reporting plan (LTMRP or monitoring plan) for the Slip 4 early action area (EAA). The monitoring plan addresses the 3.58-acre EAA in Slip 4, which is located within the Lower Duwamish Waterway Superfund site in Seattle, Washington.

The sampling methods presented in this report are designed to meet the objectives described in the monitoring plan. Included are descriptions of sampling design, field procedures, quality assurance and quality control (QA/QC) procedures, and associated documentation and reporting. The QA/QC procedures and components presented in this report are in accordance with U.S. Environmental Protection Agency (EPA) guidelines (USEPA 2012a) and are designed to assure the quality and integrity of the collected samples, the representativeness of the results, the precision and accuracy of analyses, and the completeness of data.

Site-specific health and safety issues for the monitoring work to be performed are presented in the health and safety plan (HSP), provided in Appendix B of the monitoring plan. The site-specific HSP establishes procedures and practices to protect Integral Consulting Inc. (Integral) employees and its subcontractors from potential hazards posed by field activities at the site. The HSP provides measures to minimize potential exposure, accidents, and physical injuries

that may occur during daily onsite activities and to minimize the hazards of adverse conditions. Contingency response actions are also provided in the HSP for emergency situations.

1.3 BACKGROUND AND PROBLEM DEFINITION

1.3.1 Background

The City completed a non-time-critical removal action to address contaminated sediment at the Slip 4 EAA. Slip 4 is a 6.4-acre navigational slip located 3 miles upstream from the confluence of the Lower Duwamish Waterway with Elliot Bay and Puget Sound. It is one of five priority early action sites identified within the 5.5-mile long Lower Duwamish Waterway Superfund site. The EAA contains 3.58 acres within the slip in which sediments were contaminated with polychlorinated biphenyls (PCBs), metals, organic compounds, and petroleum products.

The primary design elements included dredging and offsite disposal of contaminated nearshore soil, sediment, and debris; placement of capping materials; demolition of a large pier structure; and habitat improvements along the riverbank and intertidal areas. The primary objective of the Slip 4 removal action was to reduce the concentrations of PCBs and other chemicals in the post-cleanup surface sediments to below the Washington State Sediment Quality Standards (SQS).

The removal action design was prepared by Integral, of Seattle, Washington, in coordination with the City. Removal action construction was performed by General Construction Company, of Federal Way, Washington, under EPA oversight. The City managed the removal action construction contract; construction quality assurance (QA) was provided by Integral. Construction was initiated on October 3, 2011, and was completed on February 7, 2012. Details of the construction activities are summarized in a removal action completion report (RACR; Integral 2012), approved by EPA in July 2012.

1.3.2 Problem Definition

Hazardous substances remain onsite in Slip 4 EAA sediments and soils at levels greater than those that allow for unrestricted use or unlimited exposure. These remaining hazardous substances are physically and chemically isolated beneath an engineered sediment cap and soil cap. Long-term monitoring is being performed to verify that the remedy at the Slip 4 EAA remains protective of human health and the environment. The purpose of the monitoring plan is to present the approach and methods to be employed to monitor the long-term effectiveness of the Slip 4 EAA cleanup.

Specific study questions to be answered by the monitoring program are:

- Are contaminant concentrations in Slip 4 EAA surface sediments (0–10 cm) below the SQS?
- Is the physical integrity of the cap in the Slip 4 EAA being maintained such that the sediment cap continues to isolate contaminants in underlying sediments from marine biota?
- Do the institutional controls associated with the Slip 4 EAA remedy remain in place and continue to work effectively?
- Are physical changes occurring related to sediment erosion and sediment deposition in the Slip 4 EAA?

1.4 PROJECT TASK DESCRIPTION

The tasks to be completed as part of the LTMRP include visual inspections, hydrographic surveys, sediment sampling, review of data generated by others with potential to impact Slip 4 EAA remedy performance, and evaluation of storm flows that occur between monitoring periods. Fieldwork, laboratory analyses, data quality evaluation, data management, data analysis, and reporting associated with these tasks are described in this QAPP.

1.5 DOCUMENT ORGANIZATION

The remaining sections of this document summarize the elements of the QAPP that are intended to ensure that quality practices are used and appropriate documentation is prepared during all phases of the monitoring:

- Section 1—Presents the project organization, the roles and responsibilities of the individuals involved in the long-term monitoring project, schedule, quality objectives and criteria for measurement data, training and certification, and documentation.
- Section 2—Summarizes data generation and acquisition.
- Section 3—Provides information on assessment and oversight.
- Section 4—Provides criteria for data validation and usability.

1.6 PROJECT ORGANIZATION AND SCHEDULE

This section presents the organizational structure and schedule for activities associated with this investigation.

1.6.1 Project Organization

The City has retained Integral to perform long-term monitoring within the Slip 4 EAA. Figure A-1 illustrates the organization of personnel on the project. The primary contacts for EPA and the City are provided in the following table.

Title	Name	Contact Information
EPA Remedial Project Manager	Karen Keeley	U.S. Environmental Protection Agency, Region 10 1200 6th Avenue Suite 900, ECL-111 Seattle, WA 98101 (206) 553-2141 Keeley.Karen@epamail.epa.gov
City of Seattle Project Manager	Allison Crowley	City of Seattle/Seattle City Light 700 5th Avenue Suite 3300 Seattle, WA 98124 (206) 684-3167 Allison.Crowley@Seattle.gov

The names and QA responsibilities for key project personnel for Integral who will be involved in the long-term monitoring activities are provided below.

Title	Responsibility	Name	Contact Information
Integral Principal in Charge	Provide coordination, as necessary, between the Lower Duwamish Waterway project and the Slip 4 Operations and Maintenance. Provide QA for Slip 4 deliverables.	Reid Carscadden	Integral Consulting Inc. 411 1st Avenue South Suite 550 Seattle, WA 98104 (206) 957-0350 rcarscadden@integral-corp.com
Integral Project Manager	Provide project oversight and direction. Ensure the monitoring work is consistent with Slip 4 EAA requirements. Project planning and implementation; liaison between respective internal and external team members. Execute the study described in the LTMRP including report preparation.	Kim Magruder Carlton	Integral Consulting Inc. 411 1st Avenue South Suite 550 Seattle, WA 98104 (360) 756-9296 kmagruder@integral-corp.com
Integral Database Manager	Database development and data management.	Tom Schulz	Integral Consulting Inc. 1205 West Bay Drive NW Olympia, WA 98502 (360) 705-3534 ext. 414 tschulz@integral-corp.com
Integral Laboratory Coordinator and QA Manager	Completeness of QA documentation and procedures; liaison between project personnel, chemical testing laboratories, and data validators. Liaison for related QA communications with EPA.	Craig Hutchings	Integral Consulting Inc. 1205 West Bay Drive NW Olympia, WA 98502 (360) 705-3534 ext. 417 chutchings@integral-corp.com
Integral Field Coordinator	Implementation of QAPP; completeness of field documentation and procedures; liaison between Integral support staff and field subcontractors. Implementation of HSP.	Stefan Wodzicki	Integral Consulting Inc. 411 1st Avenue South Suite 550 Seattle, WA 98104 (360) 303-2708 swodzicki@integral-corp.com

1.6.1.1 Integral Personnel

The following responsibilities apply to members of the Integral technical team working on the Slip 4 EAA long-term monitoring program.

The Integral principal in charge will coordinate, as necessary, between the Lower Duwamish Waterway project and the Slip 4 Operations and Maintenance; and will provide QA for Slip 4 deliverables.

Responsibilities of the Integral project manager include, but are not limited to, the following:

- Providing project oversight and direction
- Ensuring the monitoring work is consistent with Slip 4 EAA requirements
- Implementing and ensuring effective execution of all QA program activities defined in this document
- Maintaining awareness of the entire project to detect conditions that may adversely affect the quality and/or progress of the work
- Functioning as the liaison with representatives of the City, agencies, subcontractors, and others
- Reviewing all project deliverables for completeness, accuracy, and quality.

The Integral laboratory coordinator and QA manager will report to the Integral project manager and will be responsible for the following:

- Analytical laboratory contract administration, coordination, and oversight
- Data validation and evaluation
- Communication of fast-turnaround verbal analytical results to the Integral project manager
- Data table preparation for inclusion in the monitoring report.

The Integral database manager will report to the Integral project manager and will be responsible for the following:

- Developing and maintaining the integrity of the database
- Coordinating with Integral's field coordinator to ensure that field data entries are correct and complete
- Coordinating with Integral's laboratory and QA manager to ensure that data are delivered in the correct format for entry into the database, and to ensure correct and efficient entry of data qualifiers

- Preparing data summary tables for data evaluation and reporting purposes.

The Integral field coordinator will report to the Integral project manager and will be responsible for implementing the sampling and analysis work including:

- Coordinating and conducting sediment sampling in accordance with this QAPP
- Maintaining records of sampling and the corresponding results, maintaining sampling equipment, and ensuring proper documentation of the samples
- Directing Integral support staff and field subcontractors (e.g., research vessel operators)
- Implementing and overseeing the health and safety program for Integral personnel associated with the field sampling events.

1.6.1.2 Laboratory Personnel

The Analytical Resources, Inc. (ARI) project manager is responsible for the successful and timely completion of sample analyses, and for performing the following tasks:

- Ensuring that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times.
- Reviewing analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory standard operating procedures (SOPs).
- Keeping the Integral laboratory coordinator and QA manager apprised of the schedule and status of sample analyses and data package preparation.
- Notifying the Integral laboratory coordinator and QA manager if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met.
- Taking appropriate corrective action as necessary.
- Reporting data and supporting QA information as specified in this QAPP.

The ARI QA manager is responsible for overseeing the QA activities in the laboratory and ensuring the quality of the data for this project. Specific responsibilities include the following:

- Overseeing and implementing the laboratory's QA program.
- Maintaining QA records for each laboratory production unit.
- Ensuring that QA/QC procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures.
- Reviewing and addressing or approving nonconformity and corrective action reports.
- Coordinating response to any quality control (QC) issues that affect this project with the ARI project manager.

1.6.2 Schedule

The schedule for long-term monitoring is described in detail in Section 2 of the LTMRP and is presented in Table 2-2 of the plan. All activities are linked to the completion of removal action construction in February 2012. Monitoring activities will be conducted between May and July to correspond roughly with the daytime occurrences of extreme low tides for shoreline sampling and visual inspections. Hydrographic surveys will be conducted during high-tide, with a tidal elevation no lower than 8 ft mean lower low water (MLLW). Topographic surveys (if required) will be conducted during low tide, with a tidal elevation no higher than 4 ft MLLW.

The reporting schedule is detailed in Section 5.2 of the LTMRP and is presented in Table 5-1 of the plan. Long-term monitoring is scheduled for the first 10 years; subsequent monitoring after year 10 will be determined upon consultation with EPA.

The QAPP and analytical results will be reviewed every sampling season and an addendum to the QAPP shall be submitted to EPA if major changes/updates are needed with respect to management, organization, contractors, sampling methods, and/or sample analyses. Every fifth year, or before the expiration date of the QAPP, the LTMRP QAPP shall be revised and re-submitted to EPA for review and approval.

1.7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data quality objective (DQOs) and QC criteria are described in this section. Data quality indicators such as the PARCC parameters (precision, accuracy or bias, representativeness, completeness, and comparability) (USEPA 2012a) and analytical sensitivity will be used to assess conformance of data with QC criteria and are described later in this section.

1.7.1 Data Quality Objectives

The goal of this QAPP is to ensure that data collected for this monitoring plan are technically defensible. DQOs are based on the monitoring plan goals and objectives; collected data will be evaluated relative to the DQOs and QA objectives described below.

1. **State the problem** – The problem definition is presented in Section 1.3.

2. **Identify the goal of the study** – The objectives of this monitoring plan are presented in Section 1.3.

3. **Identify information inputs** – The information inputs are discussed in the Project Task Description presented in Section 2.0.

4. **Define the boundaries of the study** – Monitoring will occur within the boundaries of the Slip 4 EAA and Slip 4 EAA boundary area.

5. **Identify the analytical approach** – Laboratory analyses will be conducted using EPA-approved analytical methods. Method reporting limits (MRLs) for each analytical method that will be used are provided in Table A-1. Analytical sensitivity is discussed further in the following section.

6. **Specify performance or acceptance criteria** – The chemical concentrations in surface sediments will be compared to SQS criteria listed in Table A-2. The SQS for PCBs is 12 mg/kg organic carbon when the total organic carbon (TOC) content is between 0.5 and 4.0 percent. Similarly, the cleanup screening level (CSL) for PCBs is 65 mg/kg organic carbon. When TOC is less than 0.5 percent or greater than 4.0 percent, regulatory comparisons are made to the lowest apparent effect threshold concentration (130 µg/kg based on dry weight) and the CSL established for the LDW site-wide cleanup (1,300 µg/kg based on dry weight). Laboratory QA/QC will meet method requirements as specified in this QAPP.

7. **Develop the plan for obtaining data** – The plan for obtaining the data required to meet the project objectives is presented in Section 2 of this QAPP.

1.7.2 Data Quality Indicators

The overall data quality objective for this project is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality for Slip 4 EAA monitoring activities. The QA procedures and measurements described herein are based on EPA guidance (USEPA 1997a, 2001, 2002, 2012a,b). PARCC parameters are commonly used as data quality indicators to assess the quality of environmental data. Measurement quality objectives for the quantitative PARCC parameters, accuracy (or bias), precision, and completeness, are provided in Table A-3.

Precision

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of field splits, matrix spike duplicates, and laboratory duplicates. Field splits will be collected at a minimum frequency of 5 percent of the sample total. Laboratory duplicates will be analyzed with every sample batch. Precision is expressed in terms of the relative standard deviation for three or more measurements and the relative percent difference (RPD) for two measurements. The relative standard deviation is the ratio of the standard deviation of three or more measurements to the average of the measurements, expressed as a percentage.

The following equation is used to calculate the RPD between measurements:

$$RPD = |\{(C1 - C2) / [(C1 + C2) / 2]\}| \times 100 \quad (1\text{-}1)$$

Where:

RPD	=	relative percent difference
C1	=	first measurement
C2	=	second measurement

Accuracy

Accuracy (or bias) represents the degree to which a measured concentration conforms to the reference value. The results for matrix spikes, laboratory control samples, method blanks, field equipment filter wipes, and filter blanks will be reviewed to evaluate bias of the data. Values for blanks should not exceed 2 times the reporting limit. The following calculation is used to determine percent recovery for a matrix spike sample:

$$\%R = [(M - U) / C] \times 100 \quad (1\text{-}2)$$

Where:

%R	=	percent recovery
M	=	measured concentration in the spiked sample
U	=	measured concentration in the unspiked sample
C	=	concentration of the added spike

The following calculation is used to determine percent recovery for a laboratory control sample or reference material:

$$\%R = (M / C) \times 100 \quad (1\text{-}3)$$

Where:

%R	=	percent recovery
M	=	measured concentration in the control or reference sample
C	=	established concentration of the control or reference sample

Results for method blanks, field equipment filter wipes, and filter blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Any analytes detected in field or method blanks will be evaluated as potential indicators of bias.

Representativeness

Representativeness is a qualitative QA/QC parameter. Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, representativeness will be addressed primarily in the sampling design by the selection of sampling sites and sample collection procedures. In the analytical laboratory, representativeness will be ensured by the proper handling and storage of samples and initiation of analysis within holding times.

Completeness

Completeness will be calculated as the ratio of usable data (i.e., unqualified data and *U*- or *J*-qualified data) to generated data, expressed as a percentage. Completeness will be calculated for each suite of analytes for each sample type and sampling event. The overall completeness goal for this project is 95 percent.

Comparability

Comparability is the qualitative similarity of one data set to another (i.e., the extent to which different data sets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are consistent with methods and procedures recommended by EPA and are commonly used for sediment studies. The results will be tabulated in standard spreadsheets for comparison with the criteria listed in Table A-2 and with temporal data from comparable sampling locations.

1.8 SPECIAL TRAINING AND CERTIFICATION

A technical team will be assembled with the requisite experience and technical skills to successfully complete long-term monitoring activities within the Slip 4 EAA. All technical team personnel involved in sample collection will have extensive environmental sampling experience.

Sampling personnel, including subcontractors, who enter the Slip 4 EAA will be required to have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) standard training course and annual 8-hour refresher courses (see HSP, Appendix B to the LTMRP). This training provides employees with knowledge and skills that enable them to perform their jobs safely and with minimum risk to their personal health. At least one first aid-certified Integral staff member will be onsite during all sampling activities. All Integral sampling personnel will be in compliance with Integral's medical monitoring program prior to initiation of field activities. Documentation of course completion and

certification will be maintained in personnel files. Subcontractors are responsible for providing their employees the required training, medical monitoring, etc., prior to field work, and providing associated documentation to the Integral project manager prior to the start of any field work.

The analytical laboratory is certified through the Washington State Department of Ecology and National Environmental Laboratory Accreditation Program for the methods that laboratory will perform (Attachment A1). Training and certification requirements for laboratory personnel are provided in the laboratory QA plan (Attachment A2). These certifications will remain current for the duration of this investigation, consistent with EPA's Policy to Assure Competency (USEPA 2011).

1.9 DOCUMENTS AND RECORDS

Records will be maintained documenting all activities and data related to sample collection and laboratory analyses. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section.

This QAPP and the HSP (Appendix B of the LTMRP) for long-term monitoring within the Slip 4 EAA will be provided to every task participant listed in Section 1.1. Any revisions or amendments to any of the documents that make up this QAPP will also be provided to these individuals.

1.9.1 Field Records

The integrity of each sample from the time of collection to the point of data reporting must be maintained. Proper record-keeping and chain-of-custody (COC) procedures will allow samples to be traced from collection to final disposition. This section provides details of field documentation, including the field logbook, field forms, sample COC, and sample codes.

1.9.1.1 Field Logbook

All field activities and observations will be noted in a logbook. In addition, individual field and sample log forms (depending on the sampling activity) may also be used to supplement the field logbook. The field lead is responsible for ensuring that the field logbook and all field data forms are complete and correct, including hydrographic survey field notes.

Logbook entries are to be made legibly, using dark waterproof ink, while activities are in progress or as soon afterward as possible. The date and time of the notation should be recorded as well as the time of the observation itself. The person recording the information will initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date his or her entry. The bottom of the page must be

signed and dated by the individual who makes the last entry. If needed, corrections to entries in the logbook will be made by drawing a single line through the original entry so as to preserve its legibility, and the correction will be written alongside the original. Corrections will be initialed and dated, and explanatory footnotes will be provided if necessary. Additional logbook requirements and procedures, and examples of the information to be recorded, are provided in SOP AP-02 (Attachment A3).

In addition, a sample location map will be updated during sampling and will be maintained throughout the sampling event. Copies of all logbooks and field forms will be retained by Integral and stored in the project file. Field forms, including the corrective action record, field change request, safety briefing, incident report, chain of custody, surface sediment collection, and visual inspection forms, are provided in Attachment A4.

1.9.1.2 Sample Codes

All samples will be assigned unique identification codes based on a designation scheme designed to suit the needs of the field personnel, data managers, and data users. Sample codes will be assigned to each sample to fulfill three purposes: 1) to identify related samples (i.e., field split samples) to ensure proper data analysis and interpretation; 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples; and 3) to track individual sample containers to ensure that the laboratory receives all of the material associated with a single sample. To accomplish these purposes, each sample collected for this project will be assigned three different types of codes: 1) a sample identifier, 2) a sample number, and 3) tag numbers for each container submitted to the analytical laboratory. These three types of codes and their uses are described in this section.

Sample Identifiers

Each sample from a given sampling location will have a sample identifier indicating the sample type and location. Sample identifiers will be established before field sampling begins and assigned to each sample as it is collected. Sample identifiers will consist of four components separated by dashes. The first component is "SL4" to identify the data as originating in Slip 4. The second component indicates sample type, as follows:

SG = subtidal surface sediment grab sample
IC = intertidal composite sediment sample.

The third component of the sample identification code indicates the station type and number:

WC# = waterway cap (where # indicates the WC station number, 1 through 8)
SC# = slope cap (where # indicates the SC station number, 2 or 3)

BD# = boundary area documentation (where # indicates the BD station number, 2 or 7)
FW = filter wipe (will be preceded by the station type and number related to the sample previously collected using the cleaned equipment)
FB = filter blank.

The fourth component is the sampling year in four digits (e.g., 2013).

Some examples of sample identifiers include:

- **SL4-SG-WC1-2013:** Discrete subtidal surface sediment grab sample collected from Waterway Cap Sampling Station WC-1 during the 2013 sampling event.
- **SL4-IC-SC3-2013:** Composite intertidal slope cap material sample collected from Slope Cap Sampling Station SC-3 during the 2013 sampling event.
- **SL4-SG-WC1-FW-2013:** Equipment filter wipe sample collected from grab sampling equipment following sample collection at Waterway Cap Sampling Station WC-1 during the 2013 sampling event.
- **SL4-SG-FB-2013:** Filter blank sample submitted to accompany the grab sampling equipment filter wipe sample during the 2013 sampling event.

All unique sample types collected from a given station over the multiple sampling rounds of the long-term monitoring will be assigned the same sample identifier.

Sample Numbers

The sample number is a unique number assigned to each sample. All sediment samples will be assigned a sample number starting with "SD", followed by a four-digit number that will be assigned sequentially in the field as samples are collected. For the initial round of sampling for this monitoring program sample numbers will begin with "SD0100"; sample numbers used for subsequent rounds of sampling will not repeat sample numbers used during previous rounds.

All sample containers belonging to a given sediment sample will have the same sample number. A field split sample will have a different sample number. The sample number appears on the sample containers and the COC forms, and analytical data will be reported by sample number.

Equipment filter wipe samples will be assigned a sample number starting with "FW" and filter blank samples will be assigned a number starting with "FB." For equipment filter wipe and filter blank samples, sequential numbers starting at 900 will be assigned instead of station numbers. For example, the first equipment filter wipe will be labeled as FW0900. The type of equipment from which the filter wipe sample was obtained (i.e., grab sampler, bowl, spoon, shovel, and/or trowel) will be indicated on the sample matrix form (Table A-4).

Tag Numbers

Tag numbers are used by laboratories to confirm that they have received all of the containers that were filled and shipped. A unique tag number will be assigned to each individual sample container submitted to the analytical laboratory; i.e., all containers submitted for a given sample will share the same sample number but will have different sample labels, each with a unique sample tag number. The sample tag number will appear on the COC forms. The sample matrix table (Table A-4) shows the total number of sample jars for each analysis needed at each sampling location.

Sample labels will be preprinted with tag numbers.

1.9.1.3 Chain-of-Custody Procedures

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals (SOP AP-03, Attachment A3). A COC record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC will be included in laboratory and QA/QC reports. Attachment A4 contains an example of the COC form that will be used during the field investigation. Details pertaining to COC procedures are provided in Section 2.2.

1.9.2 Laboratory Data Reports

All activities and results related to sample analysis will be documented at the analytical laboratory. Internal laboratory documentation procedures are described in the laboratory QA plan (Attachment A2).

The analytical laboratory will provide analytical results in a data package for each sample delivery group (SDG) or analysis batch that is comparable in content to a full EPA Contract Laboratory Program (CLP) package. The format of the data may differ from CLP requirements. Each data package will contain all information required for a complete QA review, including the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered
- A case narrative referencing or describing the procedures used and discussing any analytical problems and deviations from SOPs and this QAPP
- COCs and cooler receipt forms
- A summary of analyte concentrations (to two significant figures, unless otherwise justified), MRLs, and method detection limits (MDLs) or estimated detection limits

- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions
- Sample preparation, digestion, extraction, dilution, and cleanup logs
- Instrument tuning data
- Initial and continuing calibration data, including instrument printouts and quantification summaries, for all analytes
- Results for method and calibration blanks
- Results for all QA/QC checks, including but not limited to labeled compounds, surrogate spikes, internal standards, serial dilutions, laboratory control samples, matrix spike samples, matrix spike duplicate samples, and laboratory duplicate or triplicate samples provided on summary forms
- All raw instrument data quantification reports for all analyses and samples
- Examples of calculations
- Copies of all laboratory worksheets and standards preparation logs
- Standards and consumables traceability certificates.

Data will be delivered by the analytical laboratory in both hard copy and electronic format to the Integral laboratory coordinator and QA manager, who will be responsible for oversight of data verification and validation and for archiving the final data and data quality reports in the project file. Electronic data deliverables (EDDs) will be compatible with the project database.

1.9.3 Data Quality Documentation

Data verification (i.e., confirming the accuracy and completeness of field and laboratory data) will be completed by the Slip 4 EAA technical team for data generated in the field, and by the analytical laboratory for the data that it generates. Data validation reports for chemical analyses will be prepared as described in Section 4 and provided to the Integral laboratory coordinator and QA manager. All changes to data stored in the database will be recorded in the database change log. Any data tables prepared from the database for data users will include all qualifiers that were applied by the laboratory and during data validation.

1.9.4 Reports and Deliverables

Once all sampling and data analysis and validation for monitoring within the Slip 4 EAA are complete, a draft monitoring report will be prepared and submitted to EPA for each monitoring event as described in Section 5 of the LTMRP. The draft monitoring report will be submitted to EPA within 120 calendar days of completion of long-term monitoring field work. Validated data will be made available electronically within 30 calendar days of receipt of final validated results. Interpretation of the data will be included in the monitoring report.

2 DATA GENERATION AND ACQUISITION

To ensure that the data collected under the specifications of this monitoring plan achieve an acceptable level of quality, appropriate QA/QC procedures will be followed at all stages of sample collection and analysis. SOPs for field activities are provided in Attachment A3 of this report. Depending on field conditions, procedures specified in the referenced SOPs may be modified in the field if necessary. Any such modifications will be noted in the field logbook, recorded on a field change request form, and described in the monitoring reports prepared for that sampling event. Field forms, including the field change request form, are provided in Attachment A4. Field engineering specifications for the hydrographic and topographic survey work are provided in Attachment A5.

2.1 SAMPLING DESIGN AND METHODS

Data to support monitoring plan objectives will be collected through visual inspections, hydrographic/topographic surveys, and sediment sampling and analysis. This section discusses the sampling design and procedures for the following tasks:

- Documenting the locations of stations and establishing sample identifiers
- Conducting visual inspections, including photo-documentation of Slip 4 EAA from set vantage points
- Conducting a hydrographic survey to monitor sedimentation within the Slip 4 EAA and confirm the integrity of the cap
- Conducting supplemental topographic surveys (if bank slope deformation is observed) to document topographic changes to bank slope areas
- Cleaning equipment, work surfaces, and sediment sampling implements prior to commencing sampling and between stations
- Collecting and processing sediment samples to ensure proper subsampling of each matrix
- Completing standard forms to document the collection effort and field conditions
- Collecting field and laboratory QC samples
- Handling of investigation-derived wastes.

2.1.1 Station Locations

Visual inspections of the cap material will be conducted annually over the first 5 years of monitoring, in conjunction with sediment sampling events in years 7 and 10, and after significant seismic events (i.e., local peak ground acceleration greater than 0.10 g [gravitational acceleration, 9.8 m/s^2]). Locations selected for photo-documentation are provided in Figure A-2

and generally represent post-remedy vantage points that were photographed and presented in the RACR. Subsequent visual inspections will utilize these same vantage points and may be expanded to include additional vantage points based on field observations.

Hydrographic surveys will be conducted in years 5 and 10 of the monitoring plan. The hydrographic surveys will utilize the same baseline as the record document survey conducted in 2012, with transects at intervals no greater than 20 ft. In addition, the surveys will be performed using methods and equipment consistent with those used for the 2012 record document survey, to ensure comparability of the results (Attachment A5).

Supplemental shoreline topographic surveys may also be conducted if there is evidence of deformation of the bank slopes (as observed during visual inspections). Deformation of the bank slopes will be assessed based on visual observations of settlement or tension cracks in the upland area immediately adjacent to the top of the river bank slopes, bank slope movement, erosion of bank armor materials, or disturbance from beached vessels or other causes. Topographic surveys will be performed using methods and equipment consistent with those used for the 2012 record document survey, to ensure comparability of the results (Attachment A5).

Surface sediment samples (0–10 cm) will be collected from eight locations in the Slip 4 EAA and two locations in the Slip 4 EAA boundary area, following field procedures that are consistent with EPA protocols (USEPA 1996) and this QAPP. Approximate sample locations are shown on Figure A-3 and the coordinates are listed in Table A-5. Samples will be collected from within ±2 m of the specified locations. Sample locations were chosen to coincide with cap verification sampling locations used during the removal action, which will serve as the basis for comparison. The number, type, and frequency of sediment samples to be collected during long-term monitoring for the first 10 years are summarized below.

Composite Slope Cap Sediment Samples—A three-to-one composite sample of surface sediment (0–10 cm sediment horizon) will be collected from two stations on the riverbanks in the Slip 4 EAA (SC-2 and SC-3; Figure A-3). The three subsamples contributing to the composite will be collected at approximately +2, +8, and +12 ft MLLW at each station. Each composite sediment sample will be analyzed for PCB Aroclors, semivolatile organic compounds (SVOCs), metals, TOC, grain size, and total solids (Table A-1). Samples will be collected in monitoring years 1, 3, 5, 7, and 10.

Discrete Waterway Cap Samples—Samples of surface sediment (0–10 cm sediment horizon) will be collected from six stations within the waterway cap area (WC-1, WC-2, WC-3, WC-4, WC-7, and WC-8; Figure A-3). One field split sample (duplicate) will be collected from one location within the waterway, where adequate sediment is available to provide both an original and a split sample. The split sample will be collected in accordance with SOP SD-02 (Attachment A3). Samples from the Waterway Cap area will be analyzed for PCB Aroclors, SVOCs, metals, TOC, grain size, and total solids (Table A-1). The field split sample will be

analyzed for chemical parameters only. Samples will be collected in monitoring years 1, 3, 5, 7, and 10.

Boundary Documentation Sediment Samples—Samples of surface sediment (0–10 cm sediment horizon) will be collected from two stations along the boundary of the cap area (BD-2 and BD-7; Figure A-3). Boundary samples will be collected in monitoring year 1 only and analyzed for PCB Aroclors, TOC, and total solids.

2.1.2 Field Survey and Sampling Methods

The following sections describe the field surveys, sediment sampling equipment, sampling methods, and sample handling and shipping procedures that will be used during each monitoring event.

2.1.2.1 Visual Survey of Cap at Low Tide

The visual survey will be conducted from land at low tide to document any changes to the cap's integrity along its periphery. The visual survey will be recorded by taking photographs at select vantage points, including seven locations (A through G) of the sediment cap visible at low tide that were photographed and presented in the RACR (Figure A-2). Three additional locations (H through J) have been added to expand the coverage of the visual survey. Photographs will be taken from the specified vantage points in the orientations shown by the arrows on Figure A-2. Photograph locations and orientations are provided in Table A-6, and will be duplicated during each monitoring event.

Photographs taken for the RACR were taken using a 10 megapixel digital camera with 3.6x optical zoom lens with a focal length of 6.7 to 24.0 mm. A camera with similar features will be used for subsequent long-term monitoring events. Care will be taken to reproduce the same "views" presented in the RACR photographs from each vantage point.

Station locations listed in Table A-6 will be permanently marked (i.e., stamped into permanent features or marked with rebar) to allow for exact vantage point positioning throughout the monitoring program. The permanent location markers will be installed during the first monitoring event in 2013 using a sub-meter global positioning system (GPS) and the target coordinates listed in Table A-6.

Field notes will be collected on a visual inspection form (Attachment A4) in conjunction with photographs, noting evidence of disturbance, erosion, sedimentation, breaches in cap integrity, or other changes in the conditions of the exposed portion of the intertidal and shoreline caps. In addition, the condition of the constructed habitat features (e.g., integrity of anchored woody debris) will be noted.

2.1.2.2 Hydrographic/Topographic Survey Procedures

Surveys conducted as part of the long-term monitoring program will be performed using methods, equipment, and survey control points that are consistent with those used for the 2012 record document survey, to ensure comparability of the results. Specifically, surveys will be prepared in accordance with all applicable requirements set forth in the Slip 4 EAA field engineering specifications for record document surveying. A copy of these specifications is included as Attachment A5. These requirements include, but are not limited to, performing the hydrographic survey in accordance with the U.S. Army Corps of Engineers Hydrographic Surveying Engineering Manual for Navigation and Dredging Support Surveys (USACE 2002) and using a real-time kinematic (RTK) GPS and a multi-beam, echo sounder sonar system to obtain soundings. Topographic surveys will also utilize RTK-GPS and will be conducted in accordance with specifications identified in Attachment A5.

2.1.2.3 Sediment Sampling Procedures

This section describes the equipment requirements and procedures for collecting sediment samples to meet monitoring plan objectives, including sample vessel requirements, sample positioning and location documentation, sampling equipment decontamination, and sediment sample collection.

Sampling Vessel Requirements

A sampling vessel will be used for collection of waterway cap and boundary documentation samples. The specific sampling vessel that will be used during the field effort will be identified by Integral once a subcontractor has been identified and may vary from monitoring event to monitoring event. The vessel operator will be thoroughly familiar with safe vessel operation, and accurate deployment and retrieval of the grab sampler. At a minimum, the sampling vessel will be equipped with a hydraulic winch system capable of deploying the grab sampler at a rate not exceeding 1 m/second, and sufficient positional control systems to maintain position during sampling. The vessel will also provide sufficient deck space for safe crew movement and sample processing.

Land-Based Sampling Requirements

Slope cap and waterway cap sediment sample locations may be accessed by land when tide levels permit sampling on foot. If the sampling locations are to be accessed via privately owned upland properties rather than by disembarking from the sampling vessel within the EAA, it will be necessary to obtain access permission and coordinate with upland property owners or operators prior to sampling. Equipment and procedural requirements for land-based sampling such as location positioning, sample collection, etc. are included in the following sections.

Sample Location Positioning

Latitude and longitude coordinates will be obtained and recorded at each location where samples are collected, using a differential global positioning system (DGPS). The standard projection method to be used during field activities is World Geodetic System 1984. For cartographic and analytical purposes, the coordinates will be projected to the North American Datum of 1983 (NAD83), State Plane Coordinate System, Washington North Zone horizontal datum. The positioning objective is to accurately determine and record the positions of all sediment sampling locations to within ±2 m.

The DGPS unit consists of a GPS receiver and a differential receiver located at a horizontal control point. At the control point, the GPS-derived position will be compared with the known horizontal location, offsets or biases will be calculated, and the correction factors will be telemetered to the GPS receiver. Positioning accuracies on the order of approximately 1–3 m can be achieved by avoiding the few minutes per day when the satellites are not providing the appropriate quality of signal (SOP AP-06, Attachment A3). The GPS unit provides the operator with a listing of the time intervals during the day when accuracies are decreased; avoiding these time intervals will permit the operator to maintain better positioning accuracy (SOP AP-06).

Water depths will be recorded at each of the subtidal sampling locations, per SOP SD-04 (Attachment A3). The depth from the water surface to the mudline will be measured using a lead line or fathometer when the sampling device makes contact with sediment, and will be recorded to the nearest 0.1 ft.

Equipment Decontamination

All sampling equipment that comes into contact with the samples (e.g., grab sampler, stainless-steel bowls and spoons, stainless-steel shovel and spades, stainless-steel ruler) will be decontaminated prior to use and between each sample. Before sampling begins at a location, the sampling equipment will be scrubbed with a standard detergent (e.g., Alconox® or Liquinox®) and rinsed with water (i.e., river, tap, or distilled/deionized water). The final rinse for surface sediment collection equipment (i.e., the grab sampler) will be river water. The final rinse for the surface sediment compositing equipment (i.e., stainless-steel bowls and spoons) and the sample collection equipment used for intertidal sample collection (i.e., stainless-steel shovels, spades, and ruler) will be laboratory grade distilled/deionized water. If there is a lapse in time between cleaning and use, then the decontaminated sampling equipment will be covered with aluminum foil to protect it from possible contamination.

The sampling equipment decontamination procedure described above is consistent with SOP SD-01 (Attachment A3), except that no solvent rinse will be used unless residual petroleum sheen is observed. If a residual petroleum sheen remains on the sampling equipment or is difficult to remove using the standard decontaminations procedures described above, an additional hexane rinse may be added, followed by a final rinse with laboratory distilled/deionized water.

Slope Cap Sediment Sample Collection

Slope cap sediment sample locations may either be accessed by land or from the river using the sampling vessel. Samples will be collected using a stainless-steel shovel or a stainless-steel spade (or equivalent type of equipment) in accordance with standard methods used by EPA. Sampling methods are provided in SOP SD-04 (Attachment A3). Before sampling begins at a station, the grab sampler and all other sampling equipment will be decontaminated as described above.

Each of the two slope cap sediment samples will be a composite of sediment collected from three locations targeted at approximately +2, +8, and +12 ft MLLW at each station. At each of the sampling locations, the top 10 cm of slope cap sediment will be collected. Any vegetation, debris, or rocks greater than approximately 0.5 in. in size on the surface will be removed prior to sampling and noted in the field logbook. A stainless-steel ruler will be used to ensure that the sampling criterion for adequate penetration depth has been met. Approximately equal volumes will be collected from each of the three locations and composited into a single sediment sample for that station. Photographs will be taken to document general observations and the condition of each sampling station, as well as the overall sampling techniques used during the sampling event. The presence of aquatic organisms observed in slope cap sediment samples will also be recorded on the field form. All sampling activities will be documented in the field logbook (Section 1.9.1.1) and on a sample collection form (Attachment A4).

Slope cap sediment will be placed into a decontaminated, stainless-steel mixing bowl and homogenized using a stainless-steel spoon or other stainless-steel mixing implement until the sediment attains a visually uniform color and texture. Aliquots of slope cap sediment will be placed into labeled, laboratory-cleaned sample containers with Teflon-lined lids (Table A-7).

Waterway Cap and Boundary Documentation Sediment Sample Collection

Locations for intertidal and subtidal surface sediment sample collection will be accessed from the river using the sampling vessel. Surface sediment samples will be collected using a stainless-steel power grab sampler or van Veen dredge sampler in accordance with standard methods used by USEPA (1996), or by using a stainless-steel shovel or stainless-steel spade (or equivalent type of equipment) if intertidal stations are accessible at low tide. Sampling methods are provided in SOP SD-04 (Attachment A3). Before sampling begins at a station, the grab sampler and all other sampling equipment will be decontaminated as described above.

At each sampling station, one grab will be collected for chemical analysis.[1] Material in the grab sampler will be evaluated for acceptability according to whether the following criteria are met:

[1] The volume capacity provided by a power grab usually provides sufficient sediment volume for the chemical analyses called for in the monitoring plan; however, as discussed later in this section, the coarse-grained nature of the cap material may necessitate collecting multiple grabs at a station in order to collect sufficient material appropriate for chemical analysis.

- The sampler is not overfilled
- Overlying water is present
- The overlying water is not excessively turbid
- The sediment surface is relatively undisturbed
- A sediment penetration depth of at least 11 cm is attained.

The field team leader will evaluate all grabs collected. If a grab fails to meet the above criteria, it will be rejected and discarded away from the station; however, if the only limitation in the sample acceptability is the penetration depth, the sample material will be retained in a separate container and used in the event that the target sediment horizon of 0–10 cm cannot be met through subsequent attempts.

After a sediment sample is retrieved and judged to be acceptable for chemical analyses, the overlying water will be siphoned off and the upper 10 cm of sediment will be collected in accordance with USEPA (1996) guidelines and placed in a stainless-steel bowl. Stainless-steel spatulas or spoons will be used to collect the sediment. A stainless-steel ruler will be used to ensure that the sampling criterion for adequate penetration depth is met and that the correct amount (i.e., 10 cm) of sediment has been removed. Care will be taken to exclude sediment that is in contact with the sides of the grab sampler from the collected sample. A description of the pertinent physical characteristics of the sample will be recorded (e.g., sediment grain size, color, layering, odor, sheen, organics). The presence of aquatic organisms observed in the sediment samples will be recorded on the field form. Photographs will be taken to document the sediment collected at each station, as well as the overall sampling techniques used during the sampling event. All sampling activities will be documented in the field logbook (Section 1.9.1.1) and on a sample collection form (Attachment A4).

The coarse-grained nature of the cap material may complicate sample collection. Although the target sediment horizon is 0–10 cm, shallower horizons may be collected from a station, based on the judgment of the field lead, if the target horizon cannot be sampled after a minimum of three attempts. Similarly, multiple grabs per station may be necessary in order to collect sufficient volume of appropriate material to submit for the chemical analyses (e.g., less than 0.5-in. diameter). If compositing is necessary, the sample material collected from each grab will be composited in a stainless-steel bowl which will be covered with aluminum foil until a sufficient volume of sediment is collected. The sample material in the bowl will be mixed using a stainless-steel spoon to achieve a uniform texture and color prior to being transferred to the pre-cleaned sample containers specified in Table A-7.

Sampling Containers

Samples will be placed in labeled, clean sample containers with Teflon®-lined lids (Table A-7). Commercially available, laboratory certified pre-cleaned jars will be used for the samples, and the testing laboratories will maintain a record of certification from the suppliers. The bottle

shipment documentation will include batch numbers. With this documentation, jars can be traced to the supplier, and bottle-wash analysis results can be reviewed. The bottle-wash certificate documentation will be archived in Integral's project file. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Each sample container will be clearly labeled at the time of sampling with the task name, sample number, type of analysis to be performed, date and time, initials of person(s) preparing the sample, and tag number. Sample numbers and tag numbers are described in detail in Section 1.9.1.2. Immediately after sample containers are filled, any glass sample containers will be wrapped in bubble wrap, placed inside resealable plastic bags, and stored unfrozen on ice.

The sample matrix table (Table A-4) shows the total number of sample jars for each analysis needed at each sampling location as well as the type of jar required for each analysis. Integral's field lead and field personnel in charge of sample handling will use this table as a QC check to ensure that all samples at a given station are collected and that the appropriate sample container is used for each sample.

2.1.3 Field Quality Control Samples

Field QC samples will be used to assess sediment sample variability and evaluate potential sources of contamination. Details on how field QC samples will be collected for sediments are provided in SOP SD-02 (Attachment A3). The types of QC samples that will be collected specifically for this study are further described in this section. If QC problems are encountered, they will be brought to the attention of Integral's QA manager. Corrective actions, if appropriate, will be implemented to meet the task's data quality indicators.

Field QC samples for composite slope and surface sediment will be field split samples, equipment filter wipes, and filter blanks. Temperature blanks will be included in all sample coolers that are shipped on ice. The following QC samples will be collected in the field and analyzed by the analytical laboratory:

- Split samples will be collected in the field and analyzed to assess the variability associated with sample processing and laboratory variability. A blind field split sample will be collected at one station per monitoring event. A split sample will be collected at a waterway cap station where adequate material is available to provide both an original and a split sample. Samples will be assigned unique numbers and will not be identified as field splits to the laboratory.
- Equipment filter wipe samples will be collected to help identify possible contamination from the sampling environment or from the sampling equipment (e.g., stainless-steel shovel or trowel, stainless-steel bowls, and spoons). Equipment filter wipe samples will be generated at approximately 5 percent of the sediment sampling locations at a minimum, and will be collected from decontaminated sampling equipment during

sample collection. If dedicated equipment is used for each sampling station, equipment filter wipes will be collected prior to sample collection. In addition, if sediment volume is an issue and sediment in contact with the grab sampler is collected, one additional set of filter wipes of the decontaminated grab sampler will be collected. Two types of filter wipes, including Ghost Wipes (or equivalent) for metals analysis and Whatman grade GF 8 filter papers (or equivalent) for organics analysis, will be required for each equipment filter wipe sample. The Ghost Wipe is a sturdy wiping material moistened with deionized water that readily and completely dissolves during the digestion process. Ghost Wipes meet all ASTM E1792 specifications for wipe sampling materials for lead in surface dust. Whatman grade GF 8 filter papers are glass microfiber filters frequently used in analysis of organic compounds. All equipment filter wipe samples will be clearly noted in the field logbook (e.g., sample identifier, equipment type, date and time of collection, analysis and filter lot number).

- A minimum of one filter blank will be collected for each kind of sampling equipment used for chemical analyses. Filter blanks are unused filters, of the kind used for the equipment filter wipe samples (Ghost Wipes or Whatman filter papers; see Table A-4 and SOP SD-02 in Attachment A3), placed into sample jars in the field to evaluate potential background concentrations present in filter paper used for the equipment filter wipe. Filter blanks will be collected at a minimum frequency of one for each lot number of filters used for collecting the equipment filter wipes. (*Note*: Filters must be stored in their original box, or wrapped carefully in three layers of pre-cleaned aluminum foil prepared at the analytical laboratory, or contained in a glass jar. The filter box cannot be stored unprotected in plastic bags or containers.)
- Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank shall be included with each sample cooler shipped to the testing laboratory.

2.1.4 Laboratory Quality Control Samples

The frequency of chemical analysis for laboratory control samples, matrix spike samples, matrix spike duplicates or laboratory duplicates, and method blanks will be one from each monitoring event. Additional sample volume will need to be collected of all sampled media for these analyses. Sample locations designated for additional sample volume collection for laboratory QC are provided in Table A-4, but are subject to change based on available sediment volume at each station.

2.1.5 Sample Packaging and Transport

Sample coolers and packing material will be supplied by the analytical laboratories. Individual sample jars will be labeled and placed into plastic bags and sealed. Samples will then be packed in a cooler lined with a large plastic bag. Glass jars will be placed to prevent breakage and separated in the cooler by bubble wrap or other shock-absorbent material. Ice in sealed, double, plastic bags will be placed in the cooler for shipping (SOP AP-01, Attachment A3). When a cooler is full, the completed COC form will be placed into a zip-locked bag and taped to the inside lid of the cooler. A temperature blank will be added to each cooler. Each cooler will be sealed with two COC seals, one each on the front and side of the cooler. Labels indicating "This End Up" with an arrow and "Fragile" will be attached to each cooler.

The shipping containers will be clearly labeled (i.e., name of task, time and date container was sealed, person sealing the cooler, and company name and address) for positive identification. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

After the chemistry samples have been received by the laboratory, they will be stored under refrigeration as stipulated by the sample matrix. Any sediment remaining after analyses are completed will be stored frozen for possible future use.

2.1.6 Investigation-Derived Waste

Any excess water or sediment remaining after processing will be returned to the slip in the vicinity of the collection site. Any water or sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site before proceeding to the next station.

All disposable materials used in sample collection and processing, such as paper towels and disposable coveralls and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill. Phosphate-free detergent-bearing liquid wastes from decontamination of the sampling equipment will be washed overboard or disposed into the sanitary sewer system as will rinsate from the decontamination process.

2.2 SAMPLE HANDLING AND CUSTODY

Principal documents used to identify samples and to document sample possession will be field logbooks and COC records. Custody will be documented for all samples at all stages of the analytical or transfer process.

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals (SOP AP-03, Attachment A3). A COC record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC will be included in laboratory and QA/QC reports. Attachment A4 contains an example of the COC form that will be used during the field investigation.

At a minimum, the field personnel will provide the following information on the COC form:

- Site name
- Field lead's name and team members responsible for collection and processing of the listed samples
- Sample number
- Collection date and time for each sample
- Sample type (e.g., sediment, or filter blank)
- Number of sample containers
- Requested analyses and whether the sample is intended for immediate analysis or to be archived
- Tag number
- Sample preservation information (if any)
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

Integral's field lead will be designated field sample custodian and will be responsible for all sample tracking and COC procedures for the samples collected. The field sample custodian will be responsible for final sample inventory and will maintain sample custody documentation. The field sample custodian will complete COC forms prior to removing samples from the field. Upon transferring samples to the laboratory sample custodian (if a local laboratory is selected) or shipping courier (as appropriate), the field sample custodian will sign, date, and note the time of transfer on the COC form. The original COC form will be transported with the samples to the laboratories. All samples will be shipped to the testing laboratories in either coolers or shipping containers sealed with custody seals.

Upon receipt of samples at the analytical laboratory, the physical integrity of the containers and seals will be checked, and the samples will be inventoried by comparing sample labels to those on the COC forms. The analytical laboratory will include the COC and shipping container receipt forms in the data package. Any breaks in the COC or non-conformances will be noted and reported in writing to the Integral laboratory coordinator and QA manager within 24 hours of receipt of the samples. The laboratory QA plan (Attachment A2) includes procedures used

for accepting custody of samples and documenting samples at the laboratory. The ARI project manager will ensure that a sample tracking record is maintained that follows each sample through all stages of sample processing at the laboratory.

Samples will be stored in accordance with Table A-7. Aliquots of the samples remaining after analysis will be stored at –20°C. The laboratory will maintain COC documentation and documentation of proper storage conditions for the entire time that the samples are in its possession.

The analytical laboratory will not dispose of the samples until authorized to do so by the Integral laboratory coordinator and QA manager. After authorization is obtained, the laboratory will dispose of samples, as appropriate, based on matrix, analytical results, and information received from the client.

2.3 LABORATORY ANALYTICAL METHODS

Sediment samples collected for this study will be analyzed for a variety of chemical and physical parameters as outlined in Table A-1. The proposed laboratory methods and associated MDLs and MRLs are also summarized in Table A-1. These methods are consistent with requirements provided in SW-846 (USEPA 2008a) and other established and widely accepted protocols.

2.4 QUALITY CONTROL

QC samples will be prepared in the field and at the laboratory to monitor the bias and precision of the sample collection and analysis procedures.

2.4.1 Field Quality Control

As described in Section 2.1.3, field QC samples for this study will consist of field split samples (homogenization duplicate), equipment filter wipes, and filter blanks.

Field split samples will be collected at a minimum frequency of 5 percent of samples processed. Equipment filter wipes will consist of clean, ashless filter papers supplied by the analytical laboratory. Equipment filter wipes will be collected at a minimum frequency of 5 percent of samples processed for each type of non-dedicated equipment in direct contact with the sediments being collected. One filter blank will be collected for each lot of equipment filter wipes used during the field effort.

Validation criteria and procedures for field QC samples are described in Sections 4.1 and 4.2 of this QAPP.

2.4.2 Laboratory Quality Control

Extensive and detailed requirements for laboratory QC procedures are provided in the methods that will be used for this investigation (Table A-1). Performance-based control limits have been established by the analytical laboratory. These and all other control limits specified in the method descriptions will be used by the analytical laboratory to establish the acceptability of the data or the need for reanalysis of the samples. QC procedures will be completed by the laboratory, as required by each protocol and as indicated in this QAPP. Laboratory control limits for recoveries of surrogate compounds, matrix spikes, and laboratory control samples, and for RPD of matrix spike duplicates and laboratory duplicates, are provided in the analytical laboratory's QA manual (Attachment A2). Laboratory QC procedures that address the PARCC parameters are discussed in Section 1.7.

All QC requirements will be completed by the analytical laboratory as described in the analytical methods (Table A-1), including the following (as applicable to each analysis):

- Instrument tuning
- Initial calibration
- Initial calibration verification
- Continuing calibration verification
- Calibration or instrument blanks
- Method blanks
- Laboratory control samples
- Internal standards
- Surrogate spikes/labeled compounds
- Matrix spikes
- Matrix spike duplicates or laboratory duplicates.

To alert the data user to possible bias or imprecision, data qualifiers will be applied to reported analyte concentrations when associated QC samples or procedures do not meet control limits. Laboratory control limits for the methods that will be used for this monitoring plan are provided in the laboratory QA plan (Attachment A2). Data validation criteria and procedures are described in Section 4.

MRLs reflect the sensitivity of the analysis. Target MRLs for this study are summarized in Table A-1.

MDLs are determined by the analytical laboratory for each analyte, as required by USEPA (2008a). MDLs are statistically derived and reflect the concentration at which an analyte can be

detected in a clean matrix (e.g., sand or distilled water) with 99 percent confidence that a false positive result has not been reported. MRLs are established by the analytical laboratory at levels above the MDLs for the project analytes. The MRL values are based on the laboratory's experience analyzing environmental samples and reflect the typical sensitivity obtained by the analytical system in environmental samples. For this task, the concentration of the lowest standard in the initial calibration curve for each analysis is at the level of the MRL. This allows reliable quantification of concentrations to the MRL in the absence of matrix interferences.

2.5 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by the analytical laboratory in accordance with the requirements identified in the laboratory's SOPs and manufacturer instructions. In addition, each of the specified analytical methods provides protocols for proper instrument setup and tuning, and critical operating parameters. Instrument maintenance and repair will be documented in the maintenance log or record book.

2.6 INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and QC purposes.

During sample collection, the quality of laboratory water used for decontamination will be documented at the laboratory that provides the water. Pre-cleaned sample jars (with documentation) will be provided by the laboratory. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the analytical laboratory are provided in the laboratory SOPs and QA manual (Attachment A2). All supplies will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be retained by Integral (i.e., for supplies used in the field) or the laboratory.

2.7 NON-DIRECT MEASUREMENTS

Existing chemical data from previous investigations will be used for this study. Historical data will be reviewed for QA and acceptability for use in the long-term monitoring study per EPA

Region 10 checklist (Attachment A6; USEPA 2012b). Only validated data will be used for decision-making purposes.

2.8 DATA MANAGEMENT

During field, laboratory, and data evaluation operations, effective data management is critical to providing consistent, accurate, and defensible data and data products. Data management systems and procedures will be used to establish and maintain an efficient organization of the environmental information collected. Essential elements of data management and reporting activities associated with the sediment sampling program are discussed in the following sections.

Project data will be maintained in a relational database designed to accommodate all the types of environmental measurements that will be made during long-term monitoring within the Slip 4 EAA. The final repository for all sample information will be an Environmental Quality Information System (EQuIS) database. Procedures to be used to transfer data from the point of generation to the EQuIS database are described in this section.

2.8.1 Field Data

Daily field records (a combination of field logbooks, field forms, GPS records, and COC forms) will make up the main documentation for field activities. Detailed guidelines for entry of information during field sampling are provided in Section 1.9. Upon completion of sampling, hard copy notes and forms will be scanned to create an electronic record for use in creating appendices to the long-term monitoring report. Information on sampling locations, dates, depths, equipment, and other conditions, and sample identifiers, will be entered into a project database (e.g., EQuIS) managed by Integral. One hundred percent of hand-entered data will be verified based on hard copy records. Electronic QA checks to identify anomalous values will also be conducted following entry. Field and analytical data will be reported in the monitoring reports (see Section 5 of the LTMRP). Upon EPA's approval of a monitoring report, the City or its consultant shall submit project data to the Washington State Department of Ecology for incorporation into the state's Environmental Information Management (EIM) database per Section 5.1 of the LTMRP.

2.8.2 Laboratory Data

The analytical laboratory will submit data in both electronic and hard copy format. The Integral database manager or his designee will provide the desired format for EDDs to the laboratory, and the Integral database manager and Integral laboratory coordinator and QA manager will discuss these specifications with the ARI QA manager prior to data delivery and tailor them as necessary to specific laboratory capabilities. QA checks of format and consistency will be applied to EDDs received from the laboratory. After any issues have been resolved, the data

will be loaded into the project database. Each data set loaded into the database will be linked to the electronic document of the relevant laboratory data package. A complete laboratory data deliverable will be produced from the database in an electronic format for use by data validators. Validators will return an edited version of this data deliverable, and the edits will then be incorporated into the database. An automated change log will be maintained by the database so that the history of all such edits is maintained, and the origin of each data value can be determined.

Validated data will be submitted to EPA for inclusion in the agency's national database, WQX, according to the Option 2 procedures (Attachment A7). Data will be submitted via e-mail in tab-delimited text files prepared in accordance with the EPA Region 10 WQX EDD.

3 ASSESSMENT AND OVERSIGHT

This task will rely on the knowledge and expertise of the Integral technical team. The field team and laboratory will stay in close verbal contact with the Integral project manager and Integral laboratory coordinator and QA manager during all phases of this study. This level of communication will serve to keep the management team informed about activities and events, and will allow for informal but continuous task oversight.

3.1 ASSESSMENT AND RESPONSE ACTIONS

Assessment activities will include readiness reviews by the Integral field coordinator prior to sampling, by the Integral database manager prior to release of the final data to the data users, and internal review while work is in progress. An informal technical systems audit may be conducted if problems are encountered during any phase of this project.

The first readiness review will be conducted by the field lead prior to field sampling to verify that all field equipment is ready for transfer to the Site. The field lead will also verify that the field team and any subcontractors have met the appropriate training and certification requirements (see Section 1.8) and have been scheduled and briefed, and that the contracts for the subcontractors have been signed by both parties. Any deficiencies noted during this readiness review will be corrected prior to initiation of sampling activities.

The second readiness review will be completed by the Integral database manager before final data are released for use to verify that all results have been received from the laboratory, data validation and data quality assessment have been completed for all of the data, and data qualifiers have been entered into the database and verified. Any deficiencies noted during this review will be corrected by the database administrator, the Integral laboratory coordinator and QA manager or designee, and the laboratory QA manager as needed. Data will not be released for final use until all data have been verified and validated. Any issues with data quality will be noted in the data validation report and the final project report, as appropriate. No report will be prepared in conjunction with the readiness reviews.

Technical review of intermediate and final work products generated for this task will be completed throughout the course of all sampling, laboratory, data validation, data management, and data interpretation activities to ensure that every phase of work is accurate, complete, and follows the QA procedures outlined in this QAPP. Issues encountered in the field will be brought to the attention of the field lead and Integral QA manager for review and resolution. All issues and follow-up or corrective actions will be documented in the field logs, as well as the final report if applicable. Any problems that are encountered during the generation of final work products will be resolved between the reviewer and the person completing the work. Any problems that cannot be easily resolved or that affect the final

quality of the work product will be brought to the attention of the Integral project manager and Integral laboratory coordinator and QA manager for resolution.

The analytical laboratory will be required to have implemented a review system that serves as a formal surveillance mechanism for all laboratory activities. Details are provided in the laboratory QA plan (Attachment A2). It is expected that the laboratory will maintain current certification and accreditation throughout the course of this investigation, consistent with EPA policy (USEPA 2011). Should accreditation or certification be suspended at any point, the EPA project manager will be informed immediately so that potential impacts to the scope of work can be addressed.

Technical system audits may be conducted if serious problems are encountered during sampling or analysis operations. If completed, these audits will be conducted by the Integral laboratory coordinator and QA manager or designee, or by the laboratory, as appropriate. These audits may consist of on-site reviews of any phase of field or laboratory activities or data management. Results of any audits will be provided in the monitoring report. If needed, EPA may conduct a Technical System Audit and/or Quality System Review of Integral, the laboratory, or other contractors.

Any team member who discovers or suspects a nonconformance is responsible for reporting the nonconformance to the Integral project manager and Integral laboratory coordinator and QA manager, or the ARI project or QA manager, as applicable. The Integral laboratory coordinator and QA manager will ensure that no additional work dependent on the nonconforming activity is performed until a confirmed nonconformance is corrected.

3.2 REPORTS TO MANAGEMENT

Corrective actions will be required if deviations from the methods or QA requirements established in this QAPP are encountered. When a nonconformance is identified, corrective action will be taken immediately, if possible. The Integral project manager will be contacted and, if necessary, will provide assistance in resolving the issue. Any nonconformance issue that ultimately affects the quality of the data, or results in a change of scope in the work described in this QAPP, will be documented in the field log or field corrective action record form (Attachment A4), and will be brought to the Integral project manager's immediate attention. A description of the nonconformance issue, the attempted resolution, and any effects on data quality or usability will be provided in the monitoring report submittals. See Table 5-1 of the LTMRP for the monitoring report schedule.

The analytical laboratory will keep the Integral laboratory coordinator and QA manager informed of their progress on a weekly basis. The laboratory will provide the following information:

- Inventory and status of samples held at the laboratory in spreadsheet format by SDG
- Summaries of any laboratory QC data outside of control limits and any corrective actions implemented
- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

The ARI QA manager will provide this information to the Integral laboratory coordinator and QA manager, who will provide this information to the Integral project manager.

The analytical laboratory will be required to have implemented routine systems of reporting nonconformance issues and their resolution. These procedures are described in the laboratory QA plan (Attachment A2). Laboratory nonconformance issues will also be described in the monitoring report if they affect the quality of the data.

Data packages and EDDs will be prepared by the laboratory upon completion of analyses for each sample delivery group. The case narrative will include a description of any problems encountered, control limit exceedances (if applicable), and a description and rationale for any deviations from protocol. Copies of corrective action reports generated at the laboratory will also be included with the data package.

Data validation reports will be prepared following receipt of the complete laboratory data packages for each sample delivery group. These reports will be provided to the Integral laboratory coordinator and QA manager when validation is completed for each parameter. A summary of any significant data quality issues will be provided to EPA with the monitoring report.

4 DATA VALIDATION AND USABILITY

Data generated in the field and at the analytical laboratory will be verified and validated according to criteria and procedures described in this section. Data quality and usability will be evaluated, and a discussion will be included in the monitoring reports.

4.1 CRITERIA FOR DATA REVIEW, VERIFICATION, AND VALIDATION

Field and laboratory data for this task will undergo a formal verification and validation process. All entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Data verification and validation for PCBs, SVOCs, and metals will be completed in accordance with *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 2009), and according to methods described in EPA's National Functional Guidelines for inorganic and organic data review (USEPA 2008b, 2010).

No guidelines are available for validation of data for the testing of physical parameters. These data will be validated using procedures described in the functional guidelines for inorganic data review (USEPA 2010), as applicable, and their respective methods. Data will be qualified if results for laboratory QA samples do not meet the measurement quality objectives listed in Table A-3. In addition, performance-based control limits established by the laboratory and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification. Performance-based control limits are established periodically by the laboratory. Current values are provided in the laboratory QA plan (Attachment A2), as applicable. Data will be rejected if control limits for acceptance of data are not met, as described in USEPA (USEPA 2008b, 2010).

Results for field splits will be evaluated against a control limit of 50 percent RPD. Data will not be qualified as estimated if this control limit is exceeded, but RPD results will be tabulated, and any exceedances will be discussed in the monitoring report. Filter blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the functional guidelines for data review (USEPA 2008b, 2010).

4.2 VERIFICATION AND VALIDATION METHODS

Field data will be verified during preparation of samples and COC forms. Field data and COC forms will be reviewed daily by the field lead. After field data are entered into the project database, 100 percent verification of the entries will be completed by a second party to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

Data verification and validation will be completed as described in Section 4.1 by either Integral or a data validation firm. The data package generated for each analysis method will be fully validated, equivalent to a Stage 4 validation as described in USEPA (2009).

The accuracy and completion of the database will be verified at the laboratory when the EDDs are prepared and again as part of data validation. Ten percent of entries to the database from laboratory EDDs will be checked against hard copy data packages. In addition to verification of field and laboratory data and information, data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use.

Reporting limits for nondetects will be compared to the MRL goals to evaluate method sensitivity for each sample. Any exceedance of actual MRLs over the target MRLs will be discussed in the data report.

4.3 RECONCILIATION WITH USER REQUIREMENTS

The goal of data validation is to determine the quality of each data result and to identify those that do not meet the task measurement quality objectives. Nonconforming data may be qualified as estimated (i.e., a J qualifier will be applied to the result) or rejected as unusable (i.e., an R qualifier will be applied to the result) during data validation if criteria for data quality are not met. Rejected data will not be used for any purpose. An explanation of the rejected data will be included in the monitoring report.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the final project database. However, these data are less precise or less accurate than unqualified data. Data users, in cooperation with Integral project manager and Integral laboratory coordinator and QA manager, are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on statistical procedures and other data uses. The data quality discussion in the monitoring reports will include all available information regarding the direction or magnitude of bias or the degree of imprecision for qualified data, to facilitate the assessment of data usability.

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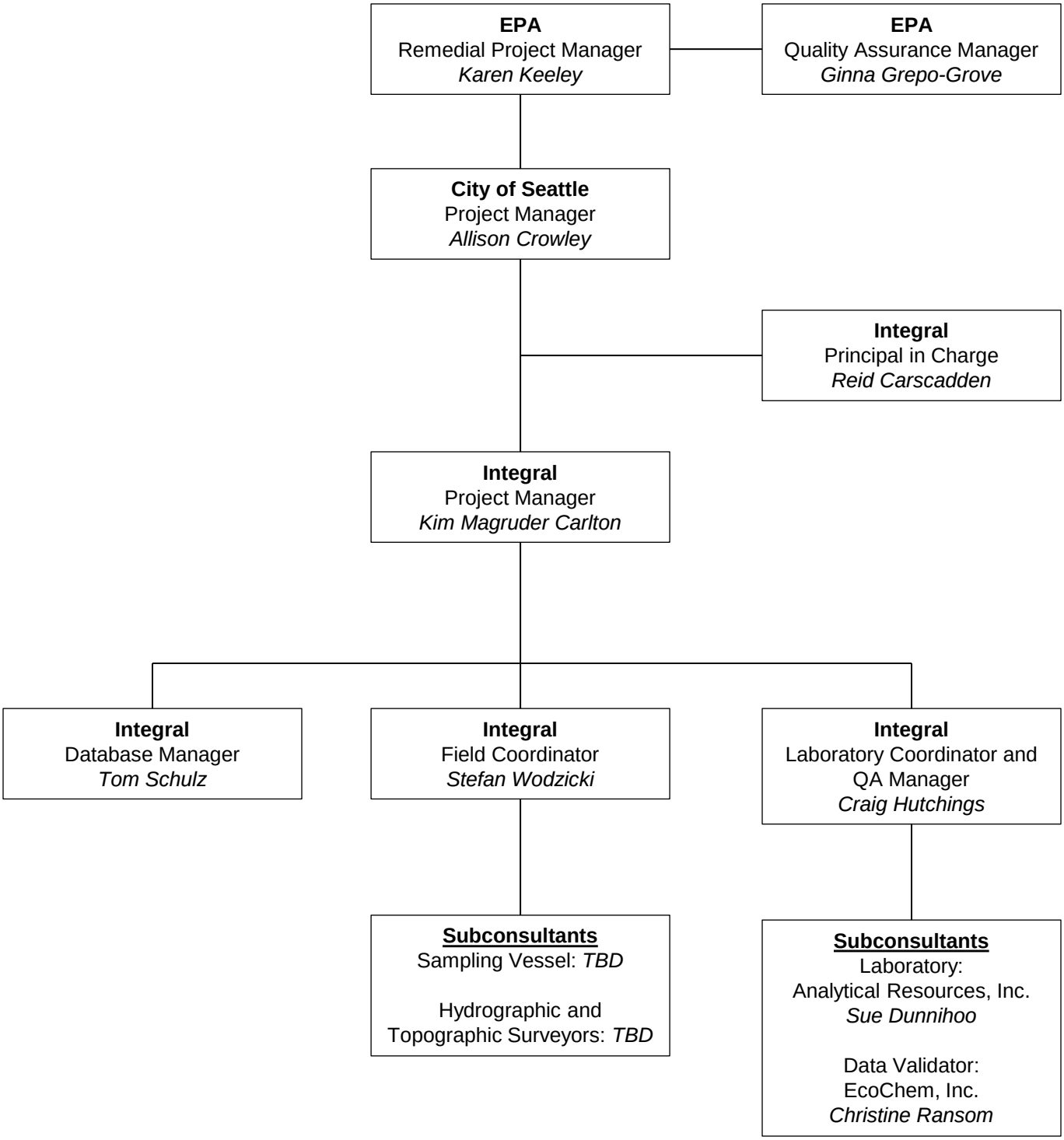
FIGURES



TBD = To be determined

Figure A-1.
Project Organization Chart

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Figure A-2.
Visual Monitoring Station Locations
Slip 4 Early Action Area

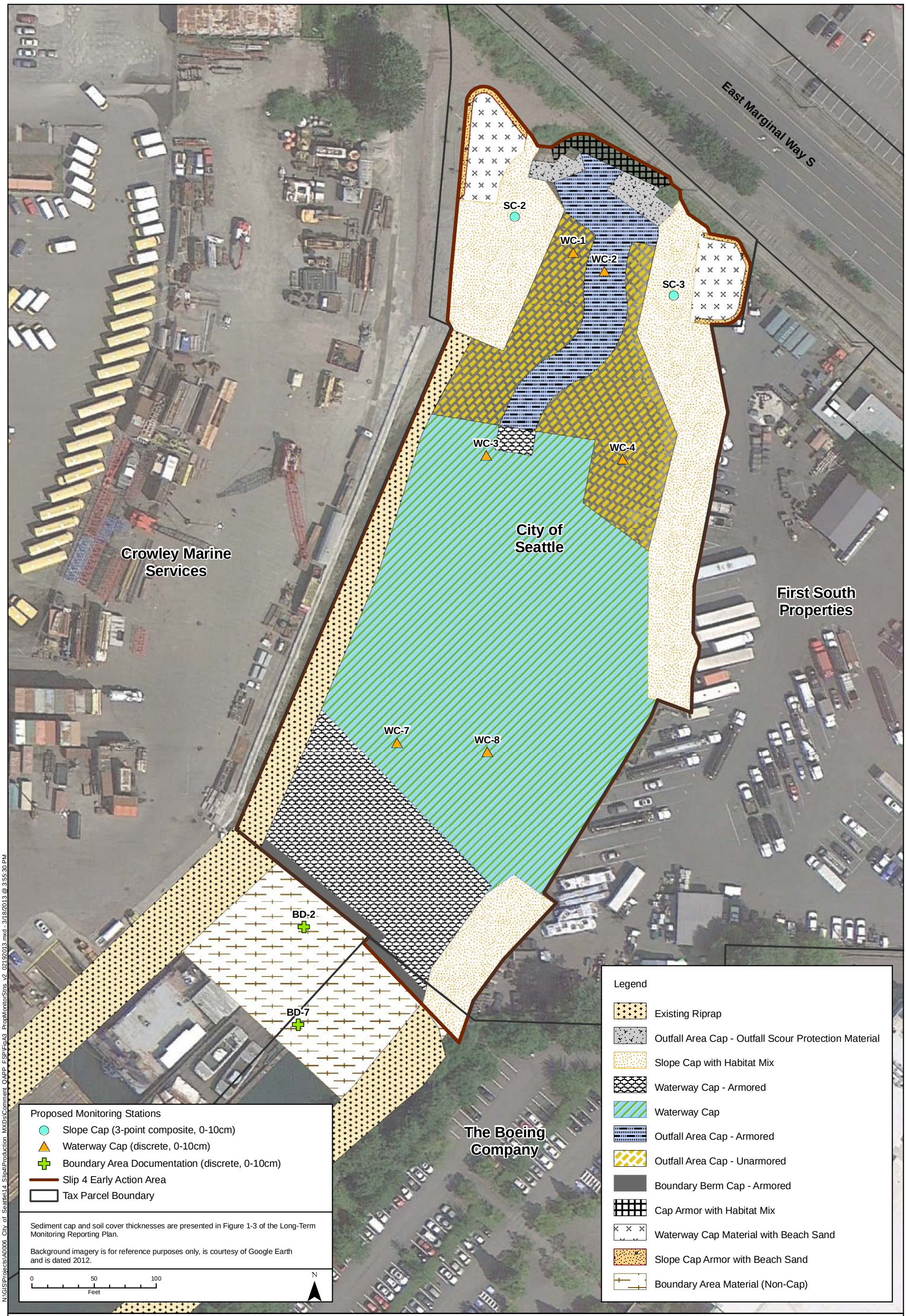

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Figure A-3.
Long-Term Monitoring Sampling Stations
Slip 4 Early Action Area

TABLES

Table A-1. Target Analytes, Methods, and Method Reporting Limits for Sediment Samples

Analyte	Sample Preparation Method	Sample Cleanup Method[a]	Analysis Method	MDL	MRL
Conventional Analytes					
Total Solids	--	--	PSEP (USEPA 1986)	--	0.01%
Grain Size	--	--	PSEP (USEPA 1986)	--	0.1%
TOC (% dry wt)	--	--	Plumb (1981)	0.018	0.02
Metals (mg/kg-dry weight)					
Arsenic	EPA 3050	--	EPA 6010B	0.78	5.0
Cadmium	EPA 3050	--	EPA 6010B	0.04	0.2
Chromium	EPA 3050	--	EPA 6010B	0.09	0.5
Copper	EPA 3050	--	EPA 6010B	0.06	0.2
Lead	EPA 3050	--	EPA 6010B	0.11	2.0
Mercury	EPA 7471A	--	EPA 7471A	0.003	0.05
Silver	EPA 3050	--	EPA 6010B	0.04	0.3
Zinc	EPA 3050	--	EPA 6010B	0.34	0.6
PCB Aroclors (µg/kg-dry weight)	ARI Low Level (EPA 3550B-mod)	EPA 3660B (sulfur) optional[b] EPA 3665A (acid) optional[b]	GC/ECD (EPA 8082)[c]	0.967	4.0
Semivolatile Organic Compounds (µg/kg-dry weight)					
Benz[a]anthracene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	3.29	20
Benzo[a]pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	5.45	20
Benzo[ghi]perylene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	4.40	20
Benzo[b+j+k]fluoranthene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	6.67	40
Chrysene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	3.75	20
Dibenz[a,h]anthracene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	4.31	20
Fluoranthene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	2.91	20
Indeno[1,2,3-cd]pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	4.68	20
Pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	1.94	20
Total HPAH	--	--	Calculation	--	--
Phenanthrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	3.64	20
Benzoic acid	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	89.00	200
Benzyl alcohol	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	14.70	20
Bis[2-ethylhexyl]phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	14.6	25
Butyl benzyl phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	6.14	20[d]
Di-n-octyl phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	5.84	20

Table A-1. Target Analytes, Methods, and Method Reporting Limits for Sediment Samples

Analyte	Sample Preparation Method	Sample Cleanup Method[a]	Analysis Method	MDL	MRL
N-nitrosodiphenylamine	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	14.1	100[d]
Phenol	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997b)	8.65	20

Notes:
ARI = Analytical Resources Inc.
EPA = U.S. Environmental Protection Agency
GC/ECD = gas chromatography/electron capture detection
HPAH = high molecular weight polycyclic aromatic hydrocarbon
MDL = method detection limit
MRL = method reporting limit
PCB = polychlorinated biphenyl
PSEP = Puget Sound Estuary Program
SQS = sediment quality standards
TOC = total organic carbon

[a] Gel permeation chromatography is required for organics analyses under PSEP. Additional cleanups will be used as required to meet MRLs.

[b] The need for cleanup to be based on screens and the color of extracts (Windward 2004).

[c] If more than one Aroclor is detected in a sample, the laboratory will choose unique peaks to quantitate each individual Aroclor (i.e., a peak can only be used in the quantitation of one Aroclor; Windward 2004).

[d] For selected analytes, method reporting limits of non-detects may exceed carbon normalized SQS values when sample TOC content is between 0.5% and 1.0%. These are butyl benzyl phthalate and N-nitrosodiphenylamine.

Table A-2. Criteria for Slip 4 EAA Cap Monitoring Samples

Chemical Name	Unit (dry weight)	SQS [a]	CSL
Conventionals			
Total solids	percent	NA	NA
Grain size	percent	NA	NA
Total organic carbon	percent	NA	NA
Metals			
Arsenic	mg/kg	57	93
Cadmium	mg/kg	5.1	6.7
Chromium	mg/kg	260	270
Copper	mg/kg	390	390
Lead	mg/kg	450	530
Mercury	mg/kg	0.41	0.59
Silver	mg/kg	6.1	6.1
Zinc	mg/kg	410	960
PCB Aroclors			
Aroclor 1016	µg/kg	NA	NA
Aroclor 1221	µg/kg	NA	NA
Aroclor 1232	µg/kg	NA	NA
Aroclor 1242	µg/kg	NA	NA
Aroclor 1248	µg/kg	NA	NA
Aroclor 1254	µg/kg	NA	NA
Aroclor 1260	µg/kg	NA	NA
Total Aroclors	µg/kg	130	1,300 [b]
Total Aroclors OC	mg/kg-oc	12	65
SVOCs			
Benzo(a)anthracene	µg/kg	110 mg/kg-oc / 1,300 µg/kg	270 mg/kg-oc / 1,600 µg/kg
Benzo(a)pyrene	µg/kg	99 mg/kg-oc / 1,600 µg/kg	210 mg/kg-oc / 1,600 µg/kg
Benzo(g,h,i)perylene	µg/kg	31 mg/kg-oc / 670 µg/kg	78 mg/kg-oc / 720 µg/kg
Benzo[b+j+k]fluoranthenes	µg/kg	230 mg/kg-oc / 3,200 µg/kg	450 mg/kg-oc / 3,600 µg/kg
Chrysene	µg/kg	110 mg/kg-oc / 1,400 µg/kg	460 mg/kg-oc / 2,800 µg/kg
Dibenzo(a,h)anthracene	µg/kg	12 mg/kg-oc / 230 µg/kg	33 mg/kg-oc / 230 µg/kg
Fluoranthene	µg/kg	160 mg/kg-oc / 1,700 µg/kg	1,200 mg/kg-oc / 2,500 µg/kg
Indeno(1,2,3-cd)pyrene	µg/kg	34 mg/kg-oc / 600 µg/kg	88 mg/kg-oc / 690 µg/kg
Pyrene	µg/kg	1000 mg/kg-oc / 2,600 µg/kg	1400 mg/kg-oc / 3,300 µg/kg
HPAH	µg/kg	960 mg/kg-oc / 12,000 µg/kg	5,300 mg/kg-oc / 17,000 µg/kg
Phenanthrene	µg/kg	100 mg/kg-oc / 1,500 µg/kg	480 mg/kg-oc / 1,500 µg/kg

Table A-2. Criteria for Slip 4 EAA Cap Monitoring Samples

Chemical Name	Unit (dry weight)	SQS [a]	CSL
Benzoic acid	µg/kg	650	650
Benzyl alcohol	µg/kg	57	73
Bis(2-ethylhexyl) phthalate	µg/kg	47 mg/kg-oc / 1,300 µg/kg	78 mg/kg-oc / 3100 µg/kg
Butylbenzyl phthalate	µg/kg	4.9 mg/kg-oc / 63 µg/kg	64 mg/kg-oc / 900 µg/kg
Di-n-octyl phthalate	µg/kg	58 mg/kg-oc / 6,200 µg/kg	4,500 mg/kg-oc / 6,200 µg/kg
N-Nitrosodiphenylamine	µg/kg	11 mg/kg-oc / 28 µg/kg	11 mg/kg-oc / 40 µg/kg
Phenol	µg/kg	420	1,200

Notes:

CSL = Washington State Sediment Management Standard cleanup screening level
HPAH = high molecular weight polycyclic aromatic hydrocarbon
NA = not available
OC = organic carbon
PCB = polychlorinated biphenyl
SQS = Washington State Sediment Management Standard sediment quality standard
SVOC = semivolatile organic compound
TOC = total organic carbon

[a] Results will be OC-normalized for samples with TOC concentrations ranging from 0.5 to 4.0%. Results for samples that have TOC concentrations below or above this range will be compared to SQS/CSL values.

[b] The cleanup screening level for total PCB Aroclors is as reported in the Lower Duwamish Waterway feasibility study.

Table A-3. Measurement Quality Objectives

Analysis	Bias (percent)	Precision[a] (RPD)	Completeness (percent)
Conventionals			
Total solids	NA	±30	95
Grain size	NA	±30	95
TOC (% dry wt)	75–125	±30	95
Metals	75–125	±35	95
Organic Compounds			
PCB Aroclors	50–150	±50	95
Semivolatile organic compounds	50–150	±50	95

Notes:
NA = not applicable
PCB = polychlorinated biphenyl
RPD = relative percent difference
TOC = total organic carbon
[a] If one or both duplicate values are less than 5 times the method reporting limit:, the difference between laboratory duplicates will be ±1 times the reporting limit for conventionals and metals, and ±2 times the reporting limit for organics.

Table A-4. Slip 4 EAA Long-Term Monitoring Sample Matrix Example

							Sediment Sample Analyses					Field/FW Blank Analyses		
												Ghost Wipe[d]	Whatman Filter Paper	
							Total solids, TOC	Grain size	Metals[c]	PCB Aroclors	SVOCs[c]	Metals[c]	PCB Aroclors	SVOCs[c]
							1 x 4 oz WMG	1 x 16 oz WMG	1 x 8 oz WMG	1 x 8 oz WMG	1 x 8 oz WMG	1 x 4 oz WMG	1 x 4 oz WMG	1 x 4 oz WMG
Station Number	**Sample Identifier[a]**	**Sample Number[a,b]**	**Sample Depth**	**Date**	**Time**	**Sample Type**	**4±2°C**	**4±2°C**	**4±2°C**	**4±2°C**	**4±2°C**	**4±2°C**	**4±2°C**	
Waterway Cap Discrete Samples (0-10cm samples)														
WC-1	**SL4-SG-WC1-xxxx[e]**	**SD0100**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
WC-2	**SL4-SG-WC2-xxxx[e]**	**SD0101**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
WC-3	**SL4-SG-WC3-xxxx[e]**	**SD0102**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
WC-4	**SL4-SG-WC4-xxxx[e]**	**SD0103**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
WC-7	**SL4-SG-WC7-xxxx[e]**	**SD0104**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
						Additonal Vol. for Lab QA/QC[f]	NA	NA	NA	Tag #	Tag #	NA	NA	
										Tag #	Tag #	NA	NA	
	SL4-SG-WC7-split-xxxx[e]	**SD0105**	0 - 10 cm			Field Split[f]	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
	SL4-SG-WC7-FW-xxxx[e]	**FW0900**	**circle all relevant:** grab/bowl/spoon/ shovel/trowel			Equipment Filter Wipe	NA	NA	NA	NA	NA	Tag #	Tag #	Tag #
WC-8	**SL4-SG-WC8-xxxx[e]**	**SD0106**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
Filter Blank	**SL4-SG-FB-xxxx[d]**	**FB0900**	NA			Filter Blank	NA	NA	NA	NA	NA	Tag #	Tag #	Tag #
Slope Cap Confirmation Composite Samples (0-10cm samples; 3-point composites collected at +2, +8, and +12 ft MLLW at each location)														
SC-2	**SL4-IC-SC2-xxxx[e]**	**SD0107**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
SC-3	**SL4-IC-SC3-xxxx[e]**	**SD0108**	0 - 10 cm			Normal	Tag #	Tag #	Tag #	Tag #	Tag #	NA	NA	
Boundary Area Discrete Samples (0-10cm samples)														
BD-2	**SL4-SG-BD2-xxxx[e]**	**SD0109**	0 - 10 cm			Normal	Tag #	NA	NA	Tag #	NA	NA	NA	
BD-7	**SL4-SG-BD7-xxxx[e]**	**SD0110**	0 - 10 cm			Normal	Tag #	NA	NA	Tag #	NA	NA	NA	
Total Number of Samples							11	9	9	13	11	2	2	2

Notes:
MLLW = mean lower low water
NA = not applicable
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TOC = total organic carbon
WMG = wide mouth glass

[a] Sample identifiers and numbers are defined and discussed in Section 1.9.1.2. e.g., SG refers to sediment grab, SD refers to sediment, FW refers to filter wipe, FB refers to filter blank.
[b] Sample numbers are unique and will be generated sequentially for subsequent monitoring years (e.g., SD0111 would be the sample number assigned to the sediment sample collected at Station WC-1 in 2015).
[c] Specific target analytes are listed in Table A-1.
[d] Ghost wipes consist of a sturdy material, moistened with deionized water, that completely dissolves during the digestion process for metals analysis.
[e] xxxx = the year in which the sample was collected (e.g., -2013 for samples collected in 2013, -2015 for samples collected in 2015, etc).

Table A-5. Station Coordinates for Slip 4 EAA Long-Term Monitoring

Station ID[a]	Northing[b]	Easting[b]	Cap Thickness and Material Type
Boundary Area Documentation[c]			
BD-2	198871.43	1273256.97	NA
BD-7	198792.66	1273252.33	NA
Slope Cap[c]			
SC-2	199443.58	1273426.92	24-33 in. slope cap and habitat mix
SC-3	199380.13	1273554.99	24-33 in. slope cap and habitat mix
Waterway Cap[d]			
WC-1	199414.43	1273474.09	30-54 in. unarmored outfall area cap
WC-2	199399.42	1273499.06	30-54 in. armored outfall area cap
WC-3	199251.02	1273403.73	30 in. waterway cap
WC-4	199247.87	1273513.70	30-54 in. unarmored outfall area cap
WC-7	199019.44	1273332.04	30 in. waterway cap
WC-8	199012.05	1273404.64	60 in. waterway cap

Notes:

NA – not applicable

[a] See Figure A-3

[b] Washington state plane coordinate system, north zone (NAD-83/91), U.S. feet.

[c] Three-point composite sample collected at +2, +8, and +12 ft MLLW. 0–10 cm horizon.

[d] Discrete sample. 0–10 cm horizon.

Table A-6. Station Coordinates for Slip 4 EAA Visual Monitoring

Station ID	Northing [a]	Easting [a]	Orientation (degrees from True North)	Photo ID	Description
Existing Stations [b]					
A	199125.904367	1273323.439160	55	A 1	East-Central Sediment Cap
B	199291.911581	1273396.353710	48	B 1	Northeast and North Slope Cap, North Sediment Cap
C	199498.733018	1273484.402090	178	C 1	Northwest Slope Cap, South Sediment Cap
			217	C 2	Northwest Beach/Anchored Logs
D	199432.238400	1273403.232640	24	D 1	Northwest Beach/Anchored Logs
E	199485.892820	1273441.295230	102	E 1	North Slope Cap, Outfalls
			144	E 2	Northeast Slope Cap, North Rip Rap Slough
F	199335.477111	1273415.155840	133	F 1	East Slope Cap, East Sediment Cap, Central Rip Rap Slough
			160	F 2	Southeast Sediment Cap
G	199354.806468	1273490.809560	200	G 1	South Rip Rap Slough
			27	G 2	North Rip Rap Slough, Sedimet Cap, North Slope Cap
			0-360	G 3	Entire Slip 4 EAA
Supplemental Stations [b]					
H	199377.666987	1273569.698510	306	H 1	Northwest Slope Cap, Beach, Sediment Cap
I	199174.055518	1273580.704720	278	I 1	West Sediment Cap
J	199002.086701	1273267.950430	130	J 1	Southeast Slope Cap

Notes:
[a] Washington state plane coordinate system, north zone (NAD-83/91), U.S. feet.
[b] Station coordinates and orientations are estimated based on existing and proposed still photos and will be updated as part of the initial visual monitoring event.

Table A-7. Sample Containers, Preservation, Holding Times, and Sample Volume

Analysis[a]	Container Type[b]	Container Size	Approximate Laboratory Subsample	Preservation	Holding Time
Sediment Samples					
Grain size	WMG	16 oz	150 g	4±2ºC	6 months
Total organic carbon	WMG	4 oz	25 g	4±2ºC	14 days
Total solids			25 g		6 months
Metals	WMG	8 oz	10 g	4±2ºC	6 months[c]
PCB Aroclors	WMG	8 oz	50 g	4±2ºC	14 days/40 days[d]
Semivolatile organic compounds	WMG	8 oz	50 g	4±2ºC	14 days/40 days[d]
Equipment Filter Wipes					
Metals	WMG	4 oz	1 Ghost Wipe[e]	4±2ºC	6 months[c]
PCB Aroclors	WMG	4 oz	1 Whatman filter paper[e]	4±2ºC	14 days/40 days[d]
Semivolatile organic compounds	WMG	4 oz	1 Whatman filter paper[e]	4±2ºC	14 days/40 days[d]

Notes:

PCB = polychlorinated biphenyl

WMG = wide mouth glass jar

[a] The laboratory may modify sample jar sizes or analyte groupings. Target analytes are listed in Table A-5.
[b] Teflon™-lined lids will be used for glass sample containers.
[c] Holding time for mercury is 28 days.
[d] Holding time is 14 days to extraction, and extracts must be analyzed within 40 days from extraction.
[e] Types of filter wipes, including Ghost Wipes and Whatman filter papers, are discussed in Section 2.1.3 and SOP SD-02.

ATTACHMENT A1

ANALYTICAL RESOURCES, INC., ACCREDITATION CERTIFICATES

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Analytical Resources Inc.

WA100006

4611 S. 134th Place, Suite 100

Tukwila,WA 98168-3240

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
		Chemistry	Chemistry	Chemistry

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Gary K. Ward

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 05/12/2012

EXPIRATION DATE: 05/11/2013

Certificate No: WA100006 - 004

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The State of Washington Department of Ecology

Analytical Resources, Incorporated
Tukwila, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective July 1, 2012 and shall expire June 30, 2013.

Witnessed under my hand on July 27, 2012

Alan D. Rue
Lab Accreditation Unit Supervisor

Laboratory ID
C558

Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

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MATRIX : Biological Tissue

Reference	Code	Description
EPA 1613B	**10120602**	**Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS**

Analyte Code	*Analyte*
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

EPA 200.7 5	**10014003**	**ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt

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Analyte Code	Analyte
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.5 **10014809** **Metals by ICP-MS**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 245.5 **10037602** **Mercury in Sediment by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 3050B **10135601** **Acid Digestion of Sediments, Sludges, and soils**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3540C **10140202** **Soxhlet Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

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EPA 3550C **10142004** **Ultrasonic Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3580A **10143007** **Waste Dilution**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5000 **10152600** **Sample Preparation for Volatile Organics**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035 **10154004** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

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EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	Analyte
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene

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Analyte Code	Analyte
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	Analyte
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)

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ORELAP Fields of Accreditation

ORELAP ID: WA100006
EPA CODE: WA00037
Certificate: WA100006 - 004

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

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EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

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Analyte Code	Analyte
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	Analyte
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
4659	2,2'-Oxybis(1-chloropropane)
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6460	2-Nitroaniline
6490	2-Nitrophenol
5945	3,3'-Dichlorobenzidine
6465	3-Nitroaniline
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether

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Analyte Code	Analyte
4910	4-Isopropyltoluene (p-Cymene)
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
7005	Alachlor
6700	alpha-Terpineol
5545	Aniline
5555	Anthracene
7075	Azinphos-methyl (Guthion)
5562	Azobenzene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
7125	Bolstar (Sulprofos)
5670	Butyl benzyl phthalate
5671	Butyl diphenyl Phosphate
5673	Butylated Hydroxy Toluene (BHT)
5680	Carbazole
7255	Chlorfenvinphos
7300	Chlorpyrifos
5855	Chrysene
7315	Coumaphos
7330	Crotoxyphos
7385	Demeton-s
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5912	Dibutyl phenyl Phospahate
7465	Dicrotophos
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
8625	Disulfoton
7550	EPN
7565	Ethion
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone

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Analyte Code	Analyte
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7880	Monocrotophos
7905	Naled
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
7955	Parathion, ethyl
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
7985	Phorate
6665	Pyrene
5095	Pyridine
6683	Retene
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8262	Tributyl phosphate
8275	Trichloronate
8282	Triphenyl phosphate

EPA 8290A **10187403** **Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS**

Analyte Code	Analyte
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

SM 4500-Norg D 21st ED **20120267** **Nitrogen (Organic) by Block Digestion and Flow Injection Analysis**

Analyte Code	Analyte
1790	Kjeldahl nitrogen
1795	Kjeldahl nitrogen - total

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EPA CODE: WA00037
Certificate: WA100006 - 004

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MATRIX : Non-Potable Water

Reference	Code	Description
AK101 GRO	**90015002**	**Determination of Gasoline Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

AK102 DRO	**90015206**	**Determination of Diesel Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)

AK103 RRO	**90015400**	**Determination of Residual Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9499	Motor Oil

EPA 110.2	**10005604**	**Color - Colorimetric, Pt-Co**

Analyte Code	*Analyte*
1605	Color

EPA 120.1	**10006403**	**Conductance - Specific @ 25 C**

Analyte Code	*Analyte*
1610	Conductivity

EPA 1311	**10118806**	**Toxicity Characteristic Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 1312	**10119003**	**Synthetic Precipitation Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 150.1	**10008409**	**pH - Electrometric Measurement**

Analyte Code	*Analyte*
1900	pH

EPA 160.4	**10010409**	**Total Volatile Solids, ignition @ 550 C.**

Analyte Code	*Analyte*
1970	Residue-volatile

EPA 1613B	**10120602**	**Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS**

Analyte Code	*Analyte*
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)

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Analyte Code	Analyte
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

EPA 1664A (HEM) **10127807** **N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry**

Analyte Code	Analyte
1803	n-Hexane Extractable Material (O&G)

EPA 1664A (SGT-HEM) **10261606** **Silica Gen Treated N-Hexane Extractable Material (Oil and Grease)**

Analyte Code	Analyte
1803	n-Hexane Extractable Material (O&G)

EPA 180.1 2 **10011800** **Turbidity - Nephelometric**

Analyte Code	Analyte
2055	Turbidity

EPA 200.7 5 **10014003** **ICP - metals**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin

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Analyte Code	Analyte
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.5 **10014809** **Metals by ICP-MS**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 245.1 4.1 **10271008** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1840	Nitrite as N
1870	Orthophosphate as P
2000	Sulfate

EPA 3005A **10133207** **Acid Digestion of waters for Total Recoverable or Dissolved Metals**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3010A **10133605** **Acid Digestion of Aqueous samples and Extracts for Total Metals**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3020A **10134404** **Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA**

Analyte Code	Analyte

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Analyte Code	Analyte
8031	Extraction/Preparation

EPA 325.2 **10057202** **Chloride - Colorimetric, automated Ferricyanide,II**

Analyte Code	Analyte
1575	Chloride

EPA 335.4 **10061402** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	Analyte
1635	Cyanide

EPA 340.2 **10062201** **Fluoride - Ion selective electrode**

Analyte Code	Analyte
1730	Fluoride

EPA 350.1 2 **10063602** **Ammonia Nitrogen - Colorimetric, Auto Phenate**

Analyte Code	Analyte
1515	Ammonia as N

EPA 350.3 **10064401** **Ammonia Nitrogen - Ion Selective Electrode**

Analyte Code	Analyte
1515	Ammonia as N

EPA 351.2 **10065006** **Total Kjeldahl Nitrogen - Block Digest, Phenate**

Analyte Code	Analyte
1790	Kjeldahl nitrogen

EPA 3510C **10138202** **Separatory Funnel Liquid-liquid extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3520C **10139001** **Continuous Liquid-liquid extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	Analyte
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N

EPA 3550C **10142004** **Ultrasonic Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3580A **10143007** **Waste Dilution**

Analyte Code	Analyte
8031	Extraction/Preparation

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EPA 3611B **10145207** **Alumina Column Cleanup and separation of petroleum wastes**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 365.1 **10069600** **Phosphorous - Colorimetric, Automated persulfate**

Analyte Code	Analyte
1870	Orthophosphate as P
1910	Phosphorus, total

EPA 365.2 **10070403** **Phosphorous - Colorimetric, single reagent**

Analyte Code	Analyte
1870	Orthophosphate as P

EPA 3650B **10147805** **Acid base partition cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 375.2 2 **10073004** **Sulfate - Colorimetric, Automated, Methylthymol.**

Analyte Code	Analyte
2000	Sulfate

EPA 376.2 **10074609** **Sulfide - Colorimetric, Methylene Blue.**

Analyte Code	Analyte
2005	Sulfide

EPA 410.4 2 **10077404** **Chemical Oxygen Demand - Colorimetric, Automated.**

Analyte Code	Analyte
1565	Chemical oxygen demand

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EPA 420.1 **10079400** **Phenolics - Spectrophotometric, manual.**

Analyte Code	Analyte
1905	Total phenolics

EPA 5000 **10152600** **Sample Preparation for Volatile Organics**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 5030B **10153409** **Purge and trap for aqueous samples**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead

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Analytical Resources Inc.

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Analyte Code	Analyte
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	Analyte
1045	Chromium VI

EPA 7470A **10165807** **Mercury in Liquid Waste by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 8021B **10174808** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	Analyte
4375	Benzene
4765	Ethylbenzene
5240	m+p-xylene
5000	Methyl tert-butyl ether (MTBE)
5250	o-Xylene
5140	Toluene

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	Analyte
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene

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Analyte Code	*Analyte*
4835	Hexachlorobutadiene
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)

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EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

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Analyte Code	*Analyte*
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4560	Cyclohexanone
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
9375	Di-isopropylether (DIPE)
4765	Ethylbenzene
4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4420	tert-Butyl alcohol
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
4659	2,2'-Oxybis(1-chloropropane)
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6460	2-Nitroaniline
6490	2-Nitrophenol

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Analyte Code	Analyte
5945	3,3'-Dichlorobenzidine
6465	3-Nitroaniline
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether
4910	4-Isopropyltoluene (p-Cymene)
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
7005	Alachlor
6700	alpha-Terpineol
5545	Aniline
5555	Anthracene
7075	Azinphos-methyl (Guthion)
5562	Azobenzene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
7125	Bolstar (Sulprofos)
5670	Butyl benzyl phthalate
5671	Butyl diphenyl Phosphate
5673	Butylated Hydroxy Toluene (BHT)
5680	Carbazole
7255	Chlorfenvinphos
7300	Chlorpyrifos
5855	Chrysene
7315	Coumaphos
7330	Crotoxyphos
7385	Demeton-s
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5912	Dibutyl phenyl Phospahate
7465	Dicrotophos
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
8625	Disulfoton
7550	EPN
7565	Ethion
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
6265	Fluoranthene
6270	Fluorene

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Analyte Code	*Analyte*
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7880	Monocrotophos
7905	Naled
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
7955	Parathion, ethyl
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
7985	Phorate
6665	Pyrene
5095	Pyridine
6683	Retene
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8262	Tributyl phosphate
8275	Trichloronate
8282	Triphenyl phosphate

EPA 8290A **10187403** **Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS**

Analyte Code	*Analyte*
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

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EPA 9010C **10243002** **Total and Amenable Cyanide by Distillation and UV-Vis**

Analyte Code	Analyte
1510	Amenable cyanide
1645	Total cyanide

EPA 9014 **10193803** **Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide**

Analyte Code	Analyte
1510	Amenable cyanide
1635	Cyanide
1645	Total cyanide

EPA 9030B **10195605** **Acid-Soluble and Acid-Insoluble sulfides: Distillation**

Analyte Code	Analyte
2005	Sulfide

EPA 9034 **10196006** **Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides**

Analyte Code	Analyte
2005	Sulfide

EPA 9036 **10196404** **Sulfate (Colorimetric, Automated, Methylthymol Blue, AA II)**

Analyte Code	Analyte
2000	Sulfate

EPA 9040C **10244403** **pH Electrometric Measurement**

Analyte Code	Analyte
1900	pH

EPA 9050A **10198808** **Specific Conductance**

Analyte Code	Analyte
1610	Conductivity

EPA 9056A **10199607** **Determination of Inorganic Anions by Ion Chromatography**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1840	Nitrite as N
1870	Orthophosphate as P
2000	Sulfate

EPA 9060A **10244801** **Total Organic Carbon**

Analyte Code	Analyte
2040	Total organic carbon

EPA 9065 **10200405** **Phenolics (Spectrophotometric, Manual 4-AAP with Distillation)**

Analyte Code	Analyte
1905	Total phenolics

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EPA 9070A — **10245008** — **Total Recoverable Oil & Grease (Gravimetric, Separatory Funnel Extraction)**

Analyte Code	Analyte
1860	Oil & Grease

EPA 9214 — **10206403** — **Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode**

Analyte Code	Analyte
1730	Fluoride

EPA 9251 — **10207406** — **Chloride (Colorimetric, Automated Ferricyanide AAII)**

Analyte Code	Analyte
1575	Chloride

EPA RSK-175 (GC-FID) — **10212905** — **Methane, Ethane, and Ethene in water by Headspace GC/FID**

Analyte Code	Analyte
4747	Ethane
4752	Ethene
4926	Methane

NWTPH-Dx — **90018409** — **Oregon DEQ TPH Diesel Range**

Analyte Code	Analyte
9369	Diesel range organics (DRO)
9488	Jet Fuel
2050	Total Petroleum Hydrocarbons (TPH)

NWTPH-Gx — **90018603** — **Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	Analyte
9408	Gasoline range organics (GRO)

NWTPH-HCID — **90013200** — **Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	Analyte
2050	Total Petroleum Hydrocarbons (TPH)

SM 2120 B-93 online — **20039207** — **Color by Visual Comparison Method**

Analyte Code	Analyte
1605	Color

SM 2130 B-94 online — **20042802** — **Turbidity by Nephelometric Method**

Analyte Code	Analyte
2055	Turbidity

SM 2320 B-97 online — **20045607** — **Alkalinity by Titration Method**

Analyte Code	Analyte
1505	Alkalinity as CaCO3

SM 2340 B-97 online — **20046600** — **Hardness by calculation**

Analyte Code	Analyte
1750	Hardness

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SM 2510 B-97 online **20048606** **Conductivity by Probe**

Analyte Code	Analyte
1610	Conductivity

SM 2520 B 20th ED **20040055** **Salinity by Electrical Conductivity**

Analyte Code	Analyte
1975	Salinity

SM 2540 B-97 online **20049405** **Total Solids Dried at 103 - 105C**

Analyte Code	Analyte
1950	Residue-total

SM 2540 C-97 online **20050402** **Total Dissolved Solids Dried at 180C**

Analyte Code	Analyte
1955	Residue-filterable (TDS)

SM 2540 D-97 online **20051201** **Total Suspended Solids Dried at 103 - 105C**

Analyte Code	Analyte
1960	Residue-nonfilterable (TSS)

SM 2540 E 20th ED **20051654** **Total Volatile Solids**

Analyte Code	Analyte
1725	Total, fixed, and volatile residue

SM 2540 F-97 online **20052204** **Settleable Solids**

Analyte Code	Analyte
1965	Residue-settleable

SM 2580 B 20th ED **20054051** **Oxidation-Reduction Potential Measurement in Clean Water**

Analyte Code	Analyte
1871	O-R Potential

SM 3500-Cr B-97 online **20066200** **Chromium by Colorimetric Method**

Analyte Code	Analyte
1045	Chromium VI

SM 3500-Fe B-97 online **20069005** **Iron by Phenanthroline Method**

Analyte Code	Analyte
1070	Iron

SM 4110 B-97 online **20077003** **Anions by Ion Chromatography with Chemical Suppression of Eluent Conductivity .**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
1870	Orthophosphate as P

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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Analyte Code	Analyte
2000	Sulfate

SM 4500-Cl⁻E-97 online **20086800** **Chloride by Automated Ferricyanide Method**

Analyte Code	Analyte
1575	Chloride

SM 4500-CN⁻C-97 online **20095607** **Cyanide by Total Cyanide after Distillation**

Analyte Code	Analyte
1635	Cyanide
1645	Total cyanide

SM 4500-CN⁻D-97 online **20096008** **Cyanide by Titrimetric Method**

Analyte Code	Analyte
1510	Amenable cyanide
1635	Cyanide
1640	Free cyanide
1923	Reactive Cyanide
1645	Total cyanide

SM 4500-CN⁻E-97 online **20096406** **Cyanide by Colorimetric Method**

Analyte Code	Analyte
1635	Cyanide

SM 4500-CN⁻G-97 online **20097205** **Cyanide by Cyanides Amenable to Chlorination after Distillation**

Analyte Code	Analyte
1510	Amenable cyanide

SM 4500-F⁻C-97 online **20102403** **Fluoride by Ion-Selective Electrode Method**

Analyte Code	Analyte
1730	Fluoride

SM 4500-H+ B-96 online **20105208** **pH Value by Electrometric Method .**

Analyte Code	Analyte
1900	pH

SM 4500-NH3 D-97 online **20109404** **Ammonia by Ammonia-Selective Electrode Method .**

Analyte Code	Analyte
1515	Ammonia as N

SM 4500-NH3 G-97 online **20111404** **Ammonia by Automated Phenate Method**

Analyte Code	Analyte
1515	Ammonia as N

SM 4500-NH3 H-97 online **20112203** **Ammonia by Flow Injection Analysis**

Analyte Code	Analyte
1515	Ammonia as N

ORELAP Fields of Accreditation

ORELAP ID: WA100006
EPA CODE: WA00037
Certificate: WA100006 - 004

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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SM 4500-NO3⁻F 20th ED **20116205** **Nitrate Nitrogen by Automated Cadmium Reduction Method**

Analyte Code	Analyte
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N

SM 4500-NO3⁻I-00 online **20116501** **Nitrate Nitrite (as N) flow injection Cadmium Reduction**

Analyte Code	Analyte
1805	Nitrate
1820	Nitrate-nitrite
1835	Nitrite

SM 4500-Norg D 21st ED **20120267** **Nitrogen (Organic) by Block Digestion and Flow Injection Analysis**

Analyte Code	Analyte
1790	Kjeldahl nitrogen
1795	Kjeldahl nitrogen - total

SM 4500-O C-93 online **20120803** **Oxygen by Azide Modification**

Analyte Code	Analyte
1880	Oxygen, dissolved

SM 4500-O G-93 online **20121602** **Oxygen by Membrane Electrode Method .**

Analyte Code	Analyte
1880	Oxygen, dissolved

SM 4500-P B-97 online **20123404** **Phosphorus by Sample Preparation**

Analyte Code	Analyte
1910	Phosphorus, total

SM 4500-P E-97 online **20124203** **Phosphorus by Ascorbic Acid Method**

Analyte Code	Analyte
1870	Orthophosphate as P
1910	Phosphorus, total

SM 4500-S2⁻D-97 online **20125808** **Sulfide by Methylene Blue Method**

Analyte Code	Analyte
2005	Sulfide

SM 4500-S2⁻F-97 online **20126607** **Sulfide by Iodometric Method**

Analyte Code	Analyte
2005	Sulfide

SM 4500-SO3⁻B-96 online **20130603** **Sulfite by Iodometric Method**

Analyte Code	Analyte
2015	Sulfite-SO3

SM 4500-SO4⁻G-97 online **20134401** **Sulfate by Methylthymol Blue Flow Injection Analysis (20th Edition)**

Analyte Code	Analyte
2000	Sulfate

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Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 **Expiration Date:** 05/11/2013

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SM 5210 B-97 online **20135200** **Biochemical Oxygen Demand, 5-Day (BOD5)**

Analyte Code	Analyte
1530	Biochemical oxygen demand
1555	Carbonaceous BOD, CBOD

SM 5220 D-97 online **20136805** **COD by Closed Reflux, Colorimetric Method**

Analyte Code	Analyte
1565	Chemical oxygen demand

SM 5310 B-96 online **20137808** **TOC by High-Temperature Combustion Method**

Analyte Code	Analyte
1710	Dissolved organic carbon (DOC)
2040	Total organic carbon

SM 5520 G-05 online **20143606** **Oil and Grease by Solid-Phase, Partition-Gravimetric Method**

Analyte Code	Analyte
1803	n-Hexane Extractable Material (O&G)
1860	Oil & Grease

SM 5530 D 20th ED **20143708** **Phenols Direct Photometric**

Analyte Code	Analyte
1905	Total phenolics

WA EPH **60015001** **Extractable Petroleum Hydrocarbons**

Analyte Code	Analyte
6211	EPH Aliphatic >C10-C12
6212	EPH Aliphatic >C12-C16
6214	EPH Aliphatic >C16-C21
6216	EPH Aliphatic >C21-C34
6220	EPH Aliphatic C8-C10
6222	EPH Aliphatic C9-C18
6224	EPH Aromatic >C10-C12
6226	EPH Aromatic >C12-C16
6228	EPH Aromatic >C16-C21
6236	EPH Aromatic C8-C10

WA VPH **60015056** **Volatile Petroleum Hydrocarbons (VPH) by GC/PID Purge & Trap**

Analyte Code	Analyte
5300	VPH Aliphatic >C10-C12
5301	VPH Aliphatic >C6-C8
5302	VPH Aliphatic >C8-C10
5303	VPH Aliphatic C5-C6
5308	VPH Aromatic >C10-C12
5309	VPH Aromatic >C12-C13
5310	VPH Aromatic >C8-C10

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ORELAP ID: WA100006
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Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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MATRIX : Solids

Reference	Code	Description
AK101 GRO	**90015002**	**Determination of Gasoline Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

AK102 DRO	**90015206**	**Determination of Diesel Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)

AK103 RRO	**90015400**	**Determination of Residual Range Organics - Alaska Department of Environmental Conservation**

Analyte Code	*Analyte*
9499	Motor Oil

EPA 1311	**10118806**	**Toxicity Characteristic Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 1312	**10119003**	**Synthetic Precipitation Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 1613B	**10120602**	**Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS**

Analyte Code	*Analyte*
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

EPA 200.7 5	**10014003**	**ICP - metals**

Analyte Code	*Analyte*

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 **Expiration Date:** 05/11/2013

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Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.5 **10014809** **Metals by ICP-MS**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 245.5 **10037602** **Mercury in Sediment by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

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ORELAP ID: WA100006
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Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1840	Nitrite as N
1870	Orthophosphate as P
2000	Sulfate

EPA 3050B **10135601** **Acid Digestion of Sediments, Sludges, and soils**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3060A **10136604** **Alkaline Digestion for Hexavalent Chromium**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 325.2 **10057202** **Chloride - Colorimetric, automated Ferricyanide,II**

Analyte Code	Analyte
1575	Chloride

EPA 335.4 **10061402** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	Analyte
1635	Cyanide

EPA 340.2 **10062007** **Fluoride - Ion selective electrode**

Analyte Code	Analyte
1730	Fluoride

EPA 350.1 2 **10063602** **Ammonia Nitrogen - Colorimetric, Auto Phenate**

Analyte Code	Analyte
1515	Ammonia as N

EPA 351.2 **10065006** **Total Kjeldahl Nitrogen - Block Digest, Phenate**

Analyte Code	Analyte
1790	Kjeldahl nitrogen

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	Analyte
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N

EPA 3540C **10140202** **Soxhlet Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

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Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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EPA 3546 **10141205** **Microwave Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3550C **10142004** **Ultrasonic Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3580A **10143007** **Waste Dilution**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3611B **10145207** **Alumina Column Cleanup and separation of petroleum wastes**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 365.1 **10069600** **Phosphorous - Colorimetric, Automated persulfate**

Analyte Code	Analyte
1910	Phosphorus, total

EPA 365.3 **10070801** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	Analyte
1910	Phosphorus, total

EPA 3650B **10147805** **Acid base partition cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

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ORELAP Fields of Accreditation

ORELAP ID: WA100006
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4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

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EPA 376.1 **10074201** **Sulfide - Titrimetric, Iodine.**

Analyte Code	Analyte
2005	Sulfide

EPA 376.2 **10074609** **Sulfide - Colorimetric, Methylene Blue.**

Analyte Code	Analyte
2005	Sulfide

EPA 420.1 **10079400** **Phenolics - Spectrophotometric, manual.**

Analyte Code	Analyte
1905	Total phenolics

EPA 5000 **10152600** **Sample Preparation for Volatile Organics**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 5035 **10154004** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1145	Silicon
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	Analyte
1000	Aluminum

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4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

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Analyte Code	Analyte
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	Analyte
1045	Chromium VI

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 8021B **10174808** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	Analyte
4375	Benzene
4765	Ethylbenzene
5240	m+p-xylene
5000	Methyl tert-butyl ether (MTBE)
5250	o-Xylene
5140	Toluene

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	Analyte
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

Issue Date: 05/12/2012 ***Expiration Date:*** 05/11/2013

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Analyte Code	Analyte
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	Analyte
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
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Analyte Code	Analyte
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)

EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	Analyte
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	Analyte
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4385	Bromobenzene

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Analyte Code	*Analyte*
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
9375	Di-isopropylether (DIPE)
4765	Ethylbenzene
4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4420	tert-Butyl alcohol
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
4659	2,2'-Oxybis(1-chloropropane)
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)

ORELAP Fields of Accreditation

ORELAP ID: WA100006
EPA CODE: WA00037
Certificate: WA100006 - 004

Analytical Resources Inc.

4611 S. 134th Place, Suite 100
Tukwila WA 98168-3240

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Analyte Code	Analyte
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6460	2-Nitroaniline
6490	2-Nitrophenol
5945	3,3'-Dichlorobenzidine
6465	3-Nitroaniline
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether
4910	4-Isopropyltoluene (p-Cymene)
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
7005	Alachlor
6700	alpha-Terpineol
5545	Aniline
5555	Anthracene
7075	Azinphos-methyl (Guthion)
5562	Azobenzene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
7125	Bolstar (Sulprofos)
5670	Butyl benzyl phthalate
5671	Butyl diphenyl Phosphate
5673	Butylated Hydroxy Toluene (BHT)
5680	Carbazole
7255	Chlorfenvinphos
7300	Chlorpyrifos
5855	Chrysene
7315	Coumaphos
7330	Crotoxyphos
7385	Demeton-s
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5912	Dibutyl phenyl Phospahate
7465	Dicrotophos
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
8625	Disulfoton

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Analyte Code	*Analyte*
7550	EPN
7565	Ethion
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7880	Monocrotophos
7905	Naled
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
7955	Parathion, ethyl
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
7985	Phorate
6665	Pyrene
5095	Pyridine
6683	Retene
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8262	Tributyl phosphate
8275	Trichloronate
8282	Triphenyl phosphate

EPA 8290A **10187403** **Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS**

Analyte Code	*Analyte*
9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)
9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)
9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)
9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)
9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)
9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)
9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)
9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)
9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)
9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)
9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)
9480	2,3,4,6,7,8-Hexachlorodibenzofuran
9549	2,3,4,7,8-Pentachlorodibenzofuran
9618	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)
9612	2,3,7,8-Tetrachlorodibenzofuran
9438	Hpcdd, total

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4611 S. 134th Place, Suite 100
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Analyte Code	Analyte
9444	Hpcdf, total
9468	Hxcdd, total
9483	Hxcdf, total
9555	Pecdd, total
9552	Pecdf, total
9609	TCDD, total
9615	TCDF, total

EPA 9010C **10243002** **Total and Amenable Cyanide by Distillation and UV-Vis**

Analyte Code	Analyte
1510	Amenable cyanide
1645	Total cyanide

EPA 9013 **10193609** **Cyanide Extraction Procedure for Solids and Oils**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 9014 **10193803** **Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide**

Analyte Code	Analyte
1510	Amenable cyanide
1635	Cyanide
1645	Total cyanide

EPA 9030B **10195605** **Acid-Soluble and Acid-Insoluble sulfides: Distillation**

Analyte Code	Analyte
2005	Sulfide

EPA 9034 **10196006** **Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides**

Analyte Code	Analyte
2005	Sulfide

EPA 9036 **10196404** **Sulfate (Colorimetric, Automated, Methylthymol Blue, AA II)**

Analyte Code	Analyte
2000	Sulfate

EPA 9045D **10244607** **Soil and Waste pH**

Analyte Code	Analyte
1900	pH

EPA 9050A **10198808** **Specific Conductance**

Analyte Code	Analyte
1610	Conductivity

EPA 9056A **10199607** **Determination of Inorganic Anions by Ion Chromatography**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1840	Nitrite as N
1870	Orthophosphate as P

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Analyte Code	Analyte
2000	Sulfate

EPA 9065 **10200405** **Phenolics (Spectrophotometric, Manual 4-AAP with Distillation)**

Analyte Code	Analyte
1905	Total phenolics

EPA 9071B **10201602** **Oil and Grease Extraction Method for sludge and sediment samples**

Analyte Code	Analyte
1860	Oil & Grease

EPA 9080 **10203200** **Cation-Exchange Capacity of Soils (Ammonium Acetate)**

Analyte Code	Analyte
1560	Cation exchange capacity

EPA 9214 **10206403** **Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode**

Analyte Code	Analyte
1730	Fluoride

EPA 9251 **10207406** **Chloride (Colorimetric, Automated Ferricyanide AAII)**

Analyte Code	Analyte
1575	Chloride

NWTPH-Dx **90018409** **Oregon DEQ TPH Diesel Range**

Analyte Code	Analyte
9369	Diesel range organics (DRO)
9488	Jet Fuel
9499	Motor Oil
2050	Total Petroleum Hydrocarbons (TPH)

NWTPH-Gx **90018603** **Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	Analyte
9408	Gasoline range organics (GRO)

NWTPH-HCID **90013200** **Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	Analyte
2050	Total Petroleum Hydrocarbons (TPH)

PLUMB 1981 **60006259** **Grain sizing**

Analyte Code	Analyte
6118	Distribution of particle sizes
8031	Extraction/Preparation

Puget Sound Estuary Program (PSEP): Conventional Sediment Variables **60006408** **PSEP: Total Organic Carbon (TOC)**

Analyte Code	Analyte
2005	Sulfide
2040	Total organic carbon

NELAP RECOGNIZED TNI ACCREDITATION BODY

ORELAP Fields of Accreditation

ORELAP ID: WA100006
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SM 2510 B-97 online **20048606** **Conductivity by Probe**

Analyte Code	Analyte
1610	Conductivity

SM 2540 G 20th ED **20005258** **Total, Fixed, and Volatile Solids in Solid and Semisolid Samples**

Analyte Code	Analyte
1725	Total, fixed, and volatile residue

SM 2580 B 20th ED **20054051** **Oxidation-Reduction Potential Measurement in Clean Water**

Analyte Code	Analyte
1871	O-R Potential

SM 3500-Cr B-97 online **20066200** **Chromium by Colorimetric Method**

Analyte Code	Analyte
1045	Chromium VI

SM 4110 B-97 online **20077003** **Anions by Ion Chromatography with Chemical Suppression of Eluent Conductivity .**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
1870	Orthophosphate as P
2000	Sulfate

SM 4500-CN⁻C-97 online **20095607** **Cyanide by Total Cyanide after Distillation**

Analyte Code	Analyte
1635	Cyanide
1645	Total cyanide

SM 4500-CN⁻D-97 online **20096008** **Cyanide by Titrimetric Method**

Analyte Code	Analyte
1510	Amenable cyanide
1635	Cyanide
1645	Total cyanide

SM 4500-CN⁻E-97 online **20096406** **Cyanide by Colorimetric Method**

Analyte Code	Analyte
1635	Cyanide

SM 4500-CN⁻I-97 online **20098004** **Cyanide by Weak Acid Dissociable Cyanide**

Analyte Code	Analyte
2074	Weak Acid Dissociable Cyanide

SM 4500-F⁻C-97 online **20102403** **Fluoride by Ion-Selective Electrode Method**

Analyte Code	Analyte
1730	Fluoride

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SM 4500-NH3 D-97 online **20109404** **Ammonia by Ammonia-Selective Electrode Method .**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-NH3 G-97 online **20111404** **Ammonia by Automated Phenate Method**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-NH3 H-97 online **20112203** **Ammonia by Flow Injection Analysis**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-NO3⁻F 20th ED **20116205** **Nitrate Nitrogen by Automated Cadmium Reduction Method**

Analyte Code	*Analyte*
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N

SM 4500-NO3⁻I-00 online **20116501** **Nitrate Nitrite (as N) flow injection Cadmium Reduction**

Analyte Code	*Analyte*
1805	Nitrate
1820	Nitrate-nitrite
1835	Nitrite

SM 4500-Norg D 21st ED **20120267** **Nitrogen (Organic) by Block Digestion and Flow Injection Analysis**

Analyte Code	*Analyte*
1790	Kjeldahl nitrogen
1795	Kjeldahl nitrogen - total

SM 4500-P B-97 online **20123404** **Phosphorus by Sample Preparation**

Analyte Code	*Analyte*
1910	Phosphorus, total

SM 4500-P E-97 online **20124203** **Phosphorus by Ascorbic Acid Method**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1910	Phosphorus, total

SM 4500-S2⁻D-97 online **20125808** **Sulfide by Methylene Blue Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-S2⁻F-97 online **20126607** **Sulfide by Iodometric Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-SO4⁻G-97 online **20134401** **Sulfate by Methylthymol Blue Flow Injection Analysis (20th Edition)**

Analyte Code	*Analyte*
2000	Sulfate

ORELAP Fields of Accreditation

ORELAP ID: WA100006
EPA CODE: WA00037
Certificate: WA100006 - 004

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SM 5310 B-96 online **20137808** **TOC by High-Temperature Combustion Method**

Analyte Code	Analyte
1710	Dissolved organic carbon (DOC)
2040	Total organic carbon

SM 5520 D-05 online **20142409** **Oil and Grease by Soxhlet Extraction Method**

Analyte Code	Analyte
1860	Oil & Grease

SM 5520 E-05 online **20142807** **Oil and Grease by Extraction Method for Sludge Samples**

Analyte Code	Analyte
1860	Oil & Grease

SM 5530 D 20th ED **20143708** **Phenols Direct Photometric**

Analyte Code	Analyte
1905	Total phenolics

WA EPH **60015001** **Extractable Petroleum Hydrocarbons**

Analyte Code	Analyte
6211	EPH Aliphatic >C10-C12
6212	EPH Aliphatic >C12-C16
6214	EPH Aliphatic >C16-C21
6216	EPH Aliphatic >C21-C34
6220	EPH Aliphatic C8-C10
6222	EPH Aliphatic C9-C18
6224	EPH Aromatic >C10-C12
6226	EPH Aromatic >C12-C16
6228	EPH Aromatic >C16-C21
6236	EPH Aromatic C8-C10

WA VPH **60015056** **Volatile Petroleum Hydrocarbons (VPH) by GC/PID Purge & Trap**

Analyte Code	Analyte
5300	VPH Aliphatic >C10-C12
5301	VPH Aliphatic >C6-C8
5302	VPH Aliphatic >C8-C10
5303	VPH Aliphatic C5-C6
5308	VPH Aromatic >C10-C12
5309	VPH Aromatic >C12-C13
5310	VPH Aromatic >C8-C10

NELAP RECOGNIZED TNI ACCREDITATION BODY

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Analytical Resources, Incorporated

Tukwila, WA

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. Accreditation for U.S. Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846) is for the latest version of the method. SM refers to EPA approved editions of “Standard Methods for the Examination of Water and Wastewater.” ASTM is the American Society for Testing and Materials. Other references are described in notes.

Matrix/Analyte	Method	Notes
Drinking Water		
Turbidity	EPA 180.1_2_1993	
Bromide	EPA 300.0_2.1_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate as N	EPA 300.0_2.1_1993	
Nitrite as N	EPA 300.0_2.1_1993	
Orthophosphate	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Color	SM 2120 B-01	
Alkalinity	SM 2320 B-97	
Hardness (calc.)	SM 2340 B-97	
Specific Conductance	SM 2510 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Cyanide, Total	SM 4500-CN^- E-99	
Orthophosphate	SM 4500-P E-99	
Total Organic Carbon	SM 5310 B-00	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	

Matrix/Analyte	Method	Notes
Chromium	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Iron	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Mercury	EPA 245.1_3_1994	
1,1,1,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,1-Trichloroethane	EPA 524.2_4.1_1995	
1,1,2,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,2-Trichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethylene	EPA 524.2_4.1_1995	
1,1-Dichloropropene	EPA 524.2_4.1_1995	
1,2,3-Trichlorobenzene	EPA 524.2_4.1_1995	
1,2,4-Trichlorobenzene	EPA 524.2_4.1_1995	
1,2,4-Trimethylbenzene	EPA 524.2_4.1_1995	
1,2-Dichlorobenzene	EPA 524.2_4.1_1995	
1,2-Dichloroethane	EPA 524.2_4.1_1995	
1,2-Dichloropropane	EPA 524.2_4.1_1995	
1,3,5-Trimethylbenzene	EPA 524.2_4.1_1995	
1,3-Dichlorobenzene	EPA 524.2_4.1_1995	
1,3-Dichloropropane	EPA 524.2_4.1_1995	
1,4-Dichlorobenzene	EPA 524.2_4.1_1995	
1-Chlorobutane	EPA 524.2_4.1_1995	
2,2-Dichloropropane	EPA 524.2_4.1_1995	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 524.2_4.1_1995	
2-Chlorotoluene	EPA 524.2_4.1_1995	
2-Hexanone	EPA 524.2_4.1_1995	
2-Nitropropane	EPA 524.2_4.1_1995	
4-Chlorotoluene	EPA 524.2_4.1_1995	
4-Methyl-2-pentanone (MIBK)	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
Acetone	EPA 524.2_4.1_1995	
Acrolein (Propenal)	EPA 524.2_4.1_1995	
Acrylonitrile	EPA 524.2_4.1_1995	
Allyl chloride (3-Chloropropene)	EPA 524.2_4.1_1995	
Benzene	EPA 524.2_4.1_1995	
Bromobenzene	EPA 524.2_4.1_1995	
Bromochloromethane	EPA 524.2_4.1_1995	
Bromodichloromethane	EPA 524.2_4.1_1995	5
Bromoform	EPA 524.2_4.1_1995	5
Carbon disulfide	EPA 524.2_4.1_1995	
Carbon tetrachloride	EPA 524.2_4.1_1995	
Chloroacetonitrile	EPA 524.2_4.1_1995	
Chlorobenzene	EPA 524.2_4.1_1995	
Chloroethane	EPA 524.2_4.1_1995	
Chloroform	EPA 524.2_4.1_1995	5
cis-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
cis-1,3-Dichloropropene	EPA 524.2_4.1_1995	
Dibromochloromethane	EPA 524.2_4.1_1995	5
Dibromomethane	EPA 524.2_4.1_1995	
Dichlorodifluoromethane	EPA 524.2_4.1_1995	
Dichloromethane (DCM, Methylene chloride)	EPA 524.2_4.1_1995	
Diethyl ether	EPA 524.2_4.1_1995	
Ethyl methacrylate	EPA 524.2_4.1_1995	
Ethylbenzene	EPA 524.2_4.1_1995	
Hexachlorobutadiene	EPA 524.2_4.1_1995	
Hexachloroethane	EPA 524.2_4.1_1995	
Isopropylbenzene	EPA 524.2_4.1_1995	
Methacrylonitrile	EPA 524.2_4.1_1995	
Methyl bromide (Bromomethane)	EPA 524.2_4.1_1995	
Methyl chloride (Chloromethane)	EPA 524.2_4.1_1995	
Methyl methacrylate	EPA 524.2_4.1_1995	
Methyl tert-butyl ether (MTBE)	EPA 524.2_4.1_1995	
m-Xylene	EPA 524.2_4.1_1995	
Naphthalene	EPA 524.2_4.1_1995	
n-Butylbenzene	EPA 524.2_4.1_1995	
Nitrobenzene	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
n-Propylbenzene	EPA 524.2_4.1_1995	
o-Xylene	EPA 524.2_4.1_1995	
Pentachloroethane	EPA 524.2_4.1_1995	
p-Isopropyltoluene	EPA 524.2_4.1_1995	
Propionitrile (Ethyl cyanide)	EPA 524.2_4.1_1995	
p-Xylene	EPA 524.2_4.1_1995	
sec-Butylbenzene	EPA 524.2_4.1_1995	
Styrene	EPA 524.2_4.1_1995	
tert-Butylbenzene	EPA 524.2_4.1_1995	
Tetrachloroethylene (Perchloroethylene)	EPA 524.2_4.1_1995	
Tetrahydrofuran (THF)	EPA 524.2_4.1_1995	
Toluene	EPA 524.2_4.1_1995	
Total trihalomethanes	EPA 524.2_4.1_1995	5
trans-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
trans-1,3-Dichloropropene	EPA 524.2_4.1_1995	
trans-1,3-Dichloropropylene	EPA 524.2_4.1_1995	
trans-1,4-Dichloro-2-butene	EPA 524.2_4.1_1995	
Trichloroethene (Trichloroethylene)	EPA 524.2_4.1_1995	
Trichlorofluoromethane	EPA 524.2_4.1_1995	
Trihalomethanes	EPA 524.2_4.1_1995	
Vinyl chloride	EPA 524.2_4.1_1995	
Xylenes (total)	EPA 524.2_4.1_1995	
1,1,1,2-Tetrachloroethane	EPA 524.3_1.0_2009	11
1,1,1-Trichloroethane	EPA 524.3_1.0_2009	11
1,1,2,2-Tetrachloroethane	EPA 524.3_1.0_2009	11
1,1,2-Trichloroethane	EPA 524.3_1.0_2009	11
1,1-Dichloroethane	EPA 524.3_1.0_2009	11
1,1-Dichloroethylene	EPA 524.3_1.0_2009	11
1,1-Dichloropropene	EPA 524.3_1.0_2009	11
1,2,3-Trichlorobenzene	EPA 524.3_1.0_2009	11
1,2,3-Trichloropropane	EPA 524.3_1.0_2009	11
1,2,4-Trichlorobenzene	EPA 524.3_1.0_2009	11
1,2,4-Trimethylbenzene	EPA 524.3_1.0_2009	11
1,2-Dibromo-3-chloropropane (DBCP)	EPA 524.3_1.0_2009	11
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 524.3_1.0_2009	11
1,2-Dichlorobenzene	EPA 524.3_1.0_2009	11

Matrix/Analyte	Method	Notes
1,2-Dichloroethane	EPA 524.3_1.0_2009	11
1,2-Dichloropropane	EPA 524.3_1.0_2009	11
1,3,5-Trimethylbenzene	EPA 524.3_1.0_2009	11
1,3-Butadiene	EPA 524.3_1.0_2009	11
1,3-Dichloropropane	EPA 524.3_1.0_2009	11
1,4-Dichlorobenzene	EPA 524.3_1.0_2009	11
1-Chlorobutane	EPA 524.3_1.0_2009	11
2-Chlorotoluene	EPA 524.3_1.0_2009	11
4-Chlorotoluene	EPA 524.3_1.0_2009	11
4-Isopropyltoluene (p-Cymene)	EPA 524.3_1.0_2009	11
Allyl chloride (3-Chloropropene)	EPA 524.3_1.0_2009	11
Benzene	EPA 524.3_1.0_2009	11
Bromobenzene	EPA 524.3_1.0_2009	11
Bromochloromethane	EPA 524.3_1.0_2009	11
Bromodichloromethane	EPA 524.3_1.0_2009	11
Bromoform	EPA 524.3_1.0_2009	11
Carbon disulfide	EPA 524.3_1.0_2009	11
Carbon tetrachloride	EPA 524.3_1.0_2009	11
Chlorobenzene	EPA 524.3_1.0_2009	11
Chlorodifluoromethane (Freon-22)	EPA 524.3_1.0_2009	11
Chloroform	EPA 524.3_1.0_2009	11
cis & trans-1,2-Dichloroethene	EPA 524.3_1.0_2009	11
cis-1,2-Dichloroethylene	EPA 524.3_1.0_2009	11
cis-1,3-Dichloropropene	EPA 524.3_1.0_2009	11
cis-2-Octene	EPA 524.3_1.0_2009	11
Dibromochloromethane	EPA 524.3_1.0_2009	11
Dibromomethane (Methylene bromide)	EPA 524.3_1.0_2009	11
Dichlorodifluoromethane	EPA 524.3_1.0_2009	11
Diethyl ether	EPA 524.3_1.0_2009	11
Di-isopropylether (DIPE)	EPA 524.3_1.0_2009	11
Ethyl methacrylate	EPA 524.3_1.0_2009	11
Ethyl tert-Butyl alcohol	EPA 524.3_1.0_2009	11
Ethylbenzene	EPA 524.3_1.0_2009	11
Ethyl-t-butylether (ETBE)	EPA 524.3_1.0_2009	11
Hexachlorobutadiene	EPA 524.3_1.0_2009	11
Hexachloroethane	EPA 524.3_1.0_2009	11

Matrix/Analyte	Method	Notes
Iodomethane (Methyl iodide)	EPA 524.3_1.0_2009	11
Isopropylbenzene	EPA 524.3_1.0_2009	11
Methyl acetate	EPA 524.3_1.0_2009	11
Methyl bromide (Bromomethane)	EPA 524.3_1.0_2009	11
Methyl chloride (Chloromethane)	EPA 524.3_1.0_2009	11
Methyl tert-butyl ether (MTBE)	EPA 524.3_1.0_2009	11
Methylene chloride (Dichloromethane)	EPA 524.3_1.0_2009	11
m-Xylene	EPA 524.3_1.0_2009	11
Naphthalene	EPA 524.3_1.0_2009	11
n-Butylbenzene	EPA 524.3_1.0_2009	11
n-Propylbenzene	EPA 524.3_1.0_2009	11
o-Xylene	EPA 524.3_1.0_2009	11
Pentachloroethane	EPA 524.3_1.0_2009	11
p-Xylene	EPA 524.3_1.0_2009	11
sec-Butylbenzene	EPA 524.3_1.0_2009	11
Styrene	EPA 524.3_1.0_2009	11
tert-Amyl ethyl ether (TAEE)	EPA 524.3_1.0_2009	11
tert-amylmethylether (TAME)	EPA 524.3_1.0_2009	11
tert-Butylbenzene	EPA 524.3_1.0_2009	11
Tetrachloroethylene (Perchloroethylene)	EPA 524.3_1.0_2009	11
Tetrahydrofuran (THF)	EPA 524.3_1.0_2009	11
Toluene	EPA 524.3_1.0_2009	11
Total trihalomethanes	EPA 524.3_1.0_2009	11
trans-1,3-Dichloropropylene	EPA 524.3_1.0_2009	11
Trichloroethene (Trichloroethylene)	EPA 524.3_1.0_2009	11
Trichlorofluoromethane (Freon 11)	EPA 524.3_1.0_2009	11
Vinyl chloride	EPA 524.3_1.0_2009	11
Xylenes (total)	EPA 524.3_1.0_2009	11
Non-Potable Water		
Specific Conductance	EPA 120.1_1982	1
Solids, Total Volatile	EPA 160.4_1971	1
n-Hexane Extractable Material (O&G)	EPA 1664A_1_1999	1
Turbidity	EPA 180.1_2_1993	1
Bromide	EPA 300.0_2.1_1993	1
Chloride	EPA 300.0_2.1_1993	1

Matrix/Analyte	Method	Notes
Fluoride	EPA 300.0_2.1_1993	1
Nitrate	EPA 300.0_2.1_1993	1
Nitrite	EPA 300.0_2.1_1993	1
Orthophosphate	EPA 300.0_2.1_1993	1
Sulfate	EPA 300.0_2.1_1993	1
Ammonia	EPA 350.1_2_1993	1
Nitrogen, Total Kjeldahl	EPA 351.2_2_1993	1
Nitrate	EPA 353.2_2_1993	1
Nitrate + Nitrite	EPA 353.2_2_1993	1
Nitrite	EPA 353.2_2_1993	1
Sulfate	EPA 375.2_2_1993	1
Phenolics, Total	EPA 420.1_1978	1
Color	SM 2120 B-01	1
Turbidity	SM 2130 B-01	1
Alkalinity	SM 2320 B-97	1
Hardness (calc.)	SM 2340 B-97	1
Specific Conductance	SM 2510 B-97	1
Salinity	SM 2520 B-93	1
Solids, Total	SM 2540 B-97	1
Solids, Total Dissolved	SM 2540 C-97	1
Solids, Total Suspended	SM 2540 D-97	1
Solids, Total, Fixed and Volatile	SM 2540 E-97	1
Solids, Settleable	SM 2540 F-97	1
Oxidation-Reduction Potential	SM 2580 B-97	1
Chromium, Hexavalent	SM 3500-Cr B-97	1
Iron, Ferrous	SM 3500-Fe B-97	1
Bromide	SM 4110 B-00	1
Chloride	SM 4110 B-00	1
Fluoride	SM 4110 B-00	1
Nitrate	SM 4110 B-00	1
Nitrite	SM 4110 B-00	1
Orthophosphate	SM 4110 B-00	1
Sulfate	SM 4110 B-00	1
Cyanide, Total	SM 4500-CN^- E-99	1
Cyanides, Amenable to Chlorination	SM 4500-CN^- G-99	1
Fluoride	SM 4500-F C-97	1

Matrix/Analyte	Method	Notes
pH	SM 4500-H+ B-00	1
Ammonia	SM 4500-NH3 D-97	1
Ammonia	SM 4500-NH3 H-97	1
Nitrogen, Total Kjeldahl	SM 4500-Norg D-97	1
Dissolved Oxygen	SM 4500-O C-01	1
Orthophosphate	SM 4500-P E-99	1
Phosphorus, total	SM 4500-P E-99	1
Sulfide	SM 4500-S2 D-00	1
Sulfide	SM 4500-S2 F-00	1
Sulfite	SM 4500-$SO3^{-}$ B-00	1
Biochemical Oxygen Demand (BOD)	SM 5210 B-01	1
Chemical Oxygen Demand (COD)	SM 5220 D-97	1
Total Organic Carbon	SM 5310 B-00	1
Phenolics, Total	SM 5530 D-05	1
Aluminum	EPA 200.7_4.4_1994	1
Antimony	EPA 200.7_4.4_1994	1
Arsenic	EPA 200.7_4.4_1994	1
Barium	EPA 200.7_4.4_1994	1
Beryllium	EPA 200.7_4.4_1994	1
Boron	EPA 200.7_4.4_1994	1
Cadmium	EPA 200.7_4.4_1994	1
Calcium	EPA 200.7_4.4_1994	1
Chromium	EPA 200.7_4.4_1994	1
Cobalt	EPA 200.7_4.4_1994	1
Copper	EPA 200.7_4.4_1994	1
Iron	EPA 200.7_4.4_1994	1
Lead	EPA 200.7_4.4_1994	1
Magnesium	EPA 200.7_4.4_1994	1
Manganese	EPA 200.7_4.4_1994	1
Molybdenum	EPA 200.7_4.4_1994	1
Nickel	EPA 200.7_4.4_1994	1
Potassium	EPA 200.7_4.4_1994	1
Selenium	EPA 200.7_4.4_1994	1
Silica as SiO2	EPA 200.7_4.4_1994	1
Silver	EPA 200.7_4.4_1994	1
Sodium	EPA 200.7_4.4_1994	1

Matrix/Analyte	Method	Notes
Strontium	EPA 200.7_4.4_1994	1
Thallium	EPA 200.7_4.4_1994	1
Tin	EPA 200.7_4.4_1994	1
Titanium	EPA 200.7_4.4_1994	1
Vanadium	EPA 200.7_4.4_1994	1
Zinc	EPA 200.7_4.4_1994	1
Aluminum	EPA 200.8_5.4_1994	1
Antimony	EPA 200.8_5.4_1994	1
Arsenic	EPA 200.8_5.4_1994	1
Barium	EPA 200.8_5.4_1994	1
Beryllium	EPA 200.8_5.4_1994	1
Cadmium	EPA 200.8_5.4_1994	1
Calcium	EPA 200.8_5.4_1994	1
Chromium	EPA 200.8_5.4_1994	1
Cobalt	EPA 200.8_5.4_1994	1
Copper	EPA 200.8_5.4_1994	1
Iron	EPA 200.8_5.4_1994	1
Lead	EPA 200.8_5.4_1994	1
Magnesium	EPA 200.8_5.4_1994	1
Manganese	EPA 200.8_5.4_1994	1
Molybdenum	EPA 200.8_5.4_1994	1
Nickel	EPA 200.8_5.4_1994	1
Potassium	EPA 200.8_5.4_1994	1
Selenium	EPA 200.8_5.4_1994	1
Silver	EPA 200.8_5.4_1994	1
Sodium	EPA 200.8_5.4_1994	1
Thallium	EPA 200.8_5.4_1994	1
Vanadium	EPA 200.8_5.4_1994	1
Zinc	EPA 200.8_5.4_1994	1
Mercury	EPA 245.1_3_1994	1
VOA & Semi-VOA Compounds	ARI SOP 427S	4
Acetylene	EPA RSK-175	1
Ethane	EPA RSK-175	1
Ethene	EPA RSK-175	1
Methane	EPA RSK-175	1
n-Propane	EPA RSK-175	1

Matrix/Analyte	Method	Notes
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B_1994	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 1613B_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4	EPA 1613B_1994	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 1613B_1994	1
1,2,3,4,7,8-Hxcdd	EPA 1613B_1994	1
1,2,3,4,7,8-Hxcdf	EPA 1613B_1994	1
1,2,3,6,7,8-Hxcdd	EPA 1613B_1994	1
1,2,3,6,7,8-Hxcdf	EPA 1613B_1994	1
1,2,3,7,8,9-Hpcdf	EPA 1613B_1994	1
1,2,3,7,8,9-Hxcdd	EPA 1613B_1994	1
1,2,3,7,8,9-Hxcdf	EPA 1613B_1994	1
1,2,3,7,8-Pecdd	EPA 1613B_1994	1
1,2,3,7,8-Pecdf	EPA 1613B_1994	1
2,3,4,6,7,8-Hxcdf	EPA 1613B_1994	1
2,3,4,7,8-Pecdf	EPA 1613B_1994	1
2,3,7,8-TCDD	EPA 1613B_1994	1
2,3,7,8-TCDF	EPA 1613B_1994	1
Hpcdd, total	EPA 1613B_1994	1
Hpcdf, total	EPA 1613B_1994	1
Hxcdd, total	EPA 1613B_1994	1
Hxcdf, total	EPA 1613B_1994	1
Pecdd, total	EPA 1613B_1994	1
Pecdf, total	EPA 1613B_1994	1
TCDD, total	EPA 1613B_1994	1
TCDF, total	EPA 1613B_1994	1
1,1-Dichloroethylene	EPA 8260C SIM	1
Vinyl chloride	EPA 8260C SIM	1
Butyl-tin Species	EPA 8270D_(2/07)	10
Total coliforms-count	SM 9222 B	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Microtox, WDOE Sediment	WDOE 03-09-043 SubApp B&C	8
Solid and Chemical Materials		
Ammonia	EPA 350.1_2_1993	1

Matrix/Analyte	Method	Notes
Nitrogen, Total Kjeldahl	EPA 351.2_2_1993	1
Nitrate + Nitrite	EPA 353.2_2_1993	1
Chromium, Hexavalent	EPA 7196A_1_1992	1
Cyanide, Total	EPA 9010C_2002	1
Cyanides, Amenable to Chlorination	EPA 9010C_2002	1
Cyanide, Free	EPA 9014_1996	1
Cyanide, Total	EPA 9014_1996	1
Sulfide	EPA 9030B_2_1996	1
Sulfide	EPA 9034_1996	1
Corrosivity	EPA 9040C_2002	1
pH	EPA 9040C_2002	1
pH	EPA 9045D_2002	1
pH (non-aqueous)	EPA 9045D_2002	1
Specific Conductance	EPA 9050A_1_1996	1
Bromide	EPA 9056A_(11/00)	1,5
Chloride	EPA 9056A_(11/00)	1
Fluoride	EPA 9056A_(11/00)	1
Nitrate	EPA 9056A_(11/00)	1
Nitrite	EPA 9056A_(11/00)	1
Orthophosphate	EPA 9056A_(11/00)	1
Sulfate	EPA 9056A_(11/00)	1
Total Organic Carbon	EPA 9060A_2004	1
Phenolics, Total	EPA 9065_1986	1
n-Hexane Extractable Material (O&G)	EPA 9071 B_2_1999	1
Fluoride	EPA 9214_1996	1
Chloride	EPA 9251_(9/86)	1
Total Organic Carbon	PSEP 1986 Combust/Grav	
Solids, Total, Fixed and Volatile	SM 2540 G-97	10
Oxidation-Reduction Potential (ORP)	SM 2580 B-97	1
Ammonia	SM 4500-NH3 D-97	1
Ammonia	SM 4500-NH3 H-97	1
Nitrate + Nitrite	SM 4500-$NO3^{-}$ I-00	10
Nitrogen, Total Kjeldahl	SM 4500-Norg D-97	1
Phosphorus, total	SM 4500-P E-99	1
Mercury in Sediments	EPA 245.5_1974	1

Matrix/Analyte	Method	Notes
Aluminum	EPA 6010C_(2/07)	1
Antimony	EPA 6010C_(2/07)	1
Arsenic	EPA 6010C_(2/07)	1
Barium	EPA 6010C_(2/07)	1,5
Beryllium	EPA 6010C_(2/07)	1
Boron	EPA 6010C_(2/07)	1
Cadmium	EPA 6010C_(2/07)	1
Calcium	EPA 6010C_(2/07)	1
Chromium	EPA 6010C_(2/07)	1
Cobalt	EPA 6010C_(2/07)	1
Copper	EPA 6010C_(2/07)	1
Iron	EPA 6010C_(2/07)	1
Lead	EPA 6010C_(2/07)	1
Magnesium	EPA 6010C_(2/07)	1
Manganese	EPA 6010C_(2/07)	1
Molybdenum	EPA 6010C_(2/07)	1
Nickel	EPA 6010C_(2/07)	1
Potassium	EPA 6010C_(2/07)	1
Selenium	EPA 6010C_(2/07)	1
Silica as SiO2	EPA 6010C_(2/07)	1
Silver	EPA 6010C_(2/07)	1
Sodium	EPA 6010C_(2/07)	1
Strontium	EPA 6010C_(2/07)	1
Thallium	EPA 6010C_(2/07)	1
Tin	EPA 6010C_(2/07)	1
Titanium	EPA 6010C_(2/07)	1
Vanadium	EPA 6010C_(2/07)	1
Zinc	EPA 6010C_(2/07)	1
Aluminum	EPA 6020A_(2/07)	1
Antimony	EPA 6020A_(2/07)	1
Arsenic	EPA 6020A_(2/07)	1
Barium	EPA 6020A_(2/07)	1
Beryllium	EPA 6020A_(2/07)	1
Cadmium	EPA 6020A_(2/07)	1
Calcium	EPA 6020A_(2/07)	1
Chromium	EPA 6020A_(2/07)	1

Matrix/Analyte	Method	Notes
Cobalt	EPA 6020A_(2/07)	1
Copper	EPA 6020A_(2/07)	1
Iron	EPA 6020A_(2/07)	1
Lead	EPA 6020A_(2/07)	1
Magnesium	EPA 6020A_(2/07)	1
Manganese	EPA 6020A_(2/07)	1
Molybdenum	EPA 6020A_(2/07)	1,5
Nickel	EPA 6020A_(2/07)	1
Potassium	EPA 6020A_(2/07)	1
Selenium	EPA 6020A_(2/07)	1
Silver	EPA 6020A_(2/07)	1
Sodium	EPA 6020A_(2/07)	1
Thallium	EPA 6020A_(2/07)	1
Vanadium	EPA 6020A_(2/07)	1
Zinc	EPA 6020A_(2/07)	1
Mercury, Liquid Waste	EPA 7470A_1_1994	1
Mercury, Solid Waste	EPA 7471B_(1/98)	1
VOA & Semi-VOA Compounds	ARI SOP 427S	4
Total Pet Hydrocarbons - Diesel	EPA 8015B_2_1996	9
Total Pet Hydrocarbons - Gasoline	EPA 8015B_2_1996	9
Benzene	EPA 8021B_2_1996	1
Ethylbenzene	EPA 8021B_2_1996	1
m+p-xylene	EPA 8021B_2_1996	1
o-Xylene	EPA 8021B_2_1996	1
Toluene	EPA 8021B_2_1996	1
Xylenes (total)	EPA 8021B_2_1996	1
2,3,4,5-Tetrachlorophenol	EPA 8041A_(11/00)	
2,3,4-Trichlorophenol	EPA 8041A_(11/00)	
2,3,5,6-Tetrachlorophenol	EPA 8041A_(11/00)	
2,3,6-Trichlorophenol	EPA 8041A_(11/00)	
2,4,5-Trichlorophenol	EPA 8041A_(11/00)	
2,4,6-Trichlorophenol	EPA 8041A_(11/00)	
2,4-Dichlorophenol	EPA 8041A_(11/00)	
2,4-Dimethylphenol	EPA 8041A_(11/00)	
2,4-Dinitrophenol	EPA 8041A_(11/00)	
2,5-Dinitrophenol	EPA 8041A_(11/00)	

Matrix/Analyte	Method	Notes
2,6-Dichlorophenol	EPA 8041A_(11/00)	
2-Chlorophenol	EPA 8041A_(11/00)	
2-Cyclohexyl-4,6-dinitrophenol	EPA 8041A_(11/00)	
Pentachlorophenol	EPA 8041A_(11/00)	
4,4'-DDD	EPA 8081B_(2/07)	1,7
4,4'-DDE	EPA 8081B_(2/07)	1,7
4,4'-DDT	EPA 8081B_(2/07)	1,7
Alachlor	EPA 8081B_(2/07)	1,7
Aldrin	EPA 8081B_(2/07)	1,7
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
alpha-Chlordane	EPA 8081B_(2/07)	1,7
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
Chlordane (tech.)	EPA 8081B_(2/07)	1,7
Chlorothalonil	EPA 8081B_(2/07)	1,7
Dacthal (DCPA)	EPA 8081B_(2/07)	1,7
delta-BHC	EPA 8081B_(2/07)	1,7
Dieldrin	EPA 8081B_(2/07)	1,7
Endosulfan I	EPA 8081B_(2/07)	1,7
Endosulfan II	EPA 8081B_(2/07)	1,7
Endosulfan sulfate	EPA 8081B_(2/07)	1,7
Endrin	EPA 8081B_(2/07)	1,7
Endrin aldehyde	EPA 8081B_(2/07)	1,7
Endrin ketone	EPA 8081B_(2/07)	1,7
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
gamma-Chlordane	EPA 8081B_(2/07)	1,7
Heptachlor	EPA 8081B_(2/07)	1,7
Heptachlor epoxide	EPA 8081B_(2/07)	1,7
Hexachlorobenzene	EPA 8081B_(2/07)	1,7
Hexachlorobutadiene	EPA 8081B_(2/07)	1,7
Hexachlorocyclopentadiene	EPA 8081B_(2/07)	1,7
Isodrin	EPA 8081B_(2/07)	1,7
Methoxychlor	EPA 8081B_(2/07)	1,7
Mirex	EPA 8081B_(2/07)	1,7
Toxaphene (Chlorinated camphene)	EPA 8081B_(2/07)	1,7
trans-Nonachlor	EPA 8081B_(2/07)	1,7
Trifluralin (Treflan)	EPA 8081B_(2/07)	1,7

Matrix/Analyte	Method	Notes
Aroclor-1016 (PCB-1016)	EPA 8082A_(2/07)	1,6
Aroclor-1221 (PCB-1221)	EPA 8082A_(2/07)	1,6
Aroclor-1232 (PCB-1232)	EPA 8082A_(2/07)	1,6
Aroclor-1242 (PCB-1242)	EPA 8082A_(2/07)	1,6
Aroclor-1248 (PCB-1248)	EPA 8082A_(2/07)	1,6
Aroclor-1254 (PCB-1254)	EPA 8082A_(2/07)	1,6
Aroclor-1260 (PCB-1260)	EPA 8082A_(2/07)	1,6
Aroclor-1262 (PCB-1262)	EPA 8082A_(2/07)_Extended	1,6
Aroclor-1268 (PCB-1268)	EPA 8082A_(2/07)_Extended	1,6
2,4,5-T	EPA 8151A_(1/98)	1
2,4-D	EPA 8151A_(1/98)	1
2,4-DB	EPA 8151A_(1/98)	1
Dacthal (DCPA)	EPA 8151A_(1/98)	1
Dalapon	EPA 8151A_(1/98)	1
Dicamba	EPA 8151A_(1/98)	1
Dichlorprop	EPA 8151A_(1/98)	1
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A_(1/98)	1
MCPA	EPA 8151A_(1/98)	1
MCPP	EPA 8151A_(1/98)	1
Pentachlorophenol	EPA 8151A_(1/98)	1
Picloram	EPA 8151A_(1/98)	1
Silvex (2,4,5-TP)	EPA 8151A_(1/98)	1
C8-C10 Aliphatic EPH	WDOE EPH	1,3
C8-C10 Aromatic EPH	WDOE EPH	1,3
>C10-C12 Aliphatic EPH	WDOE EPH	1,3
>C10-C12 Aromatic EPH	WDOE EPH	1,3
>C12-C16 Aliphatic EPH	WDOE EPH	1,3
>C12-C16 Aromatic EPH	WDOE EPH	1,3
>C16-C21 Aliphatic EPH	WDOE EPH	1,3
>C16-C21 Aromatic EPH	WDOE EPH	1,3
>C21-C34 Alpihatic EPH	WDOE EPH	1,3
>C21-C34 Aromatic EPH	WDOE EPH	1,3
Total Pet Hydrocarbons - Diesel	WDOE NWTPH-Dx	1,3
Total Pet Hydrocarbons - Gasoline	WDOE NWTPH-Gx	1,3

Matrix/Analyte	Method	Notes
C8-C10 Aromatic VPH	WDOE VPH	1,3
C5-C6 Aliphatic VPH	WDOE VPH	1,3
>C10-C12 Aliphatic VPH	WDOE VPH	1,3
>C10-C12 Aromatic VPH	WDOE VPH	1,3
>C12-C13 Aromatic VPH	WDOE VPH	1,3
>C6-C8 Aliphatic VPH	WDOE VPH	1,3
>C8-C10 Aliphatic VPH	WDOE VPH	1,3
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B_1994	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 1613B_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4	EPA 1613B_1994	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 1613B_1994	1
1,2,3,4,7,8-Hxcdd	EPA 1613B_1994	1
1,2,3,4,7,8-Hxcdf	EPA 1613B_1994	1
1,2,3,6,7,8-Hxcdd	EPA 1613B_1994	1
1,2,3,6,7,8-Hxcdf	EPA 1613B_1994	1
1,2,3,7,8,9-Hpcdf	EPA 1613B_1994	1
1,2,3,7,8,9-Hxcdd	EPA 1613B_1994	1
1,2,3,7,8,9-Hxcdf	EPA 1613B_1994	1
1,2,3,7,8-Pecdd	EPA 1613B_1994	1
1,2,3,7,8-Pecdf	EPA 1613B_1994	1
2,3,4,6,7,8-Hxcdf	EPA 1613B_1994	1
2,3,4,7,8-Pecdf	EPA 1613B_1994	1
2,3,7,8-TCDD	EPA 1613B_1994	1
2,3,7,8-TCDF	EPA 1613B_1994	1
Hpcdd, total	EPA 1613B_1994	1
Hpcdf, total	EPA 1613B_1994	1
Hxcdd, total	EPA 1613B_1994	1
Hxcdf, total	EPA 1613B_1994	1
Pecdd, total	EPA 1613B_1994	1
Pecdf, total	EPA 1613B_1994	1
TCDD, total	EPA 1613B_1994	1
TCDF, total	EPA 1613B_1994	1
1,1-Dichloroethylene	EPA 8260C SIM	1,2
Vinyl chloride	EPA 8260C SIM	1,2
1,1,1,2-Tetrachloroethane	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
1,1,1-Trichloro-2,2,2-trifluoroethane	EPA 8260C_(8/06)	1
1,1,1-Trichloroethane	EPA 8260C_(8/06)	1
1,1,2,2-Tetrachloroethane	EPA 8260C_(8/06)	1
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260C_(8/06)	1
1,1,2-Trichloroethane	EPA 8260C_(8/06)	1
1,1,2-Trichlorofluoroethane	EPA 8260C_(8/06)	1
1,1-Dichloroethane	EPA 8260C_(8/06)	1
1,1-Dichloroethylene	EPA 8260C_(8/06)	1
1,1-Dichloropropene	EPA 8260C_(8/06)	1
1,2,3-Trichlorobenzene	EPA 8260C_(8/06)	1
1,2,3-Trichloropropane	EPA 8260C_(8/06)	1
1,2,3-Trimethylbenzene	EPA 8260C_(8/06)	1
1,2,4-Trichlorobenzene	EPA 8260C_(8/06)	1
1,2,4-Trimethylbenzene	EPA 8260C_(8/06)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260C_(8/06)	1
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260C_(8/06)	1
1,2-Dichlorobenzene	EPA 8260C_(8/06)	1
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260C_(8/06)	1
1,2-Dichloropropane	EPA 8260C_(8/06)	1
1,3,5-Trimethylbenzene	EPA 8260C_(8/06)	1
1,3-Dichlorobenzene	EPA 8260C_(8/06)	1
1,3-Dichloropropane	EPA 8260C_(8/06)	1
1,3-Dichloropropene	EPA 8260C_(8/06)	1
1,4-Dichlorobenzene	EPA 8260C_(8/06)	1
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260C_(8/06)	1
1-Chlorohexane	EPA 8260C_(8/06)	1
2,2-Dichloropropane	EPA 8260C_(8/06)	1
2,2'-Oxybis(1-chloropropane)	EPA 8260C_(8/06)	1
2,3-Dichloropropene	EPA 8260C_(8/06)	1
2-Bromofluorobenzene	EPA 8260C_(8/06)	1
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260C_(8/06)	1
2-Chloroethyl vinyl ether	EPA 8260C_(8/06)	1
2-Chlorotoluene	EPA 8260C_(8/06)	1
2-Hexanone	EPA 8260C_(8/06)	1
2-Pentanone	EPA 8260C_(8/06)	1
4-Bromofluorobenzene	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
4-Chlorotoluene	EPA 8260C_(8/06)	1
4-Isopropyltoluene (p-Cymene)	EPA 8260C_(8/06)	1
4-Methyl-1-Pentene	EPA 8260C_(8/06)	1
4-Methyl-2-pentanone (MIBK)	EPA 8260C_(8/06)	1
Acetone	EPA 8260C_(8/06)	1
Acetonitrile	EPA 8260C_(8/06)	1
Acrolein (Propenal)	EPA 8260C_(8/06)	1
Acrylonitrile	EPA 8260C_(8/06)	1
Benzene	EPA 8260C_(8/06)	1
Bromobenzene	EPA 8260C_(8/06)	1
Bromochloromethane	EPA 8260C_(8/06)	1
Bromodichloromethane	EPA 8260C_(8/06)	1
Bromoethane (Ethyl Bromide)	EPA 8260C_(8/06)	1
Bromoform	EPA 8260C_(8/06)	1
Carbon disulfide	EPA 8260C_(8/06)	1
Carbon tetrachloride	EPA 8260C_(8/06)	1
Chlorobenzene	EPA 8260C_(8/06)	1
Chlorodibromomethane	EPA 8260C_(8/06)	1
Chloroethane (Ethyl chloride)	EPA 8260C_(8/06)	1
Chloroform	EPA 8260C_(8/06)	1
cis & trans-1,2-Dichloroethene	EPA 8260C_(8/06)	1
cis-1,2-Dichloroethylene	EPA 8260C_(8/06)	1
cis-1,3-Dichloropropene	EPA 8260C_(8/06)	1
Cyclohexane	EPA 8260C_(8/06)	1
Cyclohexanol	EPA 8260C_(8/06)	1
Cyclohexanone	EPA 8260C_(8/06)	1
Dibromofluoromethane	EPA 8260C_(8/06)	1
Dibromomethane (Methylene bromide)	EPA 8260C_(8/06)	1
Dichlorodifluoromethane (Freon-12)	EPA 8260C_(8/06)	1
Dichlorofluoromethane (Freon 21)	EPA 8260C_(8/06)	1
Diethyl ether	EPA 8260C_(8/06)	1
Ethanol	EPA 8260C_(8/06)	1
Ethyl acetate	EPA 8260C_(8/06)	1
Ethylbenzene	EPA 8260C_(8/06)	1
Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropan	EPA 8260C_(8/06)	1
Hexachlorobutadiene	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
Hexachloroethane	EPA 8260C_(8/06)	1
Iodomethane (Methyl iodide)	EPA 8260C_(8/06)	1
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260C_(8/06)	1
Isopropylbenzene	EPA 8260C_(8/06)	1
m+p-xylene	EPA 8260C_(8/06)	1
Methyl bromide (Bromomethane)	EPA 8260C_(8/06)	1
Methyl chloride (Chloromethane)	EPA 8260C_(8/06)	1
Methyl formate	EPA 8260C_(8/06)	1
Methyl methacrylate	EPA 8260C_(8/06)	1
Methyl tert-butyl ether (MTBE)	EPA 8260C_(8/06)	1
Methylcyclohexane	EPA 8260C_(8/06)	1
Methylene chloride (Dichloromethane)	EPA 8260C_(8/06)	1
m-Xylene	EPA 8260C_(8/06)	1
Naphthalene	EPA 8260C_(8/06)	1
n-Butylbenzene	EPA 8260C_(8/06)	1
n-Hexane	EPA 8260C_(8/06)	1
n-Propylbenzene	EPA 8260C_(8/06)	1
o-Xylene	EPA 8260C_(8/06)	1
p-Xylene	EPA 8260C_(8/06)	1
sec-Butylbenzene	EPA 8260C_(8/06)	1
Styrene	EPA 8260C_(8/06)	1
tert-Amyl alcohol (TAA)	EPA 8260C_(8/06)	1
tert-Amyl ethyl ether (TAEE)	EPA 8260C_(8/06)	1
tert-amylmethylether (TAME)	EPA 8260C_(8/06)	1
tert-Butyl alcohol	EPA 8260C_(8/06)	1
tert-Butylbenzene	EPA 8260C_(8/06)	1
Tetrachloroethylene (Perchloroethylene)	EPA 8260C_(8/06)	1
Toluene	EPA 8260C_(8/06)	1
trans-1,2-Dichloroethylene	EPA 8260C_(8/06)	1
trans-1,3-Dichloropropylene	EPA 8260C_(8/06)	1
trans-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	1
Trichloroethene (Trichloroethylene)	EPA 8260C_(8/06)	1
Trichlorofluoromethane (Freon 11)	EPA 8260C_(8/06)	1
Vinyl acetate	EPA 8260C_(8/06)	1
Vinyl chloride	EPA 8260C_(8/06)	1
Xylenes (total)	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
1,2,4,5-Tetrachlorobenzene	EPA 8270D_(2/07)	1
1,2,4-Trichlorobenzene	EPA 8270D_(2/07)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8270D_(2/07)	1
1,2-Dichlorobenzene	EPA 8270D_(2/07)	1
1,2-Diphenylhydrazine	EPA 8270D_(2/07)	1
1,3-Dichlorobenzene	EPA 8270D_(2/07)	1
1,4-Dichlorobenzene	EPA 8270D_(2/07)	1
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D_(2/07)	1
12-Chlorodehydroabietic Acid	EPA 8270D_(2/07)	1
14-Chlorodehydroabietic Acid	EPA 8270D_(2/07)	1
1-Chloronaphthalene	EPA 8270D_(2/07)	1
1-Methylnaphthalene	EPA 8270D_(2/07)	1
2,3,4,6-Tetrachlorophenol	EPA 8270D_(2/07)	1
2,4,5-Trichlorophenol	EPA 8270D_(2/07)	1
2,4,5-Trimethylaniline	EPA 8270D_(2/07)	1
2,4,6-Trichlorophenol	EPA 8270D_(2/07)	1
2,4-Dichlorophenol	EPA 8270D_(2/07)	1
2,4-Dimethylphenol	EPA 8270D_(2/07)	1
2,4-Dinitrophenol	EPA 8270D_(2/07)	1
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D_(2/07)	1
2,6-Dichlorophenol	EPA 8270D_(2/07)	1
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D_(2/07)	1
2-Benzyl-4-chlorophenol	EPA 8270D_(2/07)	1
2-Chloronaphthalene	EPA 8270D_(2/07)	1
2-Chlorophenol	EPA 8270D_(2/07)	1
2-Methoxyphenol (Guaiacol)	EPA 8270D_(2/07)	1
2-Methylnaphthalene	EPA 8270D_(2/07)	1
2-Methylphenol (o-Cresol)	EPA 8270D_(2/07)	1
2-Nitroaniline	EPA 8270D_(2/07)	1
2-Nitrophenol	EPA 8270D_(2/07)	1
3,3'-Dichlorobenzidine	EPA 8270D_(2/07)	1
3,4,5-Trichloroguaiacol	EPA 8270D_(2/07)	1
3,4,6-Trichloroguaiacol	EPA 8270D_(2/07)	1
3,4-Dichloroguaiacol	EPA 8270D_(2/07)	1
3-Methylcholanthrene	EPA 8270D_(2/07)	1
3-Methylphenol (m-Cresol)	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
3-Nitroaniline	EPA 8270D_(2/07)	1
4,5,6-Trichloroguaiacol	EPA 8270D_(2/07)	1
4,5-Dichloroguaiacol	EPA 8270D_(2/07)	1
4,6-Dichloroguaiacol	EPA 8270D_(2/07)	1
4,6-Dinitro-2-methylphenol	EPA 8270D_(2/07)	1
4-Bromophenyl phenyl ether	EPA 8270D_(2/07)	1
4-Chloro-3-methylphenol	EPA 8270D_(2/07)	1
4-Chloroaniline	EPA 8270D_(2/07)	1
4-Chloroguaiacol	EPA 8270D_(2/07)	1
4-Chlorophenol	EPA 8270D_(2/07)	1
4-Methylphenol (p-Cresol)	EPA 8270D_(2/07)	1
4-Nitroaniline	EPA 8270D_(2/07)	1
4-Nitrophenol	EPA 8270D_(2/07)	1
7,12-Dimethylbenz(a) anthracene	EPA 8270D_(2/07)	1
9,10-Dichlorostearic Acid	EPA 8270D_(2/07)	1
Abietic Acid	EPA 8270D_(2/07)	1
Acenaphthene	EPA 8270D_(2/07)	1
Acenaphthylene	EPA 8270D_(2/07)	1
Acetophenone	EPA 8270D_(2/07)	1
alpha-Terpineol	EPA 8270D_(2/07)	1
Aniline	EPA 8270D_(2/07)	1
Anthracene	EPA 8270D_(2/07)	1
Benzidine	EPA 8270D_(2/07)	1
Benzo(a)anthracene	EPA 8270D_(2/07)	1
Benzo(a)pyrene	EPA 8270D_(2/07)	1
Benzo(g,h,i)perylene	EPA 8270D_(2/07)	1
Benzo(j)fluoranthene	EPA 8270D_(2/07)	1
Benzo(k)fluoranthene	EPA 8270D_(2/07)	1
Benzo[b]fluoranthene	EPA 8270D_(2/07)	1
Benzoic acid	EPA 8270D_(2/07)	1
Benzyl alcohol	EPA 8270D_(2/07)	1
Biphenyl	EPA 8270D_(2/07)	1
bis(2-Chloroethoxy)methane	EPA 8270D_(2/07)	1
bis(2-Chloroethyl) ether	EPA 8270D_(2/07)	1
bis(2-Chloroisopropyl) ether	EPA 8270D_(2/07)	1
Butyl benzyl phthalate	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
Butyl diphenyl Phosphate	EPA 8270D_(2/07)	1
Butylated Hydroxytoluene	EPA 8270D_(2/07)	1
Butyl-tin Species	EPA 8270D_(2/07)	1
Carbaryl (Sevin)	EPA 8270D_(2/07)	1
Carbazole	EPA 8270D_(2/07)	1
Chrysene	EPA 8270D_(2/07)	1
Dehydroabietic Acid	EPA 8270D_(2/07)	1
Di(2-ethylhexyl)phthalate	EPA 8270D_(2/07)	1
Dibenz(a,h) acridine	EPA 8270D_(2/07)	1
Dibenz(a,h) anthracene	EPA 8270D_(2/07)	1
Dibenz(a,j) acridine	EPA 8270D_(2/07)	1
Dibenzo(a,e) pyrene	EPA 8270D_(2/07)	1
Dibenzofuran	EPA 8270D_(2/07)	1
Dibutyl phenyl Phospahate	EPA 8270D_(2/07)	1
Dichlorodehydroabietic Acid	EPA 8270D_(2/07)	1
Diethyl phthalate	EPA 8270D_(2/07)	1
Dimethyl phthalate	EPA 8270D_(2/07)	1
Di-n-butyl phthalate	EPA 8270D_(2/07)	1
Di-n-octyl phthalate	EPA 8270D_(2/07)	1
Diphenyl ether (Diphenyl Oxide)	EPA 8270D_(2/07)	1
Fluoranthene	EPA 8270D_(2/07)	1
Fluorene	EPA 8270D_(2/07)	1
Hexachlorobenzene	EPA 8270D_(2/07)	1
Hexachlorobutadiene	EPA 8270D_(2/07)	1
Hexachlorocyclopentadiene	EPA 8270D_(2/07)	1
Hexachloroethane	EPA 8270D_(2/07)	1
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07)	1
Isophorone	EPA 8270D_(2/07)	1
Isopimaric Acid	EPA 8270D_(2/07)	1
Linoleic Acid	EPA 8270D_(2/07)	1
Mirex	EPA 8270D_(2/07)	1
Naphthalene	EPA 8270D_(2/07)	1
Neoabietic Acid	EPA 8270D_(2/07)	1
n-Hexadecane	EPA 8270D_(2/07)	1
Nicotine	EPA 8270D_(2/07)	1
Nitrobenzene	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
N-Nitrosodiethylamine	EPA 8270D_(2/07)	1
N-Nitrosodimethylamine	EPA 8270D_(2/07)	1
N-Nitroso-di-n-butylamine	EPA 8270D_(2/07)	1
N-Nitroso-di-n-propylamine	EPA 8270D_(2/07)	1
N-Nitrosodiphenylamine	EPA 8270D_(2/07)	1
n-Tetradecane	EPA 8270D_(2/07)	1
o,o,o-Triethyl phosphorothioate	EPA 8270D_(2/07)	1
Oleic Acid	EPA 8270D_(2/07)	1
Palustric Acid	EPA 8270D_(2/07)	1
p-Benzoquinone	EPA 8270D_(2/07)	1
Pentachlorobenzene	EPA 8270D_(2/07)	1
Pentachlorophenol	EPA 8270D_(2/07)	1
Perylene	EPA 8270D_(2/07)	1
Phenanthrene	EPA 8270D_(2/07)	1
Phenol	EPA 8270D_(2/07)	1
Pimaric Acid	EPA 8270D_(2/07)	1
Pyrene	EPA 8270D_(2/07)	1
Pyridine	EPA 8270D_(2/07)	1
Retene	EPA 8270D_(2/07)	1
Sandaraopimaric Acid	EPA 8270D_(2/07)	1
Tetrachloroguaiacol	EPA 8270D_(2/07)	1
Toxaphene (Chlorinated camphene)	EPA 8270D_(2/07)	1
Tributyl phosphate	EPA 8270D_(2/07)	1
Trifluralin (Treflan)	EPA 8270D_(2/07)	1
Trimethyl phosphate	EPA 8270D_(2/07)	1
Triphenyl phosphate	EPA 8270D_(2/07)	1
1-Methylnaphthalene	EPA 8270D_(2/07) SIM	1,2
Acenaphthene	EPA 8270D_(2/07) SIM	1,2
Acenaphthylene	EPA 8270D_(2/07) SIM	1,2
Anthracene	EPA 8270D_(2/07) SIM	1,2
Atrazine	EPA 8270D_(2/07) SIM	1,2
Azinphos-ethyl (Ethyl guthion)	EPA 8270D_(2/07) SIM	1,2
Azinphos-methyl (Guthion)	EPA 8270D_(2/07) SIM	1,2
Benzo(a)anthracene	EPA 8270D_(2/07) SIM	1,2
Benzo(a)pyrene	EPA 8270D_(2/07) SIM	1,2
Benzo(g,h,i)perylene	EPA 8270D_(2/07) SIM	1,2

Matrix/Analyte	Method	Notes
Benzo(j)fluoranthene	EPA 8270D_(2/07) SIM	1,2
Benzo(k)fluoranthene	EPA 8270D_(2/07) SIM	1,2
Benzo[b]fluoranthene	EPA 8270D_(2/07) SIM	1,2
Bolstar (Sulprofos)	EPA 8270D_(2/07) SIM	1,2
Chlorfenvinphos	EPA 8270D_(2/07) SIM	1,2
Chlorpyrifos	EPA 8270D_(2/07) SIM	1,2
Chrysene	EPA 8270D_(2/07) SIM	1,2
Coumaphos	EPA 8270D_(2/07) SIM	1,2
Crotoxyphos	EPA 8270D_(2/07) SIM	1,2
Demeton	EPA 8270D_(2/07) SIM	1,2
Demeton-o	EPA 8270D_(2/07) SIM	1,2
Demeton-s	EPA 8270D_(2/07) SIM	1,2
Diazinon	EPA 8270D_(2/07) SIM	1,2
Dibenz(a,h) anthracene	EPA 8270D_(2/07) SIM	1,2
Dichlorofenthion	EPA 8270D_(2/07) SIM	1,2
Dichlorovos (DDVP, Dichlorvos)	EPA 8270D_(2/07) SIM	1,2
Dicrotophos	EPA 8270D_(2/07) SIM	1,2
Dimethoate	EPA 8270D_(2/07) SIM	1,2
Dioxathion	EPA 8270D_(2/07) SIM	1,2
Disulfoton	EPA 8270D_(2/07) SIM	1,2
EPN	EPA 8270D_(2/07) SIM	1,2
Ethion	EPA 8270D_(2/07) SIM	1,2
Ethoprop	EPA 8270D_(2/07) SIM	1,2
Famphur	EPA 8270D_(2/07) SIM	1,2
Fenitrothion	EPA 8270D_(2/07) SIM	1,2
Fensulfothion	EPA 8270D_(2/07) SIM	1,2
Fenthion	EPA 8270D_(2/07) SIM	1,2
Fluoranthene	EPA 8270D_(2/07) SIM	1,2
Fluorene	EPA 8270D_(2/07) SIM	1,2
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07) SIM	1,2
Malathion	EPA 8270D_(2/07) SIM	1,2
Merphos	EPA 8270D_(2/07) SIM	1,2
Methyl parathion (Parathion, methyl)	EPA 8270D_(2/07) SIM	1,2
Mevinphos	EPA 8270D_(2/07) SIM	1,2
Naled	EPA 8270D_(2/07) SIM	1,2
Naphthalene	EPA 8270D_(2/07) SIM	1,2

Matrix/Analyte	Method	Notes
Parathion	EPA 8270D_(2/07) SIM	1,2
Parathion, ethyl	EPA 8270D_(2/07) SIM	1,2
Pentachlorophenol	EPA 8270D_(2/07) SIM	1,2
Phenanthrene	EPA 8270D_(2/07) SIM	1,2
Phorate	EPA 8270D_(2/07) SIM	1,2
Pyrene	EPA 8270D_(2/07) SIM	1,2
Ronnel	EPA 8270D_(2/07) SIM	1,2
Sulfotepp	EPA 8270D_(2/07) SIM	1,2
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270D_(2/07) SIM	1,2
Tokuthion (Prothiophos)	EPA 8270D_(2/07) SIM	1,2
Trichloronate	EPA 8270D_(2/07) SIM	1,2
Tri-o-cresylphosphate (TOCP)	EPA 8270D_(2/07) SIM	1,2
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4	EPA 8290A_(1/98)	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 8290A_(1/98)	1
1,2,3,4,7,8-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,4,7,8-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,6,7,8-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,6,7,8-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,7,8,9-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,7,8,9-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,7,8-Pecdd	EPA 8290A_(1/98)	1
1,2,3,7,8-Pecdf	EPA 8290A_(1/98)	1
2,3,4,6,7,8-Hxcdf	EPA 8290A_(1/98)	1
2,3,4,7,8-Pecdf	EPA 8290A_(1/98)	1
2,3,7,8-TCDD	EPA 8290A_(1/98)	1
2,3,7,8-TCDF	EPA 8290A_(1/98)	1
Hpcdd, total	EPA 8290A_(1/98)	1
Hpcdf, total	EPA 8290A_(1/98)	1
Hxcdd, total	EPA 8290A_(1/98)	1
Hxcdf, total	EPA 8290A_(1/98)	1
Pecdd, total	EPA 8290A_(1/98)	1
Pecdf, total	EPA 8290A_(1/98)	1
TCDD, total	EPA 8290A_(1/98)	1

Matrix/Analyte	Method	Notes
TCDF, total	EPA 8290A_(1/98)	1
Particle Size Distribution	ASTM D422-63 (07)	
Particle Size Distribution	PSEP 1986 Wet Sieve	

Accredited Parameter Note Detail

(1) Recognition of Oregon NELAP accreditation. (2) GC-MS Selective Ion Monitoring (SIM). (3) Washington Department of Ecology Analytical Methods for Petroleum Hydrocarbons, Publication Number ECY 97-602, June 1997. (4) ARI SOP for Water Soluble Non-halogenated Volatile and Semivolatile Organic Compounds, including glycols. (5) Provisional accreditation pending submittal of additional, acceptable Proficiency Testing (PT) results (WAC 173-50-110). (6) Includes capability for low levels in aqueous samples using a modified hexane extraction. (7) Includes Low-Level Pesticides by ARI SOP 710S. (8) WDOE. Modification of PSEP Microtox Method. WDOE 02-09-043, Subappendix B & C. 2003. (9) Accreditation based in part on recognition of California ELAP accreditation. (10) Accreditation based in part on recognition of DoD-ELAP accreditation. (11) Interim accreditation pending the successful completion of an on-site audit to verify method capabilities (WAC 173-50-100).

08/03/2012

Authentication Signature
Alan D. Rue, Lab Accreditation Unit Supervisor

Date

ATTACHMENT A2

ANALYTICAL RESOURCES, INC., QUALITY ASSURANCE PLAN

Analytical Resources Inc. Quality Assurance Plan

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Quality Assurance Plan

Analytical Resources, Inc.
4611 S. 134th Place, Suite 100
Tukwila, WA 98168-3240

Revision 014-001
4/2/12

Uncontrolled Copy

A web page is configured to inform you if this is the most recent version of ARI's LQAP. Click on the link or type the URL into your web browser. No web access? Phone 206-695-6200

http://arilabs.com/cgi-bin/rcheck.cgi?f=LQAP&r=R13000

This Quality Assurance Plan is approved and authorized for release by:

Mark Weidner
Laboratory Technical Director

Brian N. Bebee
Organic Analysis Section Technical Director

Jay Kuhn
Inorganic Analysis Section Technical Director

David Mitchell
Quality Assurance Manager

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Quality Assurance Plan

Analytical Resources Inc.

Table of Contents:

Section 01:	Introduction	Page 04
Section 02:	QA Management and Responsibility	Page 09
Section 03:	Personnel Training	Page 23
Section 04:	Facilities, Equipment and Instrumentation	Page 25
Section 05:	Laboratory Documentation and Records	Page 31
Section 06:	Sample Control	Page 38
Section 07:	Project Management and Tracking	Page 48
Section 08:	Analytical Methods	Page 51
Section 09	Instrument Control	Page 55
Section 10:	Data Validation and Review	Page 66
Section 11:	Quality Control	Page 71
Section 12:	Corrective Actions	Page 78
Section 13:	Laboratory Evaluation and Audits	Page 89
Section 14:	Appendices	Page 94

A – Personnel and Organization *Page 95*
B – Training *Page 101*
C – Laboratory Facilities *Page 104*
D –Laboratory Instrumentation *Page 107*
E – Standard Operating Procedures *Page 115*
F – Sample Containers and Preservatives *Page 116*
G – Laboratory Workflow *Page 117*
H – Analytical methods *Page 119*
I – Method Detection Limits and Reporting Limits *Page 123*
J – Quality Control Recovery Limits *Page 124*
K – Internal Audit Schedule *Page 125*
L – Certifications and Accreditations *Page 127*
M – Data Reporting Qualifiers *Page 129*
N – Personal Conduct Statement *Page 133*
O – Quality Assurance Policies *Page 136*

SECTION 1: INTRODUCTION

Quality Assurance Policy and Objectives

Analytical Resources, Inc. (ARI) is dedicated to providing accurate and reliable data in a timely and cost effective manner. The management of ARI is committed to analytical excellence and continual improvement of the laboratory's quality system. Management will demonstrate this commitment by providing all required resources and promoting a corporate culture based on meeting client requirements, operating in accordance with legal and regulatory requirements in accordance with ARI's established ethics policy.

The quality assurance program detailed in this document sets forth the policies and procedures that are followed by ARI to ensure that all reported results are both legally defensible and of the highest quality.

To ensure that data quality goals are achieved, the following characteristics must be considered:

Precision, Bias and Accuracy

For all analyses, there is a degree of uncertainty or error in the measurement process. This measurement error is generally one of two types: random error (precision) or systematic error (bias). Precision is a measure of agreement between replicate measurements. Bias is considered to be the difference between the expected value and the true value for a measurement or series of measurements. Accuracy is a determination of how closely a measurement is to the expected value. Both precision and bias are considered when determining the accuracy of measurements. Precision, bias and accuracy are evaluated through the use of method guidelines, and project and laboratory control limits.

Representativeness

Representativeness is an indicator of how closely one sample aliquot resembles another aliquot from the same bulk source or sample site. Sample representativeness is more easily obtained for particulate-free water samples than for solid samples or viscous liquids. Representativeness is an important consideration in achieving other data quality objectives.

Completeness

Completeness is an indicator of the number of valid (useable) data points compared with the overall number of data points obtained. Valid data are normally obtained when sample collection and analysis is performed in accordance with specified methods and procedures. Completeness is often expressed as a percentage: the higher the number of valid data points, the higher the overall completeness

percentage. Conversely, fewer valid data points will result in an overall lower percentage of completeness. Project specifications will dictate the required level of completeness.

Comparability

Comparability is an indicator of how confidently one data set can be compared with another, as well as the consistency between data sets. Stable analytical conditions and adherence to standard procedures, combined with high levels of accuracy; help ensure that results obtained over a period of time will be comparable.

Timeliness

To ensure that the most accurate results possible are obtained, samples must be processed within specified time periods. Analytical holding times have been established to allow sufficient time for sample processing without compromising sample integrity. It is important that, while meeting timeliness requirements, other data quality objectives are still considered and met.

Documentation

Complete and accurate documentation is essential for verifying the integrity of analytical results. Achievement of other quality objectives cannot be used to substantiate data quality without full documentation of the analytical process. Documentation must be concise and readily available for subsequent review.

The quality assurance program at ARI has been developed to ensure that the specified data quality objectives are met for all reported results and the highest degree of completeness possible is achieved.

1.2 Ethics Policy on Data Quality and Confidentiality

To ensure that data quality or confidentiality is not compromised, ARI has established the following policy on corporate ethics. These steps must be taken when the quality or confidentiality of data is suspected or known to be compromised. This policy applies to all ARI employees at every organizational level.

General

ARI's corporate commitment to integrity and honesty in the workplace is clearly stated in the ARI Employee's Handbook, under "Standards of Conduct". The Standards of Conduct statement is attached as Appendix O. The ARI commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARI management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

Circumstances

All ARI employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

Altering an instrument, computer or clock to falsify time or output
Altering the content of a logbook or data sheet in order to misrepresent data
Falsifying analyst identity
Changing documents with correction fluid with the intent of falsifying information
Preparing or submitting counterfeit data packages or reports
Unauthorized release (either written or verbal) of confidential data
Illegal calibration techniques (peak shaving, fraudulent integrator parameters)
Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting

Responsibilities

It is the responsibility of all ARI employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARI employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARI Laboratory Manager. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARI employees have the right and responsibility to discuss the matter directly with the ARI Laboratory Manager.

It is the responsibility of the ARI Laboratory Manager to promptly investigate any reports of known or suspected violations. The ARI Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARI management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy. It is the responsibility of ARI to provide our clients with data of known and documented quality.

Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following "Commitment to Excellence in Data Quality" statement:

"As an ARI employee, I have the right and responsibility to report any situation which may be adverse to quality or which may impact the final quality or integrity of data produced for our clients."

"I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its associated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid ("white-out"), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis."

"I will likewise alert management of any situation or activity which may be adverse to the confidentiality of clients' data."

"I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution."

"Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARI Laboratory Manager."

Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality Project Managers will be responsible for strict control of access to any such confidential information or documentation. All data generated from the analysis of confidential samples will also be considered confidential.

SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

Management includes the Laboratory Director, Section Managers, the Customer Service Director, Laboratory Supervisors, and the Quality Manager Receiving Manager. Roles and responsibilities are defined in Section 2.2 below.

Management's commitment to good professional practice and to the quality of its products is defined in Section1.0. In addition, management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The principal tenet of the Quality Assurance Program at Analytical Resources Inc. (ARI) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible data in a timely manner. While production of quality data is a global philosophy, held by the entire laboratory, each section is responsible for ensuring that the data produced within that section meets the required quality objectives.

2.1 Overall Structure

The Board of Directors shall direct ARI′s QA Policy and shall determine the Philosophy of the QA Program. It shall be the responsibility of the Laboratory Director to translate this policy into practical procedures with respect to the business plan developed for ARI, and direct the Laboratory Manager and Section Managers regarding the incorporation of these procedures into daily laboratory activities.

The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. The Laboratory Manager will coordinate Client Services, Laboratory Section Management, Computer Services, and Data Services to ensure that project requirements and data quality objectives are met.

The Laboratory Section Managers and Supervisors shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers. Section Managers and Section Supervisors shall instruct employees in the proper employment of QA policies.

Each Section Supervisor will ensure that analyses are completed within required holding times, that data is submitted within required submission times, and all analyses are performed according to the current Standard Operating Procedures (SOPs). They will ensure that any client modifications or QA issues are well documented for each sample set and that all required documents are complete when submitted with each data set.

The analytical staff shall execute all methods following QA policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers and the Laboratory Director, and once approved will be submitted to the Quality Assurance Program Manager (QAPM).

The QAPM will be responsible for controlling Company SOPs and other internal documents, overseeing the scheduling and completion of detection limit studies. The QAPM will coordinate the production of control charts and distribution of control limit data to all laboratory sections. The QAPM will administer the blind QA proficiency tests and performance samples as described in the QA Program. The QAPM will verify that QA policies and procedures are followed through out ARI.

Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.

Computer Services is responsible for ensuring that the Laboratory Information Management System (LIMS) correctly reflects the preparations and analyses performed and that the LIMS is

updated with the current SOP, MDL, RL and QL data as submitted from the QAPM. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that this data matches the hardcopy deliverables submitted.

Client Services (Project Management, Sample Receiving), shall be responsible for ensuring that the laboratories understand and can meet project specific analytical requirements and DQO.

2.2 Hierarchical Responsibilities

Technical Director

> *It shall be the responsibility of the Laboratory Director to translate QA policy into practical procedures with respect to ARI´s business plan, and to direct the Laboratory Manager and Section Managers in the implementation of these procedures in daily laboratory activities.*

The Director shall interpret overall QA Policy based on the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It shall be the interpretation of these policies that will, in turn, direct the growth ARI, the addition or withdrawal of methods to ARI′s repertoire, and ARI′s marketing focus.

At a minimum of once a year the Technical Director shall include on the agenda of the Board of Directors meeting a discussion of ARI′s QA Policy. This discussion will include the reputation of ARI for producing quality analyses, the affect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every six months the Director shall attend management meetings, which include on the agenda the subject 'QA Program'. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, and the appropriate response to these requirements.

The Technical Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Director's authority and responsibility to hold final review approval for all SOPs of ARI. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the Laboratory Director for final approval before the SOP is released.

Laboratory Manager

> *The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. It shall be the Laboratory Manager's responsibility to coordinate Client Services, Laboratory Management, Computer Services, and Data Services to ensure that QA Program requirements and data quality objectives are met.*

The Laboratory Manager is required to attend all management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors.

It is the responsibility of the Laboratory Manager, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to establish testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The Laboratory Manager has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Laboratory Manager also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Laboratory Manager serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

Laboratory Section Managers

> *The Section Managers shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QAPM and Project Managers. Section Managers are responsible for correcting out of control events within their respective laboratories. Section Managers and supervisors shall instruct employees in the proper employment of QA Policies.*

Laboratory Sections Managers shall have the final authority in decisions concerning QA policy. It is their expertise that will determine if testing activities meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM the needs of the client.

Laboratory Section Managers are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager. They will review and approve all laboratory Standard Operation Procedures.

The Section Managers are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Section Managers will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Section Manager's responsibility to take reports from supervisors and work with the Laboratory Manager to increase staffing levels or reject samples as needed. It is the Section Manager's responsibility to work with the Laboratory Manager and the section supervisor and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Section Managers, along with the QA Manager, Laboratory Director, Laboratory Manager and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARI will pursue. It is the responsibility of the Section Managers, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Section Manager will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Section Manager to oversee this training.

It is the Section Managers' responsibility to work with the Section Supervisor and Project Manager to assure that Project Requirements are achievable and valid for the given methods. At times, ARI′s clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Section Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the QAPM. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services, as needed for implementation.

The Section Manager is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Section Manager has the authority to re-classify analysts or require additional training of analysts based on their performance.

The Section Manager has the responsibility of balancing client requests and requirements with the QA policies of ARI. It is the Section Manager's task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Project Managers, Laboratory Supervisors and Quality Assurance Manager to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Computer Services, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

Section Supervisors

It is the responsibility of each section Supervisor to ensure that analyses are completed following the most current version of ARI´s SOP, within required holding and turn around times, and assure that analyses meet the Data Quality Objectives of each project. They will ensure that any client modifications or QA issues are well documented for each sample set, and that all documentation is complete when submitted with each data set.

To ensure that analyses are completed within required hold times, the Supervisors have the authority to balance employee workloads and modify employee work schedules. The Section Supervisors, with the input of the Section Manager, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Section Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Section Supervisors' responsibility to inform management (Section Manager, Data Review, and Project Managers), when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Section Supervisor's responsibility to assure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARI QA Program. The Supervisor shall either perform the training personally, or designate the trainer for given methods or procedures. It is the Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Supervisor shall have the authority to require further training or supervision for any employee, and shall be the authority to approve each employee for working without supervision. There will be a training record for each employee. These will be kept in the laboratory section; copies will be submitted to the QA Manager for record keeping.

It is the Supervisor's responsibility to work with the Section Manager and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Section Supervisor to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Section Supervisor's responsibility to clarify any issues, with the input of the Section Manager and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for implementation.

It is the Supervisor's responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Supervisor is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Supervisor and laboratory section analysts cannot resolve the issues in a timely manner, the Supervisor's will request the assistance of laboratory management to bring the section into compliance. The Supervisor will also inform Project Management and his/her Section Manager of possible delays, and inform Data Review of possible time constraints they may face in preparation of data submissions from the lab section.

The Section Supervisors shall have the authority, usually in consultation with Laboratory or Project Management to use professional judgment in requiring samples be re-prepared, and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Section Supervisor to inform the QAPM, Section Manager and the Computer Services section of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

Analysts

> *The analytical staff shall execute all methods following QA Policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers, the Laboratory Manager, and the Laboratory Director, and once approved will be submitted to the QA Manager.*

The analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Supervisor to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

The Section Supervisor may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the ARI QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Supervisors or Managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

Quality Assurance Program Manager (QAPM)

The QAPM will be responsible for controlling Company SOPs and other internal documents. The QAPM will oversee the scheduling and completion of detection limit studies and control charts. The QAPM will administer the training program, analyst's proficiency documentation and performance evaluation analyses as described in the QA Program. The QAPM will verify that QA policies and procedures are followed at all levels in the Company. The QAPM will produce a "Quality Assurance report to Management" each calendar year.

The QAPM is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Director and Laboratory Managers.

Part of this oversight will be monitoring of the QA Program through submission of performance evaluation samples, blind QA samples and double-blind QA samples. It is the responsibility of the QAPM, along with the Laboratory Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate. The QAPM will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies, and for control of documented proficiency results.

The QAPM will be responsible for scheduling laboratory section SOP and procedural reviews and revisions, and section updates of the Quality Assurance Manual. It is the responsibility of the QAPM to work with each Section Manager to attempt to stagger these review schedules across the year within each laboratory section. The QAPM will also be responsible for maintaining document control of all SOPs, bench sheets, logbooks, and other forms used within the laboratory.

All laboratory sections, on an annual basis, will perform detection limit studies for each method used within each section. It is the responsibility of the QAPM to schedule, review, compile, and distribute the results of these studies.

The QAPM is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. Following the audit schedule (Appendix K), the QA Manager will perform the scheduled audit and prepare an evaluation that will be submitted to the Board of Directors in the Annual QA Report to Management.

The QAPM will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with the Laboratory Managers and Laboratory Director on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the QAPM to coordinate laboratory efforts towards the accreditation.

The QAPM will produce an annual "Quality Assurance Report to Management" to be distributed to ARI management personnel as described in Section 13 of this LQAP.

The QAPM will serve as a resource for quality-related issues for all Laboratory Sections, and will serve management in an advisory capacity.

The QAPM will have documented training in elementary statistics and Quality Systems theory.

Data Reviewers

Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.

Data reviewers shall ensure that all samples are analyzed according to approved methods by reviewing the data released by each laboratory section. The data will be evaluated for compliance with all Data Quality Objectives as defined in the method SOP or in the project-specific quality assurance plan, including instrument tuning and calibration, holding time, spiking level, and spiking recovery criteria. Data reviewers will also verify 100% of manual calculations, spot check computer calculations, check electronic data for correct sample matching, and do a 100% check on any manually entered data. Analytical parameters, which have concentration interdependence, will be evaluated in relationship to each other.

Final reports generated will be evaluated to ensure that laboratories are using the current detection limit/reporting limit values and the current control limits. Data will be checked to ensure that all QA issues are addressed and fully documented. Reviewers are responsible for working with Laboratory Supervisors, Laboratory Managers and Project Managers when out-

of-control events are incompletely documented, or if data is found to not meet Data Quality Objectives of a project without documentation.

It is the responsibility of data reviewers, the QAPM and section supervisors to work with Computer Services to ensure that the LIMS is updated to the current limits and methods used within the laboratory.

Computer Services

> *Computer Services is responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.*

It is the responsibility of the Computer Services Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Computer Services will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Computer Services Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Computer Services personnel will review the EDD for compliance with the Software Quality Assurance SOP before it is released to the client.

Computer Services will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

Client Services

> *Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARI's clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand*

and can meet the Data Quality Goals and Requirements of each Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to assure that specific EDD formats are submitted to Computer Services and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARI, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARI will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills will be evaluated and verified acceptable. It is the obligation of ARI′s supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARI′s training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in this SOP assure that all ARI employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP.

Basic elements of ARI′s training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARI. These documents include ARI′s *Employee Manual* and ARI′s *Chemical Hygiene Plan*.
2. All technical employees are required to read and document their knowledge of ARI′s *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARI′s general and specific requirements for the production of quality analytical data are emphasized.
4. All new technical employees will attend a laboratory specific technical orientation conducted by their laboratory supervisor or manager that provides specific information about laboratory operation.
5. All employees will complete an ‘on the job’ training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. The training is

incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all analytical work.

6. Upon completion of the training program a technical employee must complete an Initial Demonstration of Capability (IDOC) as described in ARI SOP 1017S. An analyst is considered proficient and may perform analytical procedures without supervision only after they have completed training and a successful IDOC.
7. The proficiency of each employee performing a given laboratory SOP will be continually monitored and documented as described SOP 1017S. An employee must continually generate data that meets all of ARI's published acceptance criteria for a given SOP to be considered proficient. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.
8. Each analyst is responsible for maintaining a training record as described in SOP 1017S. The training record will document an employee's experience, training and capability. The training file will be maintained in the analysts' laboratory.

SECTION 4: FACILITIES AND EQUIPMENT

4.1 Facilities

ARI′s facilities have been designed to allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

Sample receipt and storage
Sample container preparation and shipment
Sample preparation and analysis (organic and inorganic)
Project planning and management
Quality assurance
Data review and report generation
Computer programming and operations
Records storage
Instrument spare parts storage
Frozen sample archive
Short-term hazardous waste storage

A detailed description of ARI′s facilities is included as Appendix C.

4.2 Security

Facilities

To ensure that security at ARI is maintained, access to the facilities is limited to employees and escorted visitors. Upon arrival, ARI visitors are required to register at the reception desk, and must sign out prior to leaving. Visitors will be escorted at all times. A receptionist constantly monitors the main entrance. Other laboratory entrances remain closed at all times and can only be opened from the outside by key. Key access to the facility is controlled; keys are issued on a limited basis depending on access needs.

As a result of controlled access and a monitored alarm system, the entire facility is considered a secure area. This eliminates the need for locked sample storage refrigerators, data storage areas or file cabinets.

Data Access

The Computer Services Manager controls security of, and access to, electronic data on the LIMS. Security measures are required to ensure data integrity, but must not be so restrictive

as to prevent data accessibility. The security measures taken at ARI are to prevent intentional intrusion by outside parties. These measures include building security, limited computer system access, password systems, encryption, firewalls and the use of virus protection programs. ARI′s Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

LIMS - System Security

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to Computer Services personnel, escorted repair technicians, and escorted visitors. Only Computer Services personnel will be allowed access to the main console.

System Password Policy

User name and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given “read only” access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

4.3 Safety

Ensuring that all sample processing and analysis procedures are performed under safe conditions is an important consideration at ARI. While safety is the responsibility of all staff members, ARI′s Safety Committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The*

Chemical Hygiene Plan details those safety procedures and requirements that must be followed at ARI. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARI's safety program.

4.4 Instrumentation and Support Equipment

4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation and support equipment will be optimally maintained following method requirements and/or manufacturer's recommendations. Preventative maintenance is performed on a scheduled basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. Separate, permanently bound logbooks are provided for and kept at or near each instrument. The logbooks are used to record all instrument maintenance, routine and non-routine. When non-routine maintenance is required the following information must be recorded:

1. A statement of the problem or symptom that requires correction.
2. Details of the maintenance procedure including listing the parts repaired or replaced.
3. Documentation that the instrument has returned to routine performance.

Spare parts are kept on hand when possible; necessary parts are ordered on an expedited basis to minimize downtime.

Currently available Laboratory Instrumentation is detailed in Appendix D.

4.4.2 Support Equipment

4.4.2.1 Thermometers in use at ARI are traceable to an NIST standard and are calibrated or verified annually. The procedures are described in SOP 1020S. When appropriate, thermometers are assigned a correction factor based upon the most recent calibration. ARI personnel must calculate and record corrected temperatures.

4.4.2.2 Water Bath temperatures are recorded before each use to assure the temperature is acceptable for its intended use.

4.4.2.3 Incubator temperatures (corrected) are recorded and at least twice a day while in use. The date and time of each observation is recorded.

4.4.2.3 Oven temperatures are recorded before and after each use.

4.4.2.4 Refrigerator and Freezer temperatures are recorded automatically every 30 minutes by ARI's "ThermoLogger" computer system. The temperature of several refrigerators and freezers not connected to "Thermologger" are recorded daily.

4.4.2.4 Balance accuracy is verified daily prior to use with two Class S weights that bracket the normal weighting range of the balance. A balance must be accurate to ±0.1% or ±0.5 mg whichever is greater. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every five years by an outside contractor. Calibration reports are filed in the QA Office.

4.4.2.5 pH Meters are standardized prior to each use with at least two standards, one at 4.0 and one at 7.0 pH units. The meters are checked prior to each use with a pH 7.0 buffer.

4.4.2.6 Variable Volume Pipette accuracy is verified monthly following the procedure in SOP 1015S.

4.4.2.7 Mechanical Burettes are calibrated quarterly following the procedure in SOP 1015S.

4.4.2.8 Sample Containers – Upon client request ARI supplies containers for collection of field samples. All containers supplied for organic and trace metals analyses are certified pre-cleaned by the manufacturer. When the manufacturer's certified concentration is greater than ARI's reporting limit for a specific project, a container is used to prepare a method (bottle) blank. ARI certifies that the containers from the same lot are suitable for sample collection when target analytes are not detected in the bottle blank. Containers for conventional analyses are not pre-cleaned and are certified internally by ARI following the procedures in Appendix 12.3 of ARI SOP 001S (Sample Receiving).

Container lot numbers are recorded when containers are sent to a client.

4.4.3 Chemical Standards and Reagents

4.4.3.1 Reagent Water Supply

ARI maintains a centralized water purification system. The quality of the water produced is monitored and documented daily in a bound logbook. All reagent / de-ionized water used within the laboratory meet or exceed ASTM Type II Standards. Water used in the Volatile Organic Laboratory is also filtered through activated charcoal to remove organic compounds.

4.4.3.2 Chemical Standards

Most standards used to determine the concentration of target analytes are purchased as certified solutions. In general the standards are traceable to a National Institute of Standards & Technology standard. A Certificate of Analysis and/or traceability for quantitative standards is filed in the QA Section when available. All standards (traceable, non-traceable and those prepared by ARI) are verified by comparison with standard reference materials or existing standards in use. ARI documents the source, date of receipt, required storage conditions and an expiration date for all standards. Containers used to store standards are labeled with an expiration date. Receiving, storage and preparation of calibration standards is described in SOPs 526S (Metals Analysis), 620S (Conventional Analysis), 704S (Volatile Organic Analysis) and 1012S (GC and GC-MS Analyses).

4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARI require chemical reagents that are not directly used in the calibration process. These reagents are used for analyte preservation, adjustment of pH, formation of colorimetric indicators, etc. The reagents are purchased in a grade and purity sufficient for their intended use. The receipt of all reagents is recorded in the Chemical Receiving Logbook where a unique Inventory Number is assigned to each reagent. Each original reagent container is labeled with an Inventory Number, the date it is opened and an expiration date as appropriate. A Certificate of Analysis is obtained for reagents when available and archived in the QA Office.

Solutions prepared from reagents are recorded in the Reagent Preparation Logbook. The logbook includes a unique Reagent Number that is traceable to the Chemical Receiving

Logbook. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer's identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1013S.

Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, only the highest quality, certified "metals free" acids are purchased. Each lot received is analyzed for purity prior to use in the laboratory to assure that it is acceptable for use. Whenever possible, entire lots will be reserved for use exclusively by ARI. This minimizes the possibility of receiving contaminated or unacceptable acid.

Solvents

To ensure the quality of solvents used for sample preparation and analysis, the highest purity of solvents required for sample processing will be used. Purity checks are performed on solvent lots received by the laboratory. Only those solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

Compressed Gases

To reduce the possibility of system contamination, compressed gases and liquids used for operating analytical instrumentation will be of a specified purity level. Any cylinder suspected of introducing contamination into a system will be promptly replaced.

4.5 Computer Systems

ARI maintains several data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix D and various SOPs.

ARI maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARI. A separate Software Quality Assurance Plan outlines the QA/QC procedures for the LIMS system.

SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample processing are documented in logbooks, notebooks and on laboratory forms and bench sheets. Analytical data and copies of paper documents are also stored electronically. Consistent use of standard documents throughout the laboratory ensures that all activities will be traceable and serves as objective evidence of the work performed.

All procedures performed at ARI will be detailed in Standard Operating Procedures (SOPs). Sample preparation and analysis SOPs will reference approved analytical methods and detail the actual procedures followed by ARI staff. SOPs for non-analytical activities will detail the procedures developed specifically for use at ARI.

5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section develops a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and understanding SOPs, and must sign a record to document this fact. The QAPM is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents, SOPs in particular, accurately reflect the activities performed at ARI, section supervisors and managers are required to review all documents annually and recommend changes to the QAP. The QAPM is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

5.2 Document Control

ARI′s Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved version of the documents are in use, centrally organized, and readily available to all staff members. All documents will include a revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates will be used for training and orderly implementation of changes.

Electronic copies of laboratory documents will be maintained as part of the quality assurance files. Each laboratory section maintains working copies of pertinent forms and SOPs. The QAPM coordinates the generation of new forms or SOPs and modifications to existing documents. Log number assignments will be as follows:

Laboratory Section	Form Number	SOP Number
Client Services	0001 - 0999	001 - 099
Computer Systems	1000 - 1999	100 - 199
Data Services	2000 - 2999	200 - 299
Extractions	3000 - 3999	300 - 399
GC Laboratory	4000 - 4999	400 - 499
Metals Laboratory	5000 - 5999	500 - 599
Conventional Laboratory	6000 - 6999	600 - 699
Volatile Organic Laboratory	8000 - 8999	700 - 799
Semi-volatile Laboratory	7000 - 7999	800 - 899
Quality Assurance Monitoring	10000 - 10999	1000 - 1099
GeoTech Laboratory	11000 - 11999	1100 - 1199

Document numbers will be include an F for forms and an S for SOPs i.e. 101F or 1234S. Document Control Logs of all forms and SOPs, detailing the form name and number, revision number and revision date will be maintained by the QA Officer. Outdated documents will be maintained in an electronic archive file.

The QAPM will distribute new and revised documents to the appropriate laboratory sections. Section staff will replace outdated copies of the document with the revised version. Laboratory forms and SOPs will be generated or revised on an “as needed” basis, and will be reviewed and revised as at least annually. Only the latest version of a form or SOP will be available in each laboratory. Section supervisors will periodically review these documents and recommend changes to be implemented by the QAPM. A comprehensive review of all laboratory documentation will be performed annually at the direction of the QAPM.

To maintain document security, release of documents to clients or other outside agencies will be controlled by the QAPM. The QAPM will record the document to be released, revision number, person and agency receiving the document, and the release date. All documents generated by the laboratory will be considered proprietary. ARI permission must be obtained by anyone releasing the document to other agencies or including the document in a project or quality assurance plan.

5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. All activities performed within the laboratory can be referenced to a method or SOP. The laboratory maintains copies of the following method compilations:

Code of Federal Regulations (Section 40)
Test Methods for Evaluating Solid Waste (USEPA SW-846)
USEPA Contract Laboratory Program Statement of Work for Organics Analysis
USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis
Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)
Standard Methods for the Examination of Water and Wastewater
Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)
US Naval Facilities Engineering Support Activity –NFESC (formerly NEESA).
Hazardous Waste Remedial Actions Program (HAZWRAP)
State of Alaska Department of Environmental Conservation (ADEC)
Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods
Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)
Washington State SARA
AFCEE Project Quality Assurance Plan
Washington State EPH/VPH Methods
National Environmental Laboratory Accreditation Conference
Department of Defense Quality Systems Manual
Washington State Sediment Sampling and Analysis Plan

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARI, it will be detailed in an SOP. SOPs will be available for all laboratory activities. Each laboratory section will maintain a file or notebook of SOPs pertinent to that section. A compilation of all laboratory SOPs is maintained as part of the Quality Assurance Program files. A listing of laboratory SOPs is included as Appendix E.

The Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. A copy of the Quality Assurance Manual is distributed to all laboratory sections. Distribution of the QAP is coordinated by the QAPM.

ARI maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff members. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARI employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

5.5 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted on laboratory forms and logs are recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed are noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors are noted on the forms and logs. The QAPM or his/her designee prepares and controls laboratory logbooks.

Changes to existing information is annotated by drawing a single line through the original entry and initialing and dating the deletion. Correct information is written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change is added. The use of correction fluids or other techniques that cover an entry in its entirety is forbidden on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines will be followed to encourage consistency in laboratory record keeping:

Standard Logbooks

Preparation of all stock and working standards is documented in the appropriate standards logbook. Each entry includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number. Commercially prepared stock standards are recorded in the stock standard logbook.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily. The temperature and recorder's initials are recorded on the temperature log attached to each unit. The acceptable temperature range for each unit is noted on the log sheet. Any out of control temperatures and/or corrective actions, must be noted on the log sheet and reported to appropriate personnel (Lab Supervisor and QA Manager)

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded, along with the date and recorder's initials. Any actions taken, such as notifying the QAPM of malfunctions is indicated alongside the entry for that date.

Instrument Logs

The Instrument Run Logs must detail all samples analyzed on a given instrument for a given parameter. Instrument conditions, analysis date and time for each sample, analyst initials and standard or sample identifications in the analytical sequence must be recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about

sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheet.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet.

Maintenance Logs

All major maintenance performed on instrumentation or laboratory equipment must be documented. Maintenance performed, date and analyst performing the maintenance, and steps taken to verify that the maintenance was successful are detailed in the log. Routine maintenance of GC-MS instruments is documented on “maintenance cards” attached to each instrument. The demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

Individual Laboratory Notebooks

Staff members preparing USEPA CLP samples must maintain unique laboratory notebooks for these analyses. Each case submitted is documented on a separate, sequentially numbered page. A listing of all samples prepared as part of the case, the date and the preparer′s initials, and any notes specific to sample preparation must be annotated in the logbook. Individual notebooks are used only when required by a specific contract. All sample preparation information is recorded on a laboratory bench sheet.

5.5 Document /Data Storage and Archival

Logbooks

All active logbooks will remain in the appropriate laboratory sections. Completed logbooks will be forwarded to the QAPM for archival.

Magnetic Tapes and Diskettes

When instrument capabilities permit, all data generated is archived and stored on magnetic tapes or disks. The electronic media remains on file for five years.

Chromatograms and Instrument Documentation

Electronic or paper copies of chromatograms, instrument calibrations, quantification reports and any other printed documentation generated during sample analysis are maintained as part of the permanent data files. All hardcopy data remain on file at ARI for five (5) years or as specified by contract.

Project Data and Documentation

Project data and support documentation, electronic or paper copies, will be filed a minimum of five years, or as specified by contract.

SECTION 6: SAMPLE CONTROL

All samples analyzed by the laboratory will be monitored in accordance with sample control procedures. Sample control includes operations such as container preparation, sample collection, receipt and storage, and tracking of the sample throughout all processing steps. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met.

6.1 Sample Collection

Production of quality analytical data begins with proper sample collection. Improper sampling procedures may result in inaccurate final results. Although the laboratory is not routinely involved with sample collection, it will minimize the possibility for error by providing clients with appropriate sample containers and sampling instructions for the requested parameters. If, upon receipt, sample integrity appears to be compromised, the client will be immediately notified to allow for re-sampling if necessary.

6.2 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, the laboratory will furnish all necessary sample containers for client projects when requested by the client. Sample containers, pre-cleaned to EPA specifications, or certified clean by the manufacturer or ARI, are supplied for most parameters. Containers for special purposes may be acquired upon request. Lot numbers for containers are tracked to link bottle orders to lot numbers.

A blank sample label is affixed to each sample container prior sending the container to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARI are coated to prevent bleeding of recorded information if labels become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to

appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A complete listing of containers and preservatives used within the laboratory is included as Appendix F.

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as vermiculite or “bubblewrap”, is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARI courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

6.3 Sample Admission

All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate protection, such as disposable gloves, safety glasses and laboratory coats will be worn during sample receipt and log-in. Additionally, all general safety practices as specified in ARI’s Chemical Hygiene Plan will be employed.

Upon receipt, sample coolers will be inspected for general condition and custody seals. Time and date of sample receipt, as well as identification of the staff member receiving the samples, will be indicated on each Chain of Custody record accompanying the shipment. Cooler temperatures will be determined using an IR temperature measuring device or by placing a thermometer in the cooler immediately after the cooler is opened. If samples cannot be logged-in within 30 minutes after receipt, the sample coolers will be tagged and placed in the walk-in sample storage refrigerator for short-term storage. Chain of Custody records for the

stored coolers will remain in Log-In to ensure that processing of the stored samples is not overlooked.

Samples to be processed will be removed from the coolers and organized by sample identification. The number and type of sample containers received will be verified against the Chain of Custody record. Each sample container will be examined to verify that the condition is acceptable and that sample integrity has not been compromised during shipment. Sample containers broken during shipment should be handled according to procedures detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

After sample organization and initial inspection has been completed, sample information will be entered into the LIMS, and a Service Request will be generated for the sample set. The Service Request serves as a work order for the laboratory. The Service Request will contain the following information:

Client Name
Client Project Name and/or Number
Client Contact
Verified Time of Sample Receipt (VTSR)
Required Turnaround Time
Laboratory Job Number
Client Sample Identifiers(s)
Laboratory Sample Number(s)
Required Parameters
Additional Analytical Requirements/Comments

Also entered into the LIMS are the number of sample containers for each sample, sample conditions, and cooler temperatures.

A sequential laboratory job number will be assigned to each sample set. Laboratory sample numbers, determined by the job number and a sequential letter, will be assigned to each sample. Containers for each sample will also be numbered sequentially. The accuracy of sample container labeling is verified by a second person. These identifiers will be used to monitor the sample set and container throughout sample processing. All samples logged for the sample set and the analytical parameters required for each sample will be indicated on the Service Request. Client specific quality control requirements and any other pertinent information indicated on the Chain of Custody Record will also be noted. Discrepancies

between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions. To reduce the possibility of inaccurate sample processing, the sample receiving staff working with the Project Manager will resolve all noted discrepancies prior to releasing the samples to the analytical sections.

Upon completion of sample log-in, all documentation will be placed in a master folder and forwarded to the assigned Project Manager for review and approval. The master folder will be color-coded as follows:

Master File Color	Designation
Red	Accelerated Turnaround (≤ week)
Blue	Accelerated Turnaround/Fuels
Clear	Routine Turnaround

The Project Manager will review all aspects of the documentation, specify any additional analytical requirements and resolve any remaining discrepancies before sample processing begins. After Project Manager final approval has been obtained (indicated by the Project Managers initials and the date on the Service Request and laboratory-specific parameter sheets), the master file will be returned to Log-In for preparation of laboratory job folders. A job folder will be created for each laboratory section involved in sample processing for a given project. Laboratory job folders are color-coded as follows:

Job Folder Color	Designation
Red	Accelerated Turnaround (≤ 10 days)
Manila	Normal Turnaround (11 to 14 days)
Blue	Accelerated Turnaround (≤ 7 days) for Fuels Analyses (NWTPH, AK103 etc.)
Yellow	Extended Turnaround (>14 day TAT)
Other (Green, Purple ,etc)	Client or Project Specific Analyzes

Copies of the Service Request and all pertinent laboratory-specific documentation required to accurately complete sample analysis will be placed in each laboratory job folder. Laboratory

job folders will then be distributed to appropriate laboratory sections for analysis and incorporation into the section tracking system.

Subcontracting Policies

ARI may be required to subcontract work to other laboratories. The following policies are followed to assure that data produced by a subcontractor is high quality, defensible and will meet the client's expectations.

1. ARI's client must be made aware that samples will be subcontracted and what laboratory will perform the analyses.
2. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARI. When appropriate, subcontracted laboratories must submit proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies, control limits to ARI. ARI may at its discretion perform an on-site assessment of subcontracted laboratories. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARI sample analyses.
3. ARI will not subcontract Department of Defense work to be performed under the Quality Systems Manual (DoD-QSM) unless the subcontract lab is approved to perform DoD-QSM analyzes.
4. The sample information and analytical requirements are first entered into the ARI LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARI chain-of-custody forms. These chain-of-custody documents are included in the master folder for the project.
5. ARI may request that subcontract laboratories analyze, on double blind performance testing (PT) sample obtained from commercial vendors at the subcontractor's expense.
6. The laboratory must be willing to maintain an annual contract with ARI, and must list ARI as a co-insured on the subcontract laboratory's liability insurance policies.
7. Financial stability is also evaluated on a lab-by-lab basis.

6.4 Sample Custody

To ensure the traceability of sample possession, chain of custody is documented from sample collection to completion of final analysis, and is maintained during sample storage in archive prior to disposal. This is achieved through completion of a written chain of custody record. Custody of all samples and extracts processed by the laboratory is documented at each step of the analytical process.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

It is in your actual possession, or
It is in your view, after being in your physical possession, or
It was in your possession, then you locked or sealed it up to prevent tampering, or
It is in a secure area.

Sample handling may vary and specific custody procedures have been developed for each laboratory section.

Custody at Sample Log-in

A Chain of Custody Record must accompany all samples received by the laboratory. This record documents all sampling activities as well as persons handling the samples prior to receipt by the laboratory. Sample receiving staff assumes custody of samples upon receipt from the client or courier. Samples will remain in the custody of Sample receiving until the samples are delivered to a laboratory section. Should samples require shipment to a subcontracting laboratory, a separate Chain of Custody Record will be completed to document the sample transfer. Chain of Custody records will be included with sample data reports in the final analytical package submitted to the client. Copies of these records will be filed with project data.

Custody of Volatile Organic Analysis (VOA) Samples

Upon completion of sample the sample receiving process, samples requiring analysis for volatile organic analysis will be placed in the VOA refrigerator designated for incoming samples and logged into the VOA sample receipt logbook. The samples are now in the custody of the VOA laboratory. To avoid possible cross-contamination of low level samples,

those samples known or suspected to contain high levels of contaminants, such as underground storage tank (UST) samples, will be stored in a separate refrigerator prior to analysis.

VOA Laboratory analysts complete the receiving process and move the samples to a refrigerator designated for “active” samples. Samples removed from storage for analysis are considered to be in the custody of the analyst responsible for sample processing. All samples to be analyzed will be listed in the analytical logbook for the selected instrument. Laboratory and client sample identifications, the bottle number and identification of the analyst performing the analysis will be indicated in the logbook. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from sample analysis, to further document sample custody.

After completion of sample analysis, soil and intact water sample containers will be placed in the refrigerator designated for sample archival. Any water sample remaining in the container after completion of analysis will be considered compromised and will be discarded. The samples will remain in archive and in the custody of the VOA laboratory until final disposal.

Custody of Semi-volatile Organic Analysis (SVOA) Samples

Upon completion of sample log-in, samples requiring extraction for organic parameters will be placed in walk-in cooler number 5. All samples placed in the cooler will be logged into the *Walk-in Admission Logbook*. Removal of samples from the refrigerator for processing by Extractions or Conventional personnel must be indicated in the *Walk-in Admission Logbook*. Samples stored in this walk-in refrigerator remain in Log-In custody until removed to a laboratory for processing.

The analyst responsible for the custody and initial handling of samples within the sample preparation laboratory will be indicated on the Sample Preparation Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Residual sample volumes will be archived in the refrigerator designated for extractable organic samples. Transfer of residual samples to this refrigerator will be documented in the *Sample*

Archive Refrigerator Logbook. Transfer of prepared sample extracts to the appropriate analytical sections will be documented in the Extract Log in the preparation laboratory and in the Extract Log in the analytical section. Upon extract transfer, the analytical section receiving the extract assumes custody.

Extracts removed from storage for analysis are considered to be in the custody of the analyst responsible for analysis. Removal of extracts for analysis will be indicated in the Extract Log in the analytical section. All extracts to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory and client sample identifications, as well as the analyst performing the analysis will be indicated in the logbook. Analysts will initial raw data generated from extract analysis to further document sample custody. After completion of analysis, extracts will be placed in the refrigerator designated for archive. Extracts will remain in storage and in the custody of the analytical section until final disposal.

Custody of Inorganic and Metals Samples

Upon completion of the sample receiving process, samples requiring preparation or analysis for inorganic parameters will be placed in the designated walk-in cooler. Selected samples such as those requiring a critical analysis are placed directly in the laboratory. Removal of samples from the refrigerators for digestion and/or analysis will be indicated in the *Walk-in Admission Logbook* for the appropriate refrigerator. Samples stored in the walk-in refrigerators remain in Log-In custody until the laboratory removes the samples for processing.

The analyst responsible for custody and initial handling of samples within the metals preparation laboratory will be indicated on the Sample Digestion Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Transfer of completed sample digests to the metals instrument (analysis) laboratory will be documented by the metals preparation laboratory. Upon transfer of digests, custody is considered to be the responsibility of the analytical section receiving the digests.

Digests removed from storage are considered to be in the custody of the responsible analyst. All digests to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory sample identifications and the analyst performing the analysis will be indicated in the logbook. If it is necessary for digest custody to be transferred to another instrument or

analyst, the second analyst records this information. Thus, custody of a given digest can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from digest and analysis to further document sample custody. After completion of analysis, digests will be stored by and remain in the custody of the analytical laboratory personnel until final disposal.

The analyst performing the sample analysis will remove samples requiring analysis for other inorganic (conventional) parameters from storage. Removal will be documented in the *Walk-in Admission Logbook*. Custody of the sample will be considered to be the responsibility of that analyst. All samples to be analyzed will be indicated on the worksheet for the required parameter. Laboratory sample identifications and the analyst performing the analysis will be indicated on the worksheet. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. The analysts' initials will be indicated on the worksheet to further document sample custody.

Special Chain of Custody Requirements

Should a client project require additional or more detailed custody documentation, requirements will be incorporated into the procedures for that project. Samples processed as part of the USEPA Contract Laboratory Program require more stringent chain of custody procedures. For this program, removal of samples and extracts for analysis (or any reason) will be documented in the Sample Control Log. Date, time and reason for removal, and date and time of return, will be fully documented. Removal of samples or extracts for permanent archiving or disposal will also be fully documented in the Sample Control Log.

6.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for a specified period of time: 30 days for water samples and 60 days for soil samples. Colored markers are placed on samples with specific storage requirements during the sample receiving process. The color-coding is defined in the following table:

Label Color	Storage Requirement
Red	Hold until further notice
Orange	Suspected Hazardous
Yellow	Shared Sample Containers
Blue	Samples to be frozen

Samples submitted for archival will be logged into the Sample Archive Logbook. Laboratory and client identifications, as well as archive date will be indicated in the logbook. The anticipated disposal date for the sample set will also be noted. The logbook will be reviewed several times during each week to determine samples scheduled for disposal. On or soon after the scheduled disposal date, the samples will be removed from archive storage and disposed.

In consideration of disposal requirements for hazardous samples, each sample processed by the laboratory will be evaluated for contamination levels based on final analytical results. Those samples containing analytes of interest at or above regulated disposal levels will be identified and handled as hazardous waste. A designated staff member coordinates periodic pickup and disposal of hazardous waste by an USEPA approved TSD (Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records. Specific guidelines for handling hazardous samples and waste are detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures)

SECTION 7: PROJECT MANAGEMENT AND TRACKING

7.1 Project Management

Concise and accurate communication between a client and ARI, and within the laboratory, is an extremely important requirement for generating quality analytical results. All clients contracting with ARI will be assigned to a Project Manager. The Project Manager confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines. Project organization, monitoring, and follow-up is the responsibility of Project Management staff.

Client project requirements and Project Managers' areas of expertise will be considered for client assignment. To ensure that all clients and projects receive the attention necessary for successful project completion, Project Manager workloads will also be considered. Project Managers will serve as the central focus for all project related activities and communications.

The Project Manager will review work plans and requirements for all pending projects. Any questions related to the work plan will be addressed prior to project commencement. The Project Manager will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements will also be addressed at this time. Upon receipt and log-in of project samples, the Project Manager will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager will also provide any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections will not process a sample until Project Manager approval has been given. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing will be promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The Project Manager will also address any issues that arise during subsequent review of the analytical data by the client.

7.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data and meet client needs. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Project Management Database. Project particulars, sample quantities, parameters and anticipated sample delivery dates will be specified, as well as any prearranged analytical costs. Project work plans and any other project information will be kept on file with the Project Manager. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts. Upon receipt of project samples, the project Inquiry number will be referenced to ensure project requirements are accurately specified. The original project documentation will be placed in the master folder as part of the project file.

Each laboratory section analyzing project samples will be responsible for ensuring that all analyses are accurately completed by the required date. All staff members are required to be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Sample status reports are generated as needed from LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to review project status and identify any samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status.

After sample analysis, report generation, and final review have been completed, data and final reports will be forwarded to the Project Manager. If requested, preliminary and interim results will be forwarded to the client. When all final data are available, the Project Manager will assemble the final package, verifying that all analyses were completed and project requirements met. A project narrative detailing the particulars of sample processing will be generated. After assembly and prior to shipment, the Project Manager will perform a final, cursory review of the package for any inconsistencies or incorrect information. The package will then be forwarded to clerical personnel for photocopying and shipment.

The Project Manager will determine final analytical costs and submit this information to the Accounting department for invoicing. Upon completion, all raw data and documentation associated with each client project will be compiled and stored as part of the laboratory project files. A chart detailing laboratory workflow as described in this section is included as Appendix G.

SECTION 8: ANALYTICAL METHODS

To ensure that all data generated are consistent and comparable, clearly defined procedures will be followed for all aspects of sample processing, control and management. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits will ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published will be noted in the SOPs. Analysis specific deviation will be noted in Analyst Notes and in the Analytical Narrative.

8.1 Responsibilities

It is the responsibility of staff members to perform all procedures in accordance with the guidelines specified in the Standard Operating Procedures. Laboratory management is responsible for ensuring that SOPs are followed throughout the laboratory. The QAPM is responsible for coordinating periodic review and revision of existing SOPs and generation of additional SOPs. The QAPM is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

8.2 Methods

Laboratory procedures may reference any established methods specified in the following publications:

1. *Code of Federal Regulations (Section 40)*
2. *Test Methods for Evaluating Solid Waste (USEPA SW-846)*
3. *USEPA Contract Laboratory Program Statement of Work for Organic Analysis*
4. *USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
5. *Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)*
6. *Standard Methods for the Examination of Water and Wastewater*
7. *Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
8. *Navy Installation Restoration Laboratory Quality Assurance Guide(February 1996)*
9. *Hazardous Waste Remedial Actions Program (HAZWRAP)*
10. *State of Alaska Department of Environmental Conservation (ADEC)*
11. *Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
12. *Washington Department of Ecology (WA-Ecology) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
13. *The Department of Defense Quality Systems Manual (DoD-QSM)*
14. *Washington State Sediment Sampling and Analysis Plan*

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures determined to provide more accurate final results will be incorporated into the method. Should the laboratory procedures deviate from the established method, all modifications will be detailed in the associated SOP. A listing of laboratory SOPs is included as Appendix E.

8.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. An SOP is available for all procedures within the laboratory, from initial project identification to final data archival. SOPs are generated for procedures developed within the laboratory and for those that follow established methods.

To ensure consistency in defining procedural guidelines, all SOPs that describe analytical procedures will contain the following sections:

1) Method, matrix or matrices, detection limit, scope & application, components to be analyzed
2) Summary of the test method
3) Definitions
4) Interferences
5) Safety
6) Equipment and supplies
7) Reagents and standards
8) Sample collection, preservation, shipment and storage
9) Quality control
10) Calibration and standardization
11) Procedure
12) Data analysis and calculations
13) Method performance
14) Pollution prevention
15) Data assessment and acceptance criteria for quality control measures
16) Corrective actions for out of control data
17) Contingencies for handling out-of-control or unacceptable data
18) Waste management
19) References
20) Appendices, tables, diagrams, flowcharts and validation data.

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed and revised as necessary at least once a year. Personnel normally performing the procedure or

analysis perform the review. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QAPM. The QAPM will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use. Document release will be controlled as detailed in section 5.2.

8.4 Method Selection and Use

Method selection will be based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods that are defined and accepted by regulatory agencies and familiar to ARI's clients are preferred. The Laboratory Manager and QAPM in consultation with marketing, client service, and laboratory supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods may be used when appropriate.

The most recently promulgated method will be used for all procedures. Non-promulgated methods will be investigated if requested by a client. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in the SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers review newly promulgated methods. SOPs will be modified as necessary to reflect the new methods. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs will be revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. If more than one method is used for an analysis, separate SOPs should be generated. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (Navy, CLP, etc.), will be incorporated into the SOP. These

requirements will be annotated to indicate that they are project/program specific. Analysts and technicians will be responsible for ensuring that, when required, project or program specific procedures are followed. SOPs will be controlled as specified in section 5.2.

8.5 Method Performance

Method performance must be demonstrated for all new methods prior to using methods for sample analysis. Section supervisors and managers are responsible for ensuring that method performance is demonstrated and support procedures have been performed.

Method performance will be demonstrated in the following manner:

A draft SOP will be generated for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) study must be performed for the method. Method detection limits must be verified to be at or lower than any method-specified detection limits. Method detection and reporting limits must be established.

Method precision and accuracy must be evaluated. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared with spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results will be reviewed and compiled by the section supervisor. Results will be filed with the QA section. A final SOP will be generated and distributed. MDL updates will be communicated to Computer Services for LIMS updates and distributed to laboratory sections as needed.

SECTION 9: INSTRUMENT CONTROL

9.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: instrument detection limits, method detection limits, and reporting limits. Instrument and method detection limits are statistically based values, determined from replicate analyses of analytical standards. Reporting limits are based upon the experience and judgment of an analyst. Reported values will be qualified based on the established limits. All limits will be summarized and controlled by the QAPM and are included as Appendix I.

Instrument Detection Limits

The instrument detection limit (IDL) is considered to be the smallest signal above background noise that an instrument can reliably detect. This limit reflects whether or not the observed signal has been caused by a real signal or is only a random fluctuation of noise from the blank. The IDL does not take into consideration the performance or efficiency of analytical methods.

Instrument detection limits are determined annually, or when ever a major change has been made, for each instrument in the metals analysis laboratory. Seven replicates, of a blank, or standards containing analytes at levels three to five times the expected IDLs are analyzed on three non-consecutive days. The IDL value for an analyte is three times the average of the standard deviations from the three replicate sets of analyses.

Method Detection Limits

The method detection limit (MDL) is considered to be the lowest concentration of an analyte that a method can detect with 99% confidence. Method detection limits will be established for all analytical parameters according to the guidelines specified in the Code of Federal Regulations, Section 40. Seven replicate samples are fortified with target analytes at levels that are one to five times (but not exceeding 10 times) the expected detection limits. The MDL for an analyte is determined to be the standard deviation of the replicates times the appropriate

student's t-test value. More than seven replicates may be processed, but all replicates must be used in the MDL determination. MDLs are verified by analyzing a sample spiked at a concentration 3 to 5 times the calculated MDL concentration. When the analyte(s) are detected the MDL is verified. When the analytes is not detected, the concentration in the verification sample is increased until it is detected. The concentration at which the analytes is first detected then becomes the MDL.

Laboratory supervisors or managers review all statistically determined MDLs for accuracy and validity. The section supervisor or manager is responsible for ensuring that any unusable MDL studies are reprocessed. Once accepted, MDL study results and associated raw data will be forwarded to the QA section for further review and additional approval. MDLs approved by both section management and QA will be considered final and acceptable for use. Finalized MDL values are forwarded to Computer Services for incorporation into ARI's LIMS.

MDL studies will be conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies will be performed on all instruments used for sample analysis. To allow for reevaluation of method performance, MDL studies will be performed on an annual basis. The QAPM is responsible for ensuring that all MDL studies are performed at least annually. Section supervisors and managers are responsible for determining if and when additional MDL studies should be performed due to changes in analytical methods, instrumentation or personnel.

Reporting Limits

Reporting Limits (RL) are the lowest quantitative value routinely reported. Analytical results below the RL will be expressed as "less than" the reporting limit. RLs are estimated values based upon the MDLs, experience and judgment of the analyst, method efficiency, and analyte sensitivity. No reporting limit will be lower than its corresponding MDL. RLs will be verified on a regular basis either by having a calibration standard at the limit or by analyzing a standard at the RL immediately following initial calibration.

Analytical Standards

Generation of high quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard preparation are of the highest purity obtainable. Standard preparations are fully documented in appropriate logbooks.

Responsibilities

It is the responsibility of each laboratory employee involved with standards preparation to ensure that all standards are correctly and accurately prepared through the use of good laboratory practices and analytical verification. It is also the responsibility of these staff members to properly document the receipt and/or preparation of all standards. Management is responsible for ensuring that all staff members follow specified standards preparation and inventory procedures. The QAPM is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards Preparation

Two types of standards are utilized for extractable organic compounds: neat standards from which stock solutions are prepared, and commercially prepared stock solutions from which working solutions are prepared. The type of standard depends upon availability. Commercially prepared standards are preferred when available.

Preparation of stock solutions will be documented in the Stock Solutions Log. To ensure traceability, commercially prepared stock solutions will also be documented in the Stock Standard Solutions Log. Each solution will be assigned a unique stock number determined by the page number and entry number on the page, preceded by “S” to indicate the solution is a stock, volatile stock standard are labeled “VS”. For example, the third entry on page 44 will be assigned the stock number S44-3. For stock solutions prepared from neat standards, the compound(s), supplier, lot number, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst should review the preparation information to verify accuracy. For commercially prepared stock solutions, the compound, supplier, lot number and expiration date will be recorded. As a stock

solution is not actually prepared in-house for these commercial solutions, it is not necessary to record or verify a preparation schematic.

Preparation of working solutions (including spike and surrogate solutions) will be documented in the Working Standard Solutions Logbook. Each solution will be assigned a working standard number determined by the page number and entry number on the page. For example, the second entry on page 73 will be assigned the working standard number 73-2. For volatile organic standards, the working standard number is preceded by "VW". The compound, stock solution reference, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst will review the preparation information to verify accuracy. After analyzing the standard and confirming that it is acceptable, analytical verification will be documented in the logbook.

Discarded or consumed standards will be annotated in the logbook by drawing a single line through the entry, indicating "discarded" or "consumed" above the line with confirming initial and date. Existing standard numbers will not be reused. Instead, each new stock or working solution made will be assigned a new number.

Standards preparation will be performed in accordance with good laboratory practices. Syringes, glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Neat standards that are less than 97% pure must be corrected for concentration. Standard solutions will be stored in amber bottles with Teflon-lined caps. Each standard solution will be labeled with the solution number, compound, analyst initials and expiration date. Stock solutions will be stored in the appropriate standards freezer; working solutions will be stored in the appropriate standards refrigerator.

Metals Standard Preparation

Commercially prepared single element stock solutions are used for all elements. Preparation of working solutions from these single element stocks will be documented in the Solutions Logbook. Preparation of check standards will also be documented in the Solutions Logbook. The element, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. Working calibration standards are prepared weekly for furnace and ICP analyses

and as needed for ICP-MS. Calibration verification standards are prepared daily for GFA analyses and as needed for ICP and ICP-MS analyses.

Standards preparation will be performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters will be prepared on a daily basis, prior to starting an analysis. Stock and check standard solutions will be replaced as solutions expire or are consumed. Stock and check standard solutions will be labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation will be performed in accordance with good laboratory practices. Glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in containers appropriate for the parameter.

9.3 Calibration

Instrumentation and equipment used for sample processing and analysis must be operating optimally to ensure that accurate analytical results are generated. Verification of optimum operation is accomplished through various tuning and calibration procedures. Criteria for determining the accuracy of calibration are specified for all instrumentation and equipment. Prior to sample analysis, calibrations will be analyzed and evaluated against specified acceptance criteria. Acceptance criteria are either published as part of the method or generated at ARI using control charts. Calibration verifications will also be analyzed throughout an analytical sequence to ensure that instrument performance continues to meet acceptance criteria.

Gas Chromatography/Mass Spectrometry (GC/MS)

All GC/MS systems will be evaluated through analysis of an instrument performance check solution and calibration standards. The composition of the standards varies depending on the analysis performed on the system. System evaluation will be performed prior to sample

analysis. Evaluation criteria used for GC/MS analyses are as specified for the SW846 methods.

Instrument Performance Check Solution - Prior to analysis, the system will be evaluated to ensure that mass spectral ion abundance criteria are met. Bromofluorobenzene (BFB) is analyzed for volatile organic analyses and Decafluorotriphenylphosphine (DFTPP) is analyzed for semi-volatile organic analyses. All ions must meet method-specified criteria.

The instrument performance check solution will be analyzed at a minimum of every 12 hours during the analytical sequence. Each analysis of the check solution will be verified against the specified criteria.

Calibration - After instrument performance has been verified, each GC/MS system will be calibrated to verify response linearity. For volatile organic analyses, up to eight standards ranging from 1 to 200 µg/L will be analyzed. For semi-volatile organic analyses, five to seven standards ranging from 2 to 80 µg/L will be analyzed. The standard levels evaluated will vary depending on the compound. Initial calibration results will meet percent relative standard deviation acceptance criteria.

A continuing calibration verification standard at a mid-level concentration (routinely 50 µg/L for VOA and 250 µg/L for SVOA) will be analyzed at a minimum of every 12 hours during the analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria will be considered in evaluating the acceptability of the calibration. Initial and continuing calibration acceptance criteria for volatile and semi-volatile organic analyses are presented in Appendix J. All calibration data printouts will include the following documentation:

Date of calibration,
Identification of standard used
Identification of person performing the calibration

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will also note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated. These results will be kept on file with the raw data in the Data Services section.

Internal Standard Responses - Internal standard responses and retention times in all standards will be evaluated immediately after analysis. This will serve as a baseline from which all sample internal standard responses and retention times will be evaluated.

Gas Chromatography (GC)

Each GC and HPLC system will be calibrated to verify response linearity. Depending on the parameter, five to seven standards at concentrations covering the linear range of the

instrument will be analyzed. Percent relative standard deviations for initial calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

A continuing calibration standard at mid-range concentration will be analyzed after every 10 samples or more frequently if the method or conditions warrant. Percent differences between initial and continuing calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

Calibration for organochlorine pesticides will follow SW-846 guidelines. The initial calibration sequence specifies the analysis of Resolution Check, Performance Evaluation, five-point initial calibration, individual standards and instrument blanks. Criteria for evaluating these standards are as follows:

> Performance Evaluation - The Performance Evaluation standard will be analyzed immediately following the Resolution Check standard. All standard peaks will be completely resolved. Individual breakdowns of DDT and Endrin will be less than or equal to 15% on both columns. A Performance Evaluation standard will also be analyzed at the end of the calibration sequence.
>
> Initial Calibration - The percent relative standard deviation (RSD) will not exceed SW-846 guidelines or 20% on each column.
>
> Continuing Calibration - A midpoint Aroclor 1660 and or a midpoint pesticide standard along with a performance evaluation standard are analyzed after every ten (10) sample analyses. The continuing calibration standards will be within 85 - 115% of the initial calibration. The Performance Evaluation standard will meet previously specified criteria.

The analytical sequence may continue indefinitely, provided that calibration criteria are met throughout the sequence. Additionally, retention times for all compounds will fall within the retention time windows established by the initial calibration sequence of the three standard concentration levels.

All calibration data printouts will include the following documentation:

> *Date of calibration,*
> *Identification of standard used, and*
> *Identification of person performing the calibration.*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated.

Metals

Analytical instrumentation for metals will be evaluated through the analysis of calibration standards, calibration blanks, and calibration verification standards. Initial calibrations will be performed prior to sample analysis.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±2 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Atomic Absorption Spectroscopy (Graphite Furnace and Cold Vapor)

Atomic absorption instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is

performed daily or more frequently if conditions warrant. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard value will be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±10% for Graphite Furnace analysis or ±20% for Cold Vapor analysis.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected. Any sample determined to have a concentration above the high calibration standard will be diluted and reanalyzed.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Inorganic Analyses other than Metals (Conventional Analyses)

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) will be evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g. the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement being employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependant upon the pattern of response being measured.

Calibration is repeated for each analytical batch. Immediately following calibration, the standardized titrant or the calibration curve will be verified by the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB). The verification standard will be derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of any samples.

Calibration verification will be repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will verify the outlying condition and, if verified, the analysis will stop and the method will be re-calibrated. All samples run between the outlying

CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

Initial calibration depending upon the analysis is based on a direct stoichiometric relationship, a linear regression analysis or a combination of the two. Stoichiometry generally involves standardization of a titrant and use of that titrant for determining the concentration of an unknown analyte (e.g. the use of thiosulfate in iodometric determination of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between the analyte concentration and the response produced by the measurement being employed. The curve is fit by the method of least squares using a linear, polynomial or logarithmic regression depending on the response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Initial calibration curve is verified throughout the analytical sequence by analyzing a calibration verification standard after every 10 sample analyses. The calibration verification standard value will be within ± 10% of the initial calibration.

After initial calibration, a calibration blank will be analyzed to determine target analyte concentration levels. The level of analyte detected in the calibration blank will be less than the lowest standard concentration in the initial calibration.

SECTION 10: DATA VALIDATION and REVIEW

One hundred percent (100%) of laboratory data generated at ARI are subjected to a four level validation (review) process prior to release from the laboratory. The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review

The data review process is outlined below and detailed in SOPs 200S through 206S.

In addition, Quality Assurance Personnel review 10% or more of all completed data packages for technical accuracy, project compliance and completeness. The data validation outlined below is completed in addition to the initial project review explained in Section 7 and QA specific reviews outlined in Section 11. If it is determined at any point during the analysis, reporting, or review process that data are unacceptable, prompt and appropriate corrective action must be taken. The corrective action will be determined by the situation. It is the responsibility of all staff members involved in data reporting and review to be aware of the quality control requirements and to be able to identify occurrences that require corrective action.

Analyst review:

Each analyst is responsible for producing quality data that meets ARI′s established requirements for precision and accuracy and is consistent with a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. The condition of the sample or extract is described accurately on the laboratory bench sheet.

3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.
4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Laboratory Control Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, SRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are met, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify possible false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable quality control.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Review and verify that data entry and calculations are accurate and no transcription errors have occurred.
5. Document anomalous results or other analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.

7. Enter reviewed data into LIMS as appropriate, incorporate all necessary sample and quality control information into the data package and forward it for further review.

Peer review:

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, LCS, spiked sample analyses, etc.) criteria are in control.
2. Examination the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.

When a second trained analyst is not available a peer review is not completed.

Supervisory Review:

Following analyst and peer review the data is forwarded to the laboratory section supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data. The reviewers are identified on the organizational chart in Appendix A.

Administrative Review:

The results of all analyses are reviewed for compliance with quality control criteria and technical correctness before data is released to the Project Manager for distribution to clients. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel responsible for administrative reviews are noted in the Organizational Chart in Appendix A to this LQAP.

Administrative review is the final data validation process. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Following administrative review the data is released to Project Managers for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.
2. Verify that appropriate and necessary data qualifying flags (Listed in Appendix N) have been used.
3. Verify that method blank and LCS data are acceptable, quality control requirements were met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e. are total metal ≥ dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports have been generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

10.2 Quality Assurance Review

10% (1 out each 10) final data packages are reviewed by ARI′s QA staff for compliance with ARI′s QA Program. This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, LCS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications.

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAPM for corrective action.

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SECTION 11: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to validate the quality of data produced in ARI's laboratory. ARI routinely utilizes the following quality control analyses as defined in Section 11.3:

1. method blank (MB)
2. holding blank (HB)
3. surrogate standard analyses (SS)
4. laboratory control sample (LCS)
5. laboratory control sample duplicate (LCSD)
6. standardized reference material (SRM)
7. sample(matrix) replicate (MD)

8 matrix spike (MS)

9. matrix spike duplicate (MSD)

The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for a specific project. A range of acceptable result is defined for each type of QC analysis. When all quality control sample results are acceptable, the analysis is considered to be "in-control" and the data suitable for its intended use. Conversely, quality control sample results that do not meet the specified acceptance criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process back "in-control".

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

11.1 Sample Preparation Batch

All QC samples will be associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements are detailed in ARI's method specific standard operating procedures. Each preparation batch will be uniquely identified. All samples, field and QC, will be assigned an ARI LIMS ID number and will be linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARI will accommodate client, QC protocol or QAPP specific sample batching schemes.

11.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a laboratory control sample (LCS). Additional QC samples will be analyzed based upon the specific QC protocol required, data deliverable requirements or client request. ARI recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or an LCS duplicate (LCSD) for comparison with the LCS.

11.3 QC Sample Definitions

11.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and is processed as part of a sample batch. The method blank is used to verify that contaminants or compounds of interest are not introduced into samples during laboratory processing. Method blanks will be spiked with surrogate standards for all organic analyses.

ARI defines an acceptable method blank as one that contains no target analytes at a concentration greater than one-half ARI's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample which ever is greatest.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable method blank is

required prior to analysis of field samples from a preparation batch. For methods not requiring pre-analysis sample preparation, a minimum of one method blank will be analyzed immediately prior to sample analysis, periodically throughout the analytical sequence, and also at the end of the sequence.

The results of the method blank analysis will be reported with the sample results.

11.3.2 Holding Blank (HB)

Holding blanks are organic-free water samples that are placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A holding blank from each refrigerator will be analyzed every 14 days. Holding Blank analyses will be reviewed by laboratory management and archived in ARI's electronic document archive.

11.3.3 Laboratory Control Sample (LCS)

An LCS is processed as part of each preparation batch, and is used to determine method efficiency. An LCS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. The analytes spiked into LCS samples are listed in ARI's method specific SOPs. LCS will be spiked with surrogate standards for all organic analyses.

Following analysis the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are listed in Appendix K of this document. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered to be in control. Any recovery value not within specified limits requires corrective action prior to analysis of any field samples from the associated preparation batch.

A minimum of one LCS will be prepared for each sample preparation batch. LCS analysis for those methods not requiring pre-analysis sample preparation will be performed after each continuing calibration. The results of all LCS performed will be reported with the sample results. A maximum of twenty samples may be associated with one LCS.

Specific clients or QA protocol may require the analysis of a duplicate LCS. When LCS duplicates are analyzed the failure of any analyte in either LCS to meet QC limits must trigger a corrective action.

11.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time. Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set should be processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARI's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory will be analyzed as discrete samples.

11.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes have been added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARI's method specific SOPs. MS samples will be spiked with surrogate standards for all organic analyses.

Following MS analysis the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified

limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference for recovery of spiked compounds is calculated and compared to established criteria.

Unless directed otherwise, ARI's policy is to prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

11.3.6 Standardized Reference Material (SRM)

An SRM is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. SRMs are normally purchased from outside suppliers outside of ARI and are supplied with acceptance criteria. Analysis of SRM is used to assess the overall accuracy of ARI's analytical process. SRM are routinely analyzed with each batch of samples for wet chemistry (conventionals analysis) samples. External reference samples are analyzed after instrument calibration and prior to sample analysis. Compound recovery values not within the specified limit signal the need to evaluate either the calibration standards or instrumentation.

11.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARI's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to monitor extraction efficiency. Surrogate standards will also be added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

11.4 Control Limits

To provide a means for evaluating whether or not a process is in control, acceptance limits have been established. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) will be evaluated against program/contract-specified criteria. Routine samples will be evaluated against internally generated control limits. Project specific control limits will be used as required provided they have been reviewed for feasibility and approved by laboratory management.

Results of QA analyses are transferred from the LIMS to a control limit and chart generation program. The QAPM coordinates control chart and control limit generation. Control limits will be generated for LCS compound recoveries, surrogate recoveries, and matrix spike compound recoveries, on a method and matrix specific basis. Advisory control limits will be utilized for analyses performed on an infrequent basis until a sufficient number of usable data points are collected. Control limits are updated at least annually, but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are detailed in Appendix K.

Two levels of control limits are utilized in evaluating process control: warning limits and action limits. Limits are statistically determined from values obtained from LCSs or other control samples. Warning limits, within which 95% of all results are expected, equal ± two standard deviations from the average result. Action limits, within which 99.7% of all results are expected, are equal to ± three standard deviations from the average result. Mean values, warning limits, and action limits are necessary for thorough evaluation of process control.

11.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for

a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

The QA Officer will coordinate generation of control charts based on laboratory data at least semi-annually. These control charts will be distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. Copies of control charts will remain on file in the QA section. At the bench/instrument level, individual results from quality control samples are evaluated against the limits.

SECTION 12: CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. On occasion, however, procedures, reagents, standards, and instrumentation can fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing will be halted and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control will be made through the analysis of various control samples. Actions taken and observations made during reestablishment of control will be fully documented on the bench sheet or as an Analyst Note. Only when control has been regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period will be reported.

12.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to be able to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are “in control”. It is at the analytical level that unacceptable conditions are most easily detected and addressed. These personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods will be reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. The analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies will be documented on the Analyst Notes form and will include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data were generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts should be contacted to determine whether additional actions (such as reanalysis) will be taken. In addition, reviewers will confirm that anomalies

noted by the analyst were indeed addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying additional actions to be taken. Project Managers are further responsible for ensuring that clients fully understand which data are questionable and the reasons why acceptable results could not be generated.

It is the responsibility of the QAPM to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon “out of control” situations.

12.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment will be monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Addition of surrogate standards or matrix spiking solutions will be carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all

standards added to samples will be recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet will be annotated to indicate which samples may be inaccurately fortified.

If sample matrix hinders processing per standard procedures, the section supervisor or manager will be consulted for guidance on appropriate actions. Preparation of smaller sample aliquots or employment of different procedures may be necessary. Any deviations from normal protocols will be documented on the bench sheet.

If at any time during sample preparation sample integrity is compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Calibration and Tuning

Prior to sample analysis, all instrumentation will be calibrated and tuned to ensure that equipment meets all criteria necessary for production of quality data. Equipment must meet the calibration criteria specified in the section entitled “Calibrations”, per manufacturer specifications or per project/contract requirements. If these criteria are not met, corrective actions must be employed. Any corrective actions taken will be fully documented in the appropriate logbook, indicating the problem, the actions taken, and verification. Samples will not be analyzed until initial verification of system performance has been made. In the event that continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions have been employed or the system has been re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. It criteria are not met for initial calibration, the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed at a minimum of once every 12 hours. All response factor criteria will be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria

are not met, the system will be inspected for malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using either USEPA CLP or SW-846 guidelines. The Resolution Check standard will meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation standard will meet breakdown criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples will not be analyzed until all initial calibration criteria are met.

Continuing calibrations of either the mid-level calibration standard or Performance Evaluation standard will be analyzed every 12 hours. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration will be reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all other analyses, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed after every 10 samples. All percent differences between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The percent differences between the initial calibration and calibration check standard will meet specified percent difference criteria. If criteria are not met, the system will be inspected for

malfunction. The initial calibration and calibration check will be reanalyzed until acceptance criteria are met.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be evaluated for the presence of target analytes. If analytes are detected, the concentrations must be below the reporting limits for those analytes. If analytes are detected at levels above the reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks will also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank will be analyzed. If analyte levels are still above the method detection limits, the system will be inspected for malfunctions and the source of contamination will be identified. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated to determine the need for reanalysis per the following guidelines:

If no target analytes are detected in the samples, reanalysis will not be required.

If sample target analyte levels are above the method detection limits, samples will be reanalyzed at analyst discretion. Reanalysis will be dependent upon the analyte levels and whether or not there is likelihood that analytes detected are a direct result of system contamination.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis will not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out of control blank be re-analyzed.

Method Blanks

Prior to sample analysis, method blanks will be evaluated for the presence of target analytes. Ideally, no target analytes should be present in the method blank. If analytes are detected at or above the Reporting Limit, the method blank will be reanalyzed to verify that the contamination is not a result of instrument carryover or malfunction. If the presence of target analytes is confirmed, the concentrations must be below the RL for those analytes.

Several volatile and semi-volatile compounds and certain elements are considered to be common laboratory contaminants. Concentrations of these common laboratory contaminants may exceed the method detection limits, but may not be present at concentrations greater than five times the method reporting limits. Target analytes considered to be common laboratory contaminants are:

Volatile Organic Compounds

Methylene Chloride
Acetone
2-Butanone

Semi-volatile Compounds

Dimethylphthalate
Diethylphthalate
Di-n-butylphthalate
Butylbenzylphthalate
bis-(2-Ethylhexyl) phthalate
Di-n-octylphthalate

If target analyte concentrations in the method blank exceed the acceptable levels and instrument malfunction or contamination has been ruled out, the method blank and all associated samples will be re-prepared and reanalyzed. If there is insufficient sample volume remaining for reprocessing, the Project Manager will be notified. If it is necessary to report results associated with an unacceptable method blank, the results will be qualified to indicate possible laboratory contamination.

In the event that an analyte detected in the samples ≥ 20 times the method blank levels re-preparation and reanalysis is not required. It is assumed that any contamination in the method blank is insignificant and will not affect final quantified results.

Laboratory Control Samples

Prior to sample analysis, the laboratory control sample (LCS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If LCS recoveries are out of control, corrective action is required. Corrective actions may include anything from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

For volatile and semi-volatile organic analyses, internal standard results will be evaluated after each analytical run to verify that the values are within acceptance limits. Internal standard values will be within -50% to +100% of the internal standard values in the continuing calibration. If any internal standard does not meet the criteria, the system will be evaluated to confirm that all instrumentation is operating properly. The sample will then be reanalyzed. If the reanalysis results do not meet acceptance criteria, it will be assumed that the sample matrix is affecting internal standard values. Further reanalysis will not be required.

Surrogate

Surrogate recovery values will be evaluated after each analytical run to verify that the values are within acceptance limits. If recovery values are outside acceptance limits, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of surrogate spike solutions added are accurate. For extractable organic analysis, bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system documentation, solution preparation or spiking errors are identified, the following considerations will be made:

When a volatile organic surrogate recovery value is outside of acceptable limits, the sample will be reanalyzed. If the reanalysis results are within acceptance limits, it will be assumed that the initial analysis was in error. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery. Further reanalysis will not be required.

For semi-volatile organic analysis, one acid and one base/neutral surrogate recovery may be outside acceptance limits with no corrective action required provided the recoveries are at least 10%. If more than one acid or base surrogate standard is outside acceptance limits, or if any surrogate recovery value is less than 10%, the sample will be re-extracted and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery assuming all other QC analyses are acceptable. Further reanalysis will not be required. *Matrix spikes will not be re-extracted for unacceptable surrogate recovery values.*

For other extractable organic analysis, if a surrogate recovery value is outside of acceptance limits, the data will be reviewed to determine if the unacceptable surrogate is a result of matrix effect. If matrix interference is determined, the sample will be re-extracted or if re-extraction is not deemed useful, fully documented in the analytical narrative associated with the analyses. If a surrogate recovery is too low, based on the opinion of the final QA Data Reviewer, the sample will be re-extracted and reanalyzed.

Matrix Spikes

Matrix spikes will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable results are obtained, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

Organic Analyses:

If a matrix spike recovery value is outside the acceptance limits, but the LCS meets recovery acceptance criteria, re-extraction will not be required. It will be assumed that the unacceptable recovery value is a result of matrix effect.

If both LCS and matrix spike recovery values are outside the acceptance limits, the sample batch will be re-extracted and reanalyzed. This indicates the possibility of a systematic error that may affect the accuracy of final results.

Inorganic analyses:

Matrix spikes with unacceptable recovery values will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the sample matrix is affecting the recovery values. Further reanalysis will not be required.

A post-digestion spike analysis will be performed for all metals analyses processed following EPA-CLP guidelines.

Sample and Matrix Spike Replicates

Sample and matrix spike replicates will be evaluated to verify that percent differences between the replicates are within acceptable limits. Percent differences for metals and inorganic sample replicates will be within ±20%. When percent difference criteria are not met, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

If percent difference values between sample replicates for metals and inorganic analyses do not meet acceptance criteria the Project Manager in consultation with ARI's client will determine whether to re-analyze the samples or flag the analytical results. If the samples are reanalyzed and results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Replicate sample analyses are not routinely performed for organic parameters.

If percent difference values between matrix spike replicates do not meet acceptance criteria, but spike recovery values are acceptable, no re-extraction or analysis will be required. It will be assumed that the sample is not homogeneous, causing the poor analytical precision.

If percent difference values between matrix spike replicates do not meet acceptance criteria and recovery values in one or both replicates are not acceptable, the sample and associated matrix spike replicates will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the

sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Samples

In addition to monitoring sample quality control indicators, ARI evaluates samples to determine the need for reanalysis. Conditions considered while evaluating samples are:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample is diluted and reanalyzed. Dilution and reanalysis continues until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample will be re-prepared using a smaller sample aliquot.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples will be diluted and reanalyzed as required to minimize background interference. If it is not possible to remove all interference, reported results will be qualified as necessary.

If low-level analytes detected in a sample are suspected to be a result of instrument carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected and necessary maintenance/corrective actions will be taken prior to resuming analysis.

Sample Storage Temperatures

Every sample storage unit's temperature will be evaluated at the beginning of each day. Temperatures will be between 2 and 6 °C for refrigerators and < -10 °C for freezers. If a temperature is outside the specified range, the unit's temperature will be adjusted to bring the temperature back within limits. The Temperature Log will be annotated to document the adjustment.

If adjustment does not bring the temperature within range, or if adjustment is not possible, the Laboratory Supervisor will be notified and will take corrective action. The Temperature Log will be annotated to document the action. If the temperature fluctuation is chronic or extreme, the

samples will be removed from the unit and placed in another storage unit until the malfunctioning unit is repaired or replaced.

Balance Calibrations

Balances are serviced once a year by a certified technician. The service includes preventative maintenance and calibration.

Balance accuracy will be verified prior to balance use. The recorded weight will be within the acceptance criteria specified on the Calibration Log. If the recorded weight is not within the acceptance limits, the QAPM will be notified. The Calibration Log will be annotated to document the action. The balance will not be used until it can be verified that acceptance criteria can be met.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters will be changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory will be monitored daily. When the resistivity falls below 18 megaohm, system maintenance will be performed.

Section 13: LABORATORY EVALUATION AND AUDITS

Routine evaluations of the laboratory ensure that all necessary quality control activities have been implemented and are being effectively utilized. It is the responsibility of the QAPM to ensure that quality control activities are periodically evaluated for compliance. Findings from these evaluations allow the laboratory to address and modify any procedures that are not in accordance with the laboratory Quality Assurance Program or accreditation program requirements.

A number of tools are available for monitoring laboratory performance. ARI evaluates the quality of laboratory performance through the use of

Internal QA Audits
Technical System Audits
Data Quality Reviews
Audits by Outside Agencies (External Audits)
Performance Evaluation Analyses
Annual Management Review

Each audit provides an objective evaluation of laboratory performance. All internal audits and reviews are conducted according to specified guidelines. In addition, a collective review of audit findings provides an overall evaluation of the laboratory. Deficiencies noted during the course of an audit or performance evaluation will be addressed, a root cause analysis performed, and appropriate corrective actions will be taken. Follow-up audits will be conducted to verify that corrective actions have been satisfactorily implemented.

Internal QA Audits

The Quality Assurance Officer regularly evaluates quality control activities within the laboratory to verify accuracy and compliance. The QAPM or designee routinely audits the following activities:

Balance verification records
Sample storage cooler temperature records
Oven, incubator and water bath temperature records
Chain of Custody records

Standard preparation records

Documentation and Response to Client Complaints

Chain of Custody Procedures

Documentation of Computer and Software Revisions

Checklists are utilized to ensure consistent and complete audits. The checklists are included in SOP 1005S. Internal QA audit results will be summarized and reported to both staff and management. Corrective actions will be initiated as necessary. A schedule of internal QA audits is provided in Appendix L.

When an audit finding indicates possible errors or deficiencies in analytical data, ARI will correct the error and notify all affected clients within 2 working days.

Technical System Audits

An audit of technical systems within the laboratory will be conducted at least annually. The audit will focus on the quality control and data generation/collection systems. The QAPM will conduct the audit with assistance from section managers and data reviewers. This evaluation will address areas such as:

Calibration records

Maintenance records

Control charts

Computer vs. hard copy data

Adherence to SOPs and methods

Support system records (DI water, balances, pipettes, etc.)

In addition, audit results from the past year will be reviewed to verify that all necessary corrective actions have been addressed and implemented.

Data Quality Reviews

Reviews of final data packages by the QAPM or his/her designee. The Data quality review verifies that the final data deliverables meet project and quality systems specifications

Audits by Outside Agencies (External Audits)

As a requirement for many accreditation programs, on-site review of laboratory facilities and operations are conducted by clients or other outside agencies. The laboratory may be periodically audited by the following agencies:

State of Washington Department of Ecology
A United States Department of Defense Agency (US Army, US Navy or US Air Force)
State of Oregon Environmental Laboratory Accreditation Program (ORELAP) as an Accrediting Body for The NELAP Institute.

External audits are beneficial in that they provide an independent evaluation of the laboratory without internal influence or bias. The laboratory will be available for evaluation at the convenience of the auditing agency. Laboratory personnel will be available during the audit to address questions or provide information regarding laboratory procedures. All comments, deficiencies, and areas of potential improvement noted by the auditor will be reviewed, and appropriate corrective actions will be taken to resolve the noted issues. A listing of laboratory accreditations is included as Appendix M.

Performance Evaluations

Performance Evaluation (PE) sample analysis is a means of evaluating individual performance as well as the overall analytical system. In addition to the external audit, PE sample (PES) analysis is a requirement of many certification and accreditation programs. The laboratory routinely participates in the following performance evaluation programs:

Analytical Standards, Inc.(ASI) Performance Evaluation Studies
USEPA Water Pollution (WP) Performance Evaluation Studies (Commercial Supplier)
USEPA Water Supply (WS) Performance Evaluation Studies (Commercial Supplier)
USEPA Contract Laboratory Program Quarterly Performance Evaluations (as required)
AASHTO (for geotechnical samples)

A PES is a sample containing specific analytes in concentrations unknown to analysts. Comparison of the laboratory result to the "true" value determines the accuracy of the

reported result and indicates the laboratory's ability to perform a given analysis. These results are also used to verify individual analyst proficiency. The QAPM will periodically submit internal “blind” performance evaluation samples to the laboratory sections for analysis. Values obtained by the laboratory will be compared to expected or true values. Parameters with reported values outside of the specified acceptable ranges will be evaluated by the analytical staff to determine the source of error. All necessary corrective actions will then be documented and implemented.

Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance, a “Quality Assurance Report to Management” the QAPM will be produced annually and distributed to ARI management. The report will, at a minimum include:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The QAPM is responsible for follow-up and resolution of any deficiencies discussed in the report. Unresolved issues will remain on subsequent reports until addressed. Information such as performance evaluation results and audit reports will be distributed to the laboratory staff.

The application of these combined activities provides comprehensive monitoring and assessment of laboratory performance, and ensures that all data produced by ARI will be of the highest possible quality.

Annual Management Review

In the last quarter of each year, executive management will perform a comprehensive review of ARI quality system and analytical procedures to assess their continued suitability and effectiveness. Management will consider the following during the review process:

- Suitability of policies and procedures
- Reports fro management and supervisory personnel
- Results of internal audits
- Corrective and preventative actions
- Results of recent external quality systems audits
- PT results
- Changes in volume and type of analyzes performed
- Client Feedback
- Complaints
- Other relevant factors such as quality control activities, available resources and analyst training

Section 14: APPENDICES

A. Laboratory Organization and Key Personnel Resumes
B. Training and Demonstration of Proficiency
C. Laboratory Facilities
D. Laboratory Instrumentation and Computers
E. Standard Operating Procedures
F. Sample Collection Containers, Preservation and Holding Times
G. Laboratory Workflow
H. Analytical Methods
I. Method Detection Limits and Reporting Limits
J. Quality Control Recovery Limits
K. Internal Audit Schedule
L. Laboratory Accreditations
M. Data Reporting Qualifiers
N. Standards for Personal Conduct
O. QA Policies

Appendix A

Laboratory Organization Chart
and
Key Personnel Resumes

KEY PERSONNEL RESUMES

Mark Weidner

Laboratory Director

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of ARI in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of ARI and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978).

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975).

Experience:

Laboratory Director/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

Brian Bebee

Laboratory Manager

Administrative Services Manager

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of ARI, Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day to day flow of all laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, Inc., Seattle, WA (1987 to present).

Organics Division Manager/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to 1987).

GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).

Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).

Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

David Mitchell

Quality Assurance Program Manager

Profile:

Mr. Mitchell co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and Brian Bebee. Prior to his co-founding of ARI, Mr. Mitchell had gained extensive experience in the environmental chemistry field as Senior Chemist and Trace Organics Laboratory Supervisor at the Municipality of Metropolitan Seattle (METRO). His responsibilities include the management of ARI's Quality Assurance/Quality Control Program.

Education:

Graduate Work in Chemistry (Organic/Biological), University of Wyoming, Laramie, WY (1970 to 1974).

B.S., Chemistry, Upper Iowa College, Fayette, IA (1970).

Experience:

Quality Assurance Manager, Analytical Resources Inc., Seattle, WA (1998 to Present)

Client Services Manager, Analytical Resources Inc., Seattle WA (1987 to 1998)

Vice President/Co-founder of Analytical Resources, Inc., Seattle, WA (1985 to 1987).

Senior Chemist, METRO Trace Organics Laboratory, Seattle, WA (1979 to 1985).

Research Associate, Northwestern University Medical School (1974 to 1979).

Susan Dunnihoo

Director, Client Services

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc., along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of ARI, Ms. Dunnihoo had gained extensive experience in the environmental chemistry field through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Director of Client Services, Ms. Dunnihoo is responsible for assisting project managers in responding to the needs of ARI clients, and for communicating to the laboratory the analytical capabilities that should be added to satisfy future client needs. Ms. Dunnihoo also acts as project manager for a number of projects.

Education

Graduate work in Chemical Oceanography, University of Washington (1976-1980)

ACS Certified BA, Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Director, Client Services, Analytical Resources, Inc., Seattle, WA (2007-present)

Client Services Manager, Analytical Resources, Inc., Seattle, WA (1998-2007)

Computer Services Manager, Analytical Resources, Inc., Seattle, WA (1985 to 2000)

Corporate Secretary, Analytical Resources, Inc., Seattle, WA (1985 to present)

Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)

Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)

GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

Jay Kuhn

Inorganic Division Manager

Profile:

Mr. Kuhn oversees ARI's Inorganic Division, which includes the Metals Sample Preparation, Metals Analysis, and Conventional Wet Chemistry sections. He has extensive experience in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. Kuhn is experienced with in-house and EPA standard methods and protocols, as well as the operation, maintenance, and repair of ICP-MS, ICAP, CVAA, and Graphite Furnace instruments.

Education

Graduate work in Environmental Chemistry, University of Washington, Seattle, WA.

B.S. Chemistry, University of California at Santa Barbara (1980)

Experience

Inorganic Division Manager, Analytical Resources, Inc., Seattle, WA (1992 to present)

Metals Division Manager, Analytical Resources, Inc., Seattle, WA (1990 to 1992)

Research Technologist III and Laboratory Manager, UW College of Forest Resources Chemical Analysis Cost Center (1985-1990)

Research Technologist, UW College of Forest Resources Chemical Analysis Cost Center (1981 to 1985)

Appendix B

Training

Qualification Requirements

In addition to on-the-job training, ARI recommends a specific level of education and experience for the following positions:

GC/MS Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC/MS systems and one year supervisory experience.

GC Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC systems and one year supervisory experience.

Sample Preparation Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience in organic sample preparation and one year supervisory experience.

Data Systems/LIMS Manager

A Bachelor's degree with four or more computer-related courses and three years experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Programmer Analyst

A Bachelor's degree with four or more computer-related courses and two years experience in systems or application programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Quality Assurance Officer

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

Project Manager

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

GC/MS Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

Mass Spectral Interpretation Specialist

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

Purge and Trap Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

GC Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

Pesticide Analysis Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

ICP Spectroscopist

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

ICP Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

Atomic Absorption (AA) Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

Conventionals (Classical Chemistry) Analyst

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

Sample Preparation Expert

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

Appendix C

Laboratory Facilities

ANALYTICAL RESOURCES INC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to assure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for three walk-in coolers (356 sq. ft. total), two walk-in freezers (760 cubic ft.), metals archive storage, and sample cooler storage. A 400 sq. ft. walk-in freezer covered by a mezzanine for storage was added in 2005.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and Argon/Hydrogen to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The Organics Extraction Laboratory (2400 sq. ft.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The Semivolatile Organics Analysis Laboratory (3000 sq. ft) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Resolution GC/MS (HRGC-MS) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The Volatile Organics Analysis (VOA) Laboratory (2500 sq. ft) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:
   - Trace Metals Laboratory (3000 square feet)
     - The Metals Preparation Laboratory (1200 sq. ft) contains five fume hoods including two 8-foot polypropylene. An additional eight foot polypropylene laminar flow fume hood is housed in a separate class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and a spectrophotometer for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
     - The Metals Instrument Laboratory (1300 sq. ft) features two atomic absorption spectrometers for graphite furnace analyses, two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and an ICP-mass spectrometer for analysis of metals species at low detection levels.
     - A 500 sq. ft. Office provides desk area for Trace Metals laboratory personnel.
   - The Conventional Analyses (Wet Chemistry) Laboratory (2500 sq. ft.) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology room. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, an ion chromatograph, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Geotechnical Laboratory includes 2500 square feet of space with special areas and equipment for soil testing, treatability studies, and soil/sediment leaching studies. The Laboratory includes approximately 50 feet of linear bench space and 5 fume hoods.

4) The Sample Receiving Facility consists of an area to accept and log-in samples to ARI's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.
   - The Sample Receiving Facility (1000 sq. ft.) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARI's LIMS.
   - The Sampling Containers Facility (500 sq. ft.) is used to prepare sampling containers for shipment to ARI's client designated locations.

4) Administrative Areas (8600 sq. ft.) include:
   - The Quality Assurance Section
   - Executive Offices
   - Project Management Section
   - The Human Resources Section
   - The Computer Services Section
   - One Conference Room
   - A Lunch Room
   - Several Storage Areas

Appendix D

Laboratory Instrumentation and Computers

LABORATORY INSTRUMENTATION and COMPUTERS

Organic Extractions Laboratory Equipment

(MARS 1) CEM MARS™ (2008) – Microwave extraction apparatus.

(MARS 2) CEM MARS™ (2010) – Microwave extraction apparatus.

(MARS 3) CEM MARS™ (2011) – Microwave extraction apparatus.

(GPC 1) Gel Permeation Chromatograph (1985) – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

(GPC 2) Gel Permeation Chromatograph (2003) – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

Zymark Turbo-Vap LV (1999) - 24 place

Zymark Turbo-Vap LV (2002) - 24 place

Zymark Turbo-Vap LV (2007) - 24 place

Zymark Rapid Trace Solid Phase Extraction Workstations (2007) - 5 each

Horizon Technology – DryVap Concentrator System Model 5000 – 2 each

Dioxin Extractions Laboratory Equipment

(MARS 1) CEM MARS™ Express (2010) – Microwave extraction apparatus.

Zymark Turbo-Vap LV (2010) - 24 place

Rotovap R-205 with V-805 Vacuum Controller (2010) – 2 each

Glas-Col Combo Heating Mantle (2010) – 6 place – 3 each

Vacuum Manifold – 6Place (2010) – for SPE

Gas Chromatograph - High Resolution Mass Spectrometer (GC/HRMS)

(HR1) Waters Autospec Premier (2009) – A GC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 7890A GC and 7683B autosampler.

Gas Chromatograph - Mass Spectrometers (GC/MS)

(NT2) Hewlett Packard (1999) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes Agilent 6890 GC, 5973 MSD, and 7683 autosampler.

(NT3) Hewlett Packard (1999) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous or solid samples.

(NT4) Hewlett Packard (2001) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes HP 6890-Plus GC, 5973 MSD and 6890 autosampler

(NT5) Hewlett Packard (2002) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

(NT6) Hewlett Packard (2002) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

(NT7) Hewlett Packard (2007) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

(NT8) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Agilent 6890N GC, 5975C MSD, and 7683 autosampler.

(NT9) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Agilent 6890 GC and 5973 MSD, a Tekmar LSC 2000 Purge and Trap and a Dynatech PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

(NT10) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Aglient 6850GC,an Agilent 5975C inert MSD GC, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous samples.

(NT11) Hewlett Packard (2009) - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an Agilent 6890 N GC, an HP 5973 MSD and a Combi-pal SPME autosampler.

(NT12) Hewlett Packard (2011) - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an Agilent 6890 GC, an HP 5973N MSD and an HP G2614A autosampler.

Gas Chromatographs

Hewlett Packard 5890 Series II (2003) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and Chemstation. Used for screening samples before full extraction.

(ECD1) Hewlett Packard 5890 Series II (2004) - A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler and HP Chem Station data system.

(ECD3) Hewlett Packard 5890 Series II (1991) – A GC system equipped with Dual ECD detectors, two Cool on column capillary injectors, an HP7673 autosampler and ChromPerfect data system.

(FID2) Hewlett Packard 5890 Series II (2004) – A GC system equipped with an FID detector, a capillary injector, an HP 7673A autosampler and HP Chem Station data system.

(FID3 A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chem Station data system. A Restek GC Racer has been added to enhanced performance.

(FID4 A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chem Station data system. A Restek GC Racer has been added to enhanced performance.

(PID1) Hewlett Packard 5890 Series II (2002) – A GC system equipped PID and FID detectors in series, an Dynatech PT30 autosampler and Tekmar LCS 2000 Sample Concentrator and Chemstation data system.

(PID2) Hewlett Packard 5890 Series II – (2005) –A GC system equipped with dual PID detectors, one in series with an FID, a Dynatech PT30 autosampler, a Tekmar 2000 sample concentrator and HP Chem Station data system.

(PID 3) Hewlett Packard 5890 Series II – (2006) –A GC system equipped with PID and FID detectors in series, a Dynatech PT30 WS autosampler, a Tekmar 2000 sample concentrator and HP Chem Station data system.

(ECD5) Hewlett Packard 6890 Plus Micro – (2002) – A GC system equipped with dual ECD detectors, an HP 7683 autosampler and an HP Chem Station data system.

(ECD6) Hewlett Packard 6890 Plus Micro – (2008) – A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler and an HP Chem Station data system.

(FID5) Hewlett Packard 5890E Series II (2005) – A GC system equipped with dual FID detectors, an HP 7683 autosampler and HP Chem Station data acquisition system.

(FID6) Hewlett Packard 5890 Series II (2005) – A GC system equipped with an FID detector, an HP 7694 Headspace Sampler and HP Chem Station data acquisition system.

(FID7) Agilent 6850 (2008) – A GC system equipped with a single FID detectors, an Agilent 6850 autosampler and HP Chem Station data acquisition system.

(ECD7) Hewlett Packard 6890 Plus Micro – (2008) – A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler, and HP Chem Station data system.

(ECD8) Hewlett Packard 6890N – (2011) – A GC system equipped with dual ECD detectors, an Agilent 2614 autosampler, and HP Chem Station data system.

(FID8) Agilent 6890N (2008) – A GC system equipped with a dual FID detectors, an Agilent 7683B autosampler and HP Chem Station data acquisition system.

(FID9) Agilent 6850 (2009) – A GC system equipped with a single FID detector, an Agilent 6850 autosampler and HP Chem Station data acquisition system.

Inorganic Instrumentation

Perkin-Elmer SCIEX ELAN 6000 ICP-MS (1996) - A completely automated ICP-Mass Spectrometer with autosampler and multitasking software.

Perkin-Elmer NexIon 300D ICP-MS (2011) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with autosampler and multitasking software.

Perkin-Elmer Optima 7300DV ICP (2009) – Automated dual view simultaneous ICP with an Elemental Scientific SC-2 fast autosampler system

Perkin-Elmer Optima 4300 ICP (2001) - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

Varian 300Z (1992) - A single channel atomic absorption graphite furnace instrument equipped with Zeeman background correction, and an auto-sampler

CETAC M-6000A Mercury Analyzer (2000) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler

Dionex Ion Chromatography DX 500 (1997) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

Dionex Ion Chromatography 2100 (2009) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Chromeleon CHM-2 Version 7.0 software.

Thermo Genesys 10 (2003) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Thermo Genesys 10 (2005) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Lachat QuickChem 8000 Flow Injection Analyzer (2003) – Automated flow injection instrument dedicated to low level nutrient analysis

Lachat QuickChem 8500 Flow Injection Analyzer (2007) – Automated flow injection instrument dedicated to low level nutrient analysis

Dohrmann Apollo 9000 (2001) - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis and a boat sampler for solids analysis.

Dohrmann Apollo 9000 (2009) - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis and a boat sampler for solids analysis.

Kontes Midi-Vap Cyanide Distillation Systems (3 each)(1995-2008) – Each of the systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

Centrifuge (1987) - Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

Aim 500 Block Digestion System (2006) with Controller

Environmental Express Hot Block digestion blocks (10 ea) (1999-2008) for digestion of samples prior to trace metals analysis.

Hach COD Digestion Blocks (2)

Hach Ratio Nephelometer

Incubators: Lab-Line Ambi Hi-Lo Chamber and **Thermolyne 41900.**

GeoTech Laboratory Equipment

Trautwein Sigma 1 (2008) – Triaxial loading system

Sedigraph III Model 5120 (2007) – Automatic particle size analyzer

Beckman Coulter LS 13320 (2008) – Laser diffraction particle size analyzer with microliquid and universal liquid modules

Trautwein Soil Equipment – 12 position flexible wall permeability station

Soil Test Load Frame – with 500, 2,000 and 10,000 pound load cells for QU, UU, and CU triaxial tests, with pore pressure.

Soil Consolidation Apparatus – 16 tsf

Biosciences BI-1000 – 8 position electrolytic respirometer

Microtox – photo-luminescence toxicity test instrument

Beckman JP-21 – refrigerated centrifuge with 6 x 500 ml fixed angle head

IEC DRP-6000 – refrigerated centrifuge with a 4 x 1,000 ml swinging bucket head

Plas-Labs Anaerobic Test Chambers – 3 each

U.S. Army Corps of Engineers – column settling; column and batch leaching apparatus

Network Servers

ARI's central laboratory computer is a Dell PC Server, PowerEdge 2300/450, running Microsoft Windows NT 4.0 SP6. This system is home to ARI's Laboratory Information Management System (LIMS) database developed by Northwest Analytical of Portland, OR. The LIMS receives electronic data from all lab sections and produces hardcopy and electronic deliverables. In addition, the LIMS stores sample demographic data while providing a common tracking mechanism for all laboratory information.

The LIMS is connected to two sub-networks. Most data, with the notable exception of Conventionals and Geotech, is transferred electronically as text files from other data systems to the LIMS. This key process enhances data integrity by reducing manual entry and manipulation of instrument output.

The metals section uses an Intel PC Server with the Windows 2000 Server operating system. This system runs as a file server for dBASE IV and MS Access 2000 database applications.

Once data is collected by the metals instrument computers, dBASE is used to aggregate and process the results and transfer it to the LIMS. The MS Access software has been customized by ARI's metals data supervisor to generate metals CLP forms and other internal reports. This server also provides additional services such as DHCP, WSUS, and the corporate vacation calendar.

The organics section uses an HP-UX Server with the HP-UX 10.20 operating system. This system runs Target 3.4 data analysis software. All GC/MS and other GC instruments are networked to this system. In addition to providing one common platform for organics data processing, the Target software produces CLP forms for organics data packages.

The conventional analysis laboratory uses individual PC Workstations with MS Excel for data reduction. Filled spreadsheets are saved to Server3. Data is manually copied from the MS Excel spreadsheet into the LIMS systems using LIMS worklists specific to a test method.

Server2 is the primary internal/external interface and provides email, NTP, web (internet and intranet), DHCP, proxy, document (Geotech), CVS, database, and authentication services. Access to Server2 is limited to authorized users and only IT personal have access to the shell.

Server3, running Windows 2000 Advanced Server, is the primary document server for ARI and is used to warehouse all scanned (pdf) data packages. The hardware for Server3 consists of a generic box with a 2.4 MHz Intel Pentium 4 processor. Packages saved to this server are indexed using the CI service of Windows and are available for searching via the ARI intranet.

All servers are secured in a locked room where only management and IT staff have access. Some users have external access to the network but this is limited to current employees and only through an end-to-end encrypted VPN (OpenVPN).

Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARI employees.

Appendix E

ARI Active Standard Operating Procedures (SOP)

A list of ARI's current Standard Operating Procedures (SOPs) is available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-SOPs.zip

SOPs are updated periodically. Assure that you have ARI's current SOPs by downloading the files at the time of use.

Appendix F

Sample Containers, Preservation and Holding Times

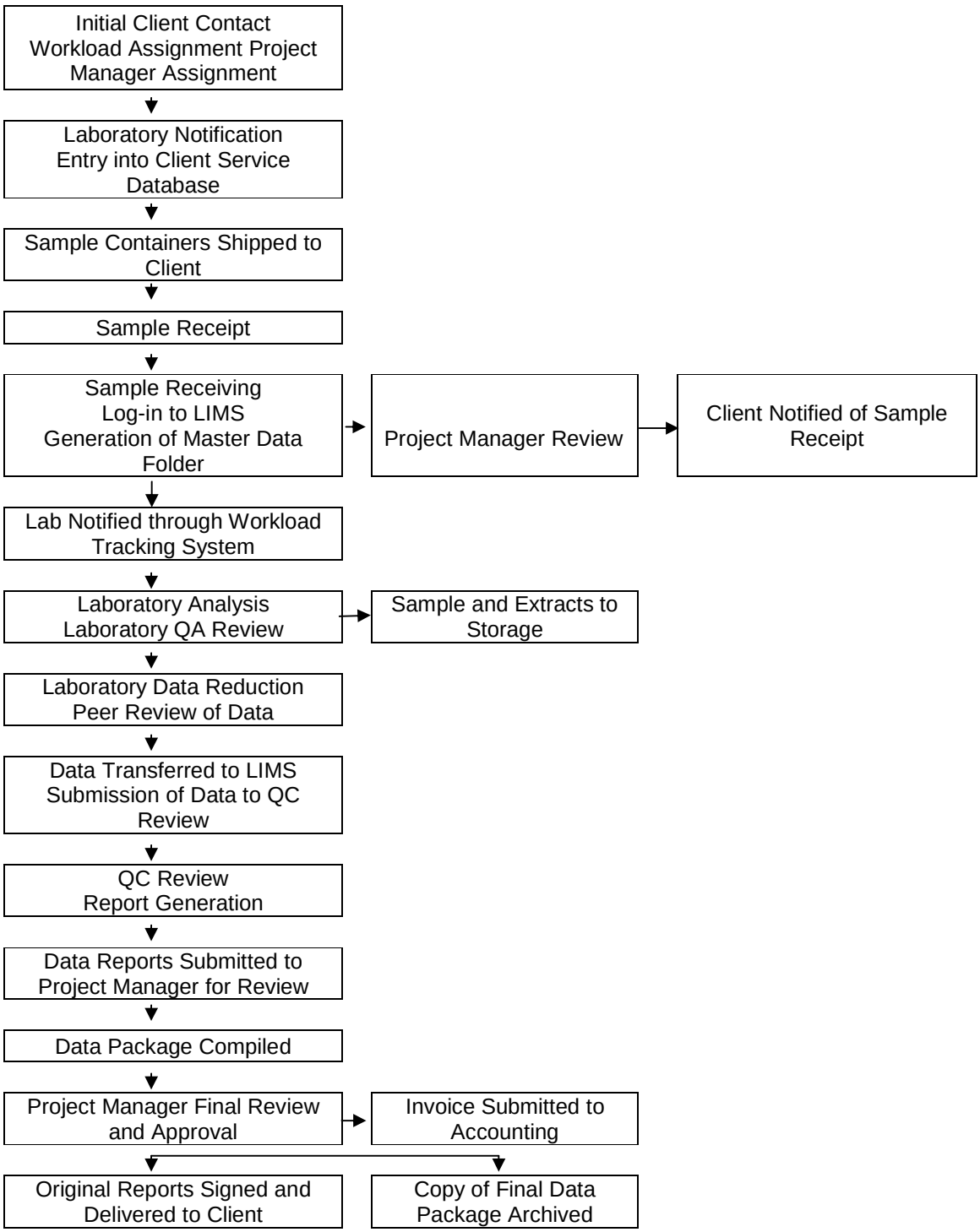
A summary of sample containers, preservatives and holding times is available on ARI's web site at:

http://www.arilabs.com/portal/downloads/

The summary is updated periodically. Assure that you have ARI's current document by downloading the files at the time of use.

Appendix G

Laboratory Workflow


Initial Client Contact
Workload Assignment Project Manager Assignment
Laboratory Notification
Entry into Client Service Database
Sample Containers Shipped to Client
Sample Receipt
Sample Receiving
Log-in to LIMS
Generation of Master Data Folder
Project Manager Review
Client Notified of Sample Receipt
Lab Notified through Workload Tracking System
Laboratory Analysis
Laboratory QA Review
Sample and Extracts to Storage
Laboratory Data Reduction
Peer Review of Data
Data Transferred to LIMS
Submission of Data to QC Review
QC Review
Report Generation
Data Reports Submitted to Project Manager for Review
Data Package Compiled
Project Manager Final Review and Approval
Invoice Submitted to Accounting
Original Reports Signed and Delivered to Client
Copy of Final Data Package Archived

Appendix H

Analytical Methods

ORGANIC ANALYSES

Parameter	Methods	Technique
Volatiles (GC/MS)	524.2/624/8260B	GC/MS
	Low Level Vinyl Chloride & 1,1 – Dichloroethene	GC-MS-SIM
Volatiles (GC)		
Volatile Aromatics	602/8021B	GC/PID
Semivolatiles (GC/MS)		
Semivolatile Organics	625/8270D	GC/MS
Polynuclear Aromatic Hydrocarbons (PNA/PAH)	625/8270D	GC/MS (SIM)
Isotope Dilution Semivolatiles	1625	GC/MS
Butyl Tin Species	Krone (1988)	GC/MS-SIM
Pesticides/GC Analyses		
Chlorinated Pesticides	608/8081A	GC/ECD
Aroclors/PCBs	608/8082	GC/ECD
PCB Congeners	ARI Method	GC/ECD
Phenols	604/8041	GC/FID
Chlorinated Phenols	8041 (mod)	GC/ECD
Pentachlorophenol	8151A (mod)	GC/ECD
Organophosphorous Pesticides	614/8141A	GC/NPD
Polynuclear Aromatic Hydrocarbons (PNA/PAH)	610/8100	GC/FID
Chlorinated Hydrocarbons	612/8121	GC/ECD
Herbicides	615/8151A	GC/ECD
Glycols	ARI Method(SOP 426S R2)	GC/FID
Hydrocarbon ID	NWTPH-HCID	GC/FID
Gasoline Range Hydrocarbons	(N)WTPH-G/AK101/WI-GRO	GC/FID
Diesel Range Hydrocarbons	(NWTPH-D/AK102/WI-DRO)	GC/FID
Extractable Petroleum Hydrocarbons	ARI Method	GC/FID
Volatile Petroleum Hydrocarbons	ARI Method	GC/PID
Organic Sample Preparation and Clean Up		
TCLP / SPLP Extraction		1311 / 1312
Sonication		3550B
Soxhlet		3540C
Accelerated Solvent Extraction (ASE)		3545B
Separatory Funnel		3510C
Continuous Liquid-Liquid		3520C
Alumina Clean-up		3610B

Florisil Clean-up	3620B
Gel Permeation (GPC)	3640A
Silica Gel	3630C
Sulfur Clean-up	3660B
Sulfuric Acid Clean-up	3665A

INORGANIC ANALYSES

Parameter	Methods	Technique
Wet Chemistry		
Acidity	2310/305.1	Titrimetric
Alkalinity	2320/310.1	Titrimetric
Ammonia	4500NH_3H/350.1	AutomatedPhenate/ISE
Biological Oxygen Demand-BOD		
Carbonaceous – BOD	5210.B/405.1	5-day Winkler Titration
Bromide	4500Br.B	Phenol Red Colorimetric
Anions	300.0	Ion Chromatography
Cation Exchange Capacity	9080	Neutral Ammonium Acetate
Chemical Oxygen Demand	5220.D/410.4	Closed Reflux, Colorimetric
Chromium Hexavalent (Cr6+)	3500Cr-D/7196A	Diphenylcarbazide
Chloride	4500CI.E/325.2	Automated Ferricyanide
Chlorophyll a	10200.H	Spectrophotometric
Coliform, Total / Fecal	9222.B/D	Membrane Filtration
Color	2120.B/110.2	Visual Comparison
Conductivity	2510/120.1	Electrometric
Corrosivity (CaCO3 Saturation)	2330	Calc. (pH, Alk, TDS, Ca)
Cyanide, Total	4500CN.C/335.2/9010	PBA, Colorometric
Cyanide, Amenable	4500CN.G/335.1	Alkaline Chlorination
Cyanide, WAD	4500CN.I	Weak Acid Distillation
Dissolved Oxygen	4500-O.C/360.2	Winkler Titration
Fats/Oils/Grease	5520.B/413.1/9070A	Gravimetric
Fluoride	4500F.C/340.2	Ion Specific Electrode
	300.0	Ion Chromatography
Formaldehyde	ASTM D-19 P216	Colorimetric
Hardness, Calculation	2340.B/6010B	Ca, Mg Calculation
Heterotrophic Plate Count	9215.D	Membrane Filtration
Iron (II) ferrous	3500Fe.D	Phenanthrolene
Nitrate + Nitrite	4500NO_3F/353.2	Automated Cd Reduction
Nitrate	4500NO_3F/353.2	Calculated
	300.0	Ion Chromatography
Nitrite	4500NO_3.F/353.2mod	Automated Colorimetric
	300.0	Ion Chromatography
Oil & Grease, Solids	5520.D/907	Gravimetric
Oil & Grease, Polar/Non Polar	5520.F	Gravimetric
PH	150.1	Electrometric
Phenols	5530.D/420.1/9065	4-AAP w/ Distillation
Phosphorous, Total	4500P.B/365.2	Colorimetric w/ digestion

Phosphorous, Ortho (SRP)	4500P.B/365.2	Colorimetric
	300.0	Ion Chromatography
Salinity	2520	Conductimetric
Silicate	4500Si.E/370.1	Heteropoly Blue
Total Kjeldahl Nitrogen (TKN)	4500N.org/351.4	Block Digest/ISE
Total Solids	2540.B/160.3	Gravimetric, 104°C
Total Suspended Solids (TSS)	2540.D.160.2	Gravimetric, 104°C
Total Dissolved Solids (TDS)	2540.C/160.1	Gravimetric, 180°C
Total Volatile Solids (TVS)	2540.E/160.4	Gravimetric, 550°C
Settleable Solids	2540.F	Volumetric
Streptococcus, Fecal	9230.C	Membrane Filtration
Sulfide	4500S^2.E/376.1/9034	Iodometric
Sulfide, Low Level	4500S^2.D/376.2	Methylene Blue
Sulfide, Acid Volatile	4500S^2.D/376.2	Methylene Blue
Sulfate	4500SO_4^2.F/375.2/9036	Auto. Methylthymol Blue
	300.0	Ion Chromatography
Sulfite	4500SO_3^2.B.377.1	Iodometric
Total Organic Carbon (TOC)	5310.B415.1/PSEP	Combustion NDIR
Turbidity	2130.B/180.1	Nephelometric
Total Lipids in Tissue	Bligh & Dyer (mod)	Gravimetric

Trace Metals Analyses

Inductively Coupled Plasma (ICP):

Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, (Li, Th, U, W - special request only)	Zn200.7 / 6010B	ICP

Graphite Furnace (GFAA):

Ag, As, Cd, Sb, Pb, Se, Tl	200 Series / 7000 Series	GFAA

Cold Vapor (CVAA):

Hg	7470A/7471A	CVAA

Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):

Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn	200.8/ 6020 Mod.	ICP/MS

Trace Metals Sample Preparation

Toxicity Characteristic Leaching Procedure	1311
Synthetic Precipitation Leaching Procedure	1312
Digestion for Total Recoverable or Dissolved Metals	3005A
Digestion of Aqueous Samples for Total Metals by ICP	3010A
Digestion of Aqueous Samples for Total Metals by GFAA	3020A
Digestion of Sediment, Sludge and Soil	3050B

Appendix I

Method Detection Limits and Reporting Limits

Summaries of method specific MDL studies and reporting limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-MDLs.zip

MDL's and reporting are updated periodically. Assure that you have ARI's current detection limit data by downloading the files at the time of use.

Appendix J

Quality Control Recovery Limits

Method specific control limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use.

Appendix K

Internal Audit Schedule

Schedule of Laboratory Quality Assurance Audits

Process To Be Audited	Frequency
Verify Effectiveness of Corrective Actions	Monthly
Verify Refrigerator and Freezer Temperature Logs	Monthly*
Verify Oven and Incubator Temperature Logs	Monthly*
Verify That Balance Records Are Complete	Quarterly*
Verify That Standard Records are Complete	Monthly#
Verify That Logbooks Are Reviewed	Monthly#
Verify That SOPs Are Current and Available in Labs	Monthly#
Review Chain of Custody Documentation	Monthly#
Audit Internal Technical Systems	Annually
Post-Completion Project Review	Monthly**

* all sections will be audited

one section will be audited each month

** frequency may be contract specific i.e. 10% of NFESC projects must be audited

Appendix L

Laboratory Accreditations

Laboratory Accreditations

Analytical Resources Inc. is currently certified to perform environmental analysis by the National Environmental Laboratory Accreditation Program (NELAP), the State of Washington Department of Ecology and the State of Alaska Department of Environmental Conservation. ARI is approved to perform analyzes for the US Navy and the US Army Corps of Engineers following the Department of Defense Quality Systems Manual (DoD-QSM)

ARI's laboratory QA/QC Program has been audited and approved by The Boeing Company and Battelle Pacific Northwest Laboratories.

ARI analyzes drinking water, waste water and solid matrix performance testing (PT) samples semiannually.

List of Accreditations

1) National Environmental Laboratory Accreditation Conference (NELAC) – Accrediting authority is Oregon Environmental Laboratory Accreditation Program (ORELAP).
2) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
3) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
4) United States Army Corps of Engineers (USACE)
5) United States Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)

Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) The City of Seattle
3) The Port of Seattle

Appendix M

Data Reporting Qualifiers

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

NA The flagged analyte was not analyzed for

NR Spiked compound recovery is not reported due to chromatographic interference

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

M2 The sample contains PCB congeners that do not match any standard Aroclor pattern. The PCBs are identified and quantified as the Aroclor whose pattern most closely matches that of the sample. The reported value is an estimate.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification"

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

EMPC Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and /or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria" **(Dioxin/Furan analysis only)**

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

X Analyte signal includes interference from polychlorinated diphenyl ethers. **(Dioxin/Furan analysis only)**

Z Analyte signal includes interference from the sample matrix or perfluorokerosene ions. **(Dioxin/Furan analysis only)**

Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of “fines” required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

Appendix N

Standards for Personal Conduct

Standards of Conduct

Since effective working relationships depend upon each of us, ARI expects certain minimum standards of personal conduct.

This list highlights general Company expectations and standards and does not include all possible offenses or types of conduct which may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities deemed equally serious, will normally be terminated:

theft or embezzlement
disclosure of trade secrets or industrial espionage;
willful violation of safety or security regulations;
conviction of a felony;
working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

being intoxicated, under the influence or in possession of illegal drugs on the job;
falsification of records;
abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
gambling on the premises;
chronic tardiness or absenteeism;
insubordination;
unwillingness to perform the job;
unauthorized requisition of materials from vendors.

There may be no alcoholic beverages on the Company premises, other than at times designated as Company functions. At such times, non-alcoholic beverages will be provided as well.

Personal and corporate honesty and integrity have built the character of ARI. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARI employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and,

Standards of Personnel Conduct – continued

if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARI or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARI further expects that each employee will:

Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.

Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.

Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARI except as required by faithful performance of assigned duties.

Conduct business dealings with clients and members of the public in a courteous manner.

Appendix O

Quality Assurance Policies

QUALITY ASSURANCE POLICY

POLICY NUMBER: 1

SUBJECT: CORRECTIONS TO DATA/BENCHSHEETS

DATE: 8/2/96

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **2**

SUBJECT: **LINING OUT UNUSED BENCHSHEET PORTIONS**

DATE: **8/2/96**

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 3

SUBJECT: STOP WORK ORDERS

DATE: 8/28/96

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **4**

SUBJECT: **SOP Review**

DATE: **9/3/96**

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **5**

SUBJECT: **Reporting Dilutions**

DATE: **9/11/96**

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **6**

SUBJECT: **Formatting for SOPs – Computer Related**

DATE: **1/31/00**

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **`bold courier`** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***`SET CENTURY ON`***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in *`courier`* and *`italicized`*.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**7**
SUBJECT:	**Manual Adjustment of Data**
DATE of IMPLEMENTATION:	**1/1/01**

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

_____

Quality Assurance Program Manager Date

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**8**
SUBJECT:	**Performance Evaluation Samples**
IMPLEMENTATION DATE:	**1/1/01**

Performance Evaluation Samples (PES) will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PES samples contain target analytes in concentrations unknown to laboratory personnel. PES may be submitted by a third party or prepared internally under the direction of ARI's QA personnel.

PES will be submitted blind to the laboratory whenever possible.

PES will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**9**
SUBJECT:	**Modifications to Analytical Methods Procedures or Reports**
DATE of IMPLEMENTATION:	**8/24/05**

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources Inc. (ARI). The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARI's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARI's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARI management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

A. A new or revised SOP as appropriate including the modification or new protocol.
B. An Initial Demonstration of Proficiency as defined in ARI SOP 1018S for new or modified analytical procedures.
C. An MDL study following the procedure in ARI SOP 1018S for new or modified analytical procedure.
D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
E. Documentation that new or modified software provides the desired result.

4. ARI staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**10**
SUBJECT:	**Reporting of Target and Spiked Analytes For Dual Column GC Analyses**
DATE of IMPLEMENTATION:	**8/24/05**

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARI's policy for deciding which value to report is outlined as follows:

1. ARI considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARI's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns (R_1 & R_2) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARI's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e. perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARI's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARI's client or the data user.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**11**
SUBJECT:	**Calculation of Analytical Uncertainty**
DATE of IMPLEMENTATION:	**8/31/06**

Analytical Resources Inc. will use the procedure[1] proposed by Thomas Georgian, PhD to estimate analytical uncertainty. Dr. Georgian's proposes using the formulae below to calculate uncertainty:

For biased corrected analytical results:

100 (c/R)(1± L / R)
Where:
c = Measured concentration of the analyte
R = Average LCS spike recovery
L = ½ the warning or control range

And for unbiased results i.e. R = 100

c (± L / 100)

Example:

For a 10 ppb analytical result when the mean LCS recovery is 50% and the control limits are 20% to 80% an interval for the analytical results is calculated as follows:

100 (10 ppb / 50)(1±30 / 50) = 20 ± 12 ppb

[1] Estimation of Laboratory Analytical Uncertainty Using Laboratory Control Samples, Thomas Georgian, Ph.D., *Environmental Testing & Analysis*, November/December 2000.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Rounding of Numbers and Reporting Limits**
DATE of IMPLEMENTATION:	**8/24/05**

I. ARI reports analytical results in concentration units as follows:

A. Values expressed as a concentration (mg/L, µg/Kg etc.)

1. Values less than or equal 10 are reported using 2 significant figures.
2. Values greater than 10 are reported using 2 or 3 significant figures.

B. Values expressed as percent (control limits, RSD etc.) are reported using the appropriate whole number. Examples: 6.38 rounds to 6, 9.95 rounds to 10, 99.93 rounds to 100, 145.48 rounds to 145.

II. ARI rounds numbers to the appropriate level of precision using the following rules:

A. If the figure following those to be retained is greater than or equal to 5, the absolute value of the result is to be rounded up: otherwise, the absolute value of the result is rounded down. Examples: -0.4365 rounds to -0.437 and 2.3564 rounds to -2.356; 11.443 is rounded down to 11.44 and 11.455 is rounded up to 11.46.

B. When a series of multiple operations is performed (add, subtract, divide, multiply), all significant figures are carried through the calculations and the final result is rounded to the appropriate number of significant figures.

III. ARI compares concentration values to reporting limits prior to rounding final concentration values. Example: with an RL of 0.50, 0.499 is undetected at 0.50 (0.50U) and 0.504 is detected at 0.50.

III. ARI will round quality control results prior to determining if the value is in control. Example: for spike recovery limits of ± 10% (90 – 110%), a recovery of 110.47is in control at 110% and a calculated recovery of 110.50 is out of control at 111%.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Use of "J" Flag when Reporting Analytical Data**
DATE of IMPLEMENTATION:	**3/1/09**

1. ARI uses a "J" flag to indicate that a quantitative result chemical analysis is an estimated value. In general, "J" flags note positively identified compounds that are not in an instrument's verified calibrated range.
2. A "J" indicates quantitative values with a high degree of uncertainty. Data users must consider the greater uncertainty when using "J" flagged quantitative values.
3. ARI will not use "J" flags when reporting the results of metals analyses. Instrumental analysis of metals is subject to inter-element interference, non-specific absorption and sample-to-sample carryover that make quantification of elements below the reporting limit difficult. MDL studies performed on clean sample matrices are not subject to these interferences.
4. ARI will not report analytes below the RL ("J" flag is not used) for any single column GC analysis. (HCID, TPH-D, BTEX, TPH-G, RSK-175, Direct Aqueous Injection)
5. ARI uses "J" flags when reporting results of GC-MS (VOA and SVOA) and dual column GC analyses using the following criteria:
   A. All analyses must meet ARI established QA criteria for calibration and spike recovery.
   B. Analytes must meet method specific identification criteria (i.e. spectral match, retention time and/or relative retention time).
   C. The analyte concentration must exceed the greater of either the MDL or ½ the reporting limit before a "J" flag is applied.
   D. An analyte in a method blank will be "J" flagged only when any associated sample contains the same analyte.
   E. The application of a "J" flag is discretionary, depending on the professional judgment of ARI's data reviewers. GC-MS parameters such as ion ratios, spectral match, background contamination and instrument noise are weighted when considering the application of "J" flags.
6. Some typical circumstances that may warrant the use of a "J" flag:
   A. A compound identified at a concentration between the MDL or ½ RL and ARI's reporting limit (normally the low concentration used to calibrate the instrument).
   B. The quantified values in a dual column GC analysis differ by > 40% with obvious interference on one column. ARI may report the value with the lowest concentration or the least interference.
   C. The analyte is present at low concentration due to extract dilution and identified in a previous analysis of less dilute extract.
   D. Analytes < the RL and reported in previous analyses from the same sampling site.
   E. An analyte is < the RL in a sample and greater than the RL a duplicate or replicate analysis. This often applies to Matrix Spike and Laboratory Control Samples and their duplicates.

ATTACHMENT A3

STANDARD OPERATING PROCEDURES

-SOP AP-01_SAMPLE PACKAGING AND SHIPPING
-SOP AP-02_FIELD DOCUMENTATION
-SOP AP-03_SAMPLE CUSTODY
-SOP AP-04_SAMPLE LABELING
-SOP AP-06_NAVIGATION AND STATION POSITIONING
-SOP SD-01_DECONTAMINATION OF SEDIMENT SAMPLING EQUIPMENT
-SOP SD-02_PREPARATION OF FIELD QUALITY CONTROL SAMPLES FOR SEDIMENTS
-SOP SD-04_SURFACE SEDIMENT SAMPLING

STANDARD OPERATING PROCEDURE (SOP) AP-01

SAMPLE PACKAGING AND SHIPPING

SCOPE AND APPLICATION

This SOP describes specific requirements for sample packaging and shipping to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein. This SOP also presents the method to be used when packing samples that will either be hand delivered or shipped by commercial carrier to the laboratory.

EQUIPMENT AND SUPPLIES REQUIRED

Make sure that you have the equipment and supplies necessary to properly pack and ship environmental samples, including the following:

- Project-specific sampling and analysis plan (SAP)
- Project-specific field logbook
- Sealable airtight bags in assorted sizes (e.g., Ziploc®)
- Wet ice in doubled, sealed bags; frozen Blue Ice®; or dry ice
- Cooler(s)
- Bubble wrap
- Fiber-reinforced packing tape, clear plastic packing tape, and duct tape
- Scissors or knife
- Chain-of-custody (COC) forms
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 in.] thick)
- Paper towels
- "Fragile," "This End Up," or "Handle With Care" labels
- Mailing labels
- Air bills for overnight shipment

PROCEDURE

Customize the logistics for sample packaging and shipping to each study. If necessary, transfer samples from the field to a local storage facility where they can be frozen or refrigerated. Depending on the logistics of the operation, field personnel may transport samples to the laboratory or use a commercial courier or shipping service. In the latter case, Integral field personnel must be aware of any potentially limiting factors to timely shipping, such as availability of overnight service and weekend deliveries to specific areas, and shipping regulations regarding "restricted articles" (e.g., dry ice, formalin) prior to shipping the samples.

SAMPLE PREPARATION

Take the following steps to ensure the proper transfer of samples from the field to the laboratories:

At the sample collection site:

1. Document all samples using the proper logbooks or field forms (see SOP AP-02), required sample container identification (i.e., sample labels with tag numbers), and COC form (example provided in SOP AP-03). Fill out the COC form as described in SOP AP-03, and use the sample labeling techniques provided in SOP AP-04.
2. Make all applicable laboratory quality control sample designations on the COC forms. Clearly identify samples that will be archived for future possible analysis. Label these samples as follows: "Do Not Analyze: Hold and archive for possible future analysis." Some laboratories interpret "archive" to mean that they should continue holding the residual sample after analysis.
3. Notify the laboratory contact and the Integral project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all COC forms to Integral's project QA/QC coordinator or project manager, as appropriate.
4. Keep the samples in the possession of the sampling personnel at all times. Lock and secure any temporary onsite sample storage areas to maintain sample integrity and COC requirements.
5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
6. Complete the COC form as described in SOP AP-03, and retain the back (pink) copy for project records prior to sealing the cooler. Check sample containers against the COC form to ensure all the samples that were collected are in the cooler.

7. Store each sample container in a sealed plastic bag that allows the sample label (example provided in SOP AP-03) to be read. Before sealing the bags, ensure that volatile organic analyte (VOA) vials are encased in a foam sleeve or in bubble wrap.
8. If the samples require storage at a specific temperature, place enough ice in the sample cooler to maintain the temperature (e.g., 4°C) throughout the sampling day.

At the sample processing area (immediately after sample collection) take the following steps:

1. If the samples require a specific storage temperature, then cool the samples and maintain the temperature prior to shipping. For example, place enough ice in each sample cooler to maintain the temperature at 4°C until processing begins at the testing laboratory.
2. Be aware of holding time requirements for project-specific analytes and arrange the sample shipping schedule accordingly.
3. Place samples in secure storage (i.e., locked room or vehicle) or keep them in the possession of Integral sampling personnel before shipment. Lock and secure any sample storage areas to maintain sample integrity and COC requirements.
4. Store samples in the dark (e.g., keep coolers shut).

At the sample processing area (just prior to shipping), do the following:

1. Check sample containers against the COC form to account for all samples intended for shipment.
2. Choose cooler(s) of appropriate size and make sure they are clean of gross contamination inside and out. If the cooler has a drain, close the drain and secure it with duct tape.
3. Line the cooler with bubble wrap and place a large plastic bag (preferably with a thickness of 3 mil), open, inside the cooler.
4. Individually wrap each glass container (which was sealed in a plastic bag at the collection site) in bubble wrap and secure with tape or a rubber band. Place the wrapped samples in the large plastic bag in the cooler, leaving room for ice to keep the samples cold (i.e., 4°C).
5. If temperature blanks have been provided by the testing laboratory, place one temperature blank in each sample cooler.
6. If the samples require a specific storage temperature, add enough wet ice or Blue Ice® to maintain that temperature during overnight shipping (i.e., 4°C). Always overestimate the amount of ice that will be required. Keep ice in a sealed plastic bag, which is placed in a second sealed plastic bag to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it may insulate the samples from the ice. After adding all samples and ice to the cooler, use bubble wrap (or other

available clean packing material) to fill any empty space and prevent the samples from shifting during transport.

7. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the project-specific QA project plan calls for them.
8. Sign, date, and include any tracking numbers provided by the shipper on the COC form. Remove the back (pink) copy of the original COC form and retain this copy for the project records.
9. Seal the rest of the signed COC form in a bag and tape the bag to the inside of the cooler lid. Each cooler should contain an individual COC form for the samples contained inside it. If time is short and it becomes necessary to combine all the samples onto a single set of COC forms and ship multiple coolers together, then indicate on the outside of the appropriate cooler, "Chain-of-Custody Inside."
10. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it with fiber-reinforced packing tape. Tape the cooler around the opening, joining the lid to the bottom, and around the circumference of the cooler at both hinges.
11. As security against unauthorized handling of the samples, apply two COC seals across the opening of the cooler lid (provided with example field forms). Place one seal on the front right portion of the cooler and one on the back left. Be sure the seals are properly affixed to the cooler to prevent removal during shipment. Additional tape across the seal may be necessary if the outside of the cooler is wet.

SAMPLE SHIPPING

Hand Delivery to the Testing Laboratory

1. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be delivered to the laboratory and the estimated arrival time.
2. When hand-delivering environmental samples, make sure the testing laboratory receives them on the same day that they were packed in the coolers.
3. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after it has been faxed. Never leave the original COC form in the custody of non-Integral staff.

Shipped by Commercial Carrier to the Laboratory

1. Apply a mailing label to the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the cooler and to protect it from the weather. This is a secondary label in case the air bill is lost during shipment.
2. Fill out the air bill and fasten it to the handle tags provided by the shipper (or the top of the cooler if handle tags are not available).
3. If samples must be frozen (–20°C) during shipping, make sure that dry ice has been placed in the sample cooler. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require.
4. Make sure that benthic infauna samples have been preserved with formalin in the field prior to shipping. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require for these samples.
5. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be shipped and the estimated arrival date and time. If environmental samples must be shipped at 4°C or –20°C, choose overnight shipping for delivery next morning. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after faxing. Never leave the original COC form in the custody of non-Integral staff.

STANDARD OPERATING PROCEDURE (SOP) AP-02

FIELD DOCUMENTATION

SCOPE AND APPLICATION

This SOP describes the Integral procedure for accurate record-keeping in the field for the purposes of ensuring that samples can be traced from collection to final disposition.

Document all information relevant to field operations properly to ensure that activities are accounted for in written records to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. Several types of field documents are used for this purpose and should be consistently used by field personnel. Field documentation should include only a factual description of site-related activities and observations. Field personnel should not include superfluous comments or speculation regarding the field activities or observations.

FIELD LOGBOOKS

During field sampling events, field logbooks must be used to record all daily activities. The purpose of the field logbook is to document events and record data measured in the field to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. The project manager (or designee) should issue a field logbook to the appropriate site personnel for the direction of onsite activities (e.g., reconnaissance survey team leader, sampling team leader). It is this designee's responsibility to maintain the site logbook while it is in his or her possession and return it to the project manager or turn it over to another field team.

Make entries in the field logbook as follows:

1. Document all daily field activities in indelible ink in the logbook and make no erasures. Make corrections with a single line-out deletion, followed by the author's initials and the date. The author must initial and date each page of the field logbook. The author must sign and date the last page at the end of each day, and draw a line through any blank space remaining on the page below the last entry.

2. Write the project name, dates of the field work, site name and location (city and state), and Integral job number on the cover of the field logbook. If more than one logbook is used during a single sampling event, then annotate the upper right-hand corner of the logbook (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Secure all field logbooks when not in use in the field. The following is a list of the types of information that is appropriate for entry in the field notebook:
   - Project start date and end date
   - Date and time of entry (24-hour clock)
   - Time and duration of daily sampling activities
   - Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, current, tide, vessel traffic, air and water temperature, thickness of ice if present)
   - Name and affiliation of person making entries and other field personnel and their duties, including what times they are present
   - The location and description of the work area, including sketches, map references, and photograph log, if appropriate
   - Level of personal protection being used
   - Onsite visitors (names and affiliations), if any, including what times they are present
   - The name, agency, and telephone number of any field contacts
   - Notation of the coordinate system used to determine the station location
   - The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets
   - All field measurements made (or reference to specific field data sheets used for this purpose), including the time of collection and the date of calibration, if appropriate
   - The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets
   - For aquatic sampling, the type of vessel used (e.g., size, power, type of engine)
   - Specific information on each type of sampling activity
   - The sample type (e.g., groundwater, soil, surface sediment), sample number, sample tag number, and any preservatives used, if not included on separate field data sheets
   - Sample storage methods

- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/thickness of the redox potential discontinuity [RPD] layer, and odor) and penetration depth, if not included on separate field data sheets
- Estimate of length and appearance of recovered cores, if not included on separate field data sheets
- Photographs (uniquely identified) taken at the sampling location, if any
- Details of the work performed
- Variations, if any, from the project-specific sampling and analysis plan (SAP) or standard operating protocols and reasons for deviation
- Details pertaining to unusual events that might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
- References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log)
- Any field results not appearing on the field data sheets (if used), including station identification and location, date, and time of measurement
- Sample shipment information (e.g., shipping manifests, chain-of-custody (COC) form numbers, carrier, air bill numbers, time addresses)
- A record of quantity of investigation-derived wastes (if any) and storage and handling procedures.

3. During the field day, as listed above, record in the logbook a summary of all site activities. Provide a date and time for each entry. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., site health and safety officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the pages in these logbooks for detailed information.
4. If measurements are made at any location, record the measurements and equipment used, or refer to the logbook and page number(s) or field forms on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.

5. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., groundwater monitoring form, sediment core profile form, water quality measurement form) to record the relevant sample information collected. For instructions regarding the proper identification of field data forms, sampling personnel should consult the project-specific SAP.

Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain cases, photographs (print or digital) of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Ensure that photographs include a measured scale in the image, when practical. If you take photographs of sample characteristics and routine sampling activities, avoid using telephoto or wide-angle shots, because they cannot be used in enforcement proceedings. Record the following items in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work shown in the picture
3. For print photographs, the sequential number of the photograph and the roll number on which it is contained
4. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up disk number (if applicable).

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all photographic materials to be developed (prints) or copied (disks). Place the prints or disks and associated negatives in the project files (at the Integral project manager's location). Make photocopies of photo logs and any supporting documentation from the field logbooks, and place them in the project files with the prints or disks.

EQUIPMENT CALIBRATION RECORDS

Record in the field logbook all equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration. Calibrate all equipment used during the investigation daily, at a minimum, in accordance with the manufacturers' recommendations.

DISTRIBUTION OF COPIES

When the field team has returned from the sampling event, the field team leader is responsible for making sure that the field documentation is 1) scanned and placed into the project file on the portal (in a subfolder named Field under Working_Files), and 2) a copy of all field logbooks and additional field data forms is made and placed into the project file. Both the scanned copy and the hard copy will be available for general staff use.

The original field logbooks and forms will be placed in a locked file cabinet for safekeeping. One file cabinet at each Integral office will contain the original field documentation for multiple projects. The original field documentation will be filed at the Integral office where the project manager is located.

SET-UP OF LOCKING FILE CABINET

Place each project in its own file folder in a locking file cabinet. On the folder label, include the project name and contract number. Each project folder will include up to six kinds of files:

- Field logbook(s)
- Additional field data forms
- Photographs
- COC forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at an Integral field storage facility or Integral laboratory).

STANDARD OPERATING PROCEDURE (SOP) AP-03

SAMPLE CUSTODY

SCOPE AND APPLICATION

This SOP describes Integral procedures for custody management of environmental samples.

A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP AP-01, which covers sample packaging and shipping; SOP AP-02, which covers the use of field logbooks and other types of field documentation; and SOP AP-04, which covers sample labeling. Chain-of-custody (COC) forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in his or her possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of Integral personnel's custody unless the samples have been transferred to a secure area (i.e., locked up). If the samples cannot be placed in a secure area, then an Integral field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

CHAIN-OF-CUSTODY FORMS

The COC form is critical because it documents sample possession from the time of collection through final disposition. The form also provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

Complete the COC form after each field collection activity and before shipping the samples to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. The individuals relinquishing and receiving the samples must sign the

COC form(s), indicating the time and date of the transfer, when transferring possession of the samples.

A COC form consists of three-part carbonless paper with white, yellow, and pink copies. The sampling team leader keeps the pink copy. The white and yellow sheets are placed in a sealed plastic bag and secured inside the top of each transfer container (e.g., cooler). Field staff retain the pink sheet for filing at the Integral project manager's location. Each COC form has a unique four-digit number. This number and the samples on the form must be recorded in the field logbook. Integral also uses computer-generated COC forms. If computer-generated forms are used, then the forms must be printed in triplicate and all three sheets signed so that two sheets can accompany the shipment to the laboratory and one sheet can be retained on file. Alternatively, if sufficient time is available, the computer-generated forms will be printed on three-part carbonless paper.

Record on the COC form the project-assigned sample number and the unique tag number at the bottom of each sample label. The COC form also identifies the sample collection date and time, type of sample, project name, and sampling personnel. In addition, the COC form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC form is sent to the laboratory along with the sample(s).

PROCEDURES

Use the following guidelines to ensure the integrity of the samples:

1. Sign and date each COC form. Have the person who relinquishes custody of the samples also sign this form.
2. At the end of each sampling day and prior to shipping or storage, make COC entries for all samples. Check the information on the labels and tags against field logbook entries.
3. Do not sign the COC form until the team leader has checked the information for inaccuracies. Make corrections by drawing a single line through any incorrect entry, and then initial and date it. Make revised entries in the space below the entries. After making corrections, mark out any blank lines remaining on the COC form, using single lines that are initialed and dated. This procedure will prevent any unauthorized additions.

   At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date of the transfer. The time the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as FedEx or United Parcel Service (UPS), record the name of the carrier on the COC form. Also enter on the COC form any tracking numbers supplied by the carrier. The time of transfer should be as close to the actual drop-off time as possible. After signing the COC forms and removing the pink copy, seal them inside the transfer container.
5. If errors are found after the shipment has left the custody of sampling personnel, make a corrected version of the forms and send it to all relevant parties. Fix minor errors by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.
6. Provide a COC form and an Archive Record form for any samples that are archived internally at Integral.

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all COC forms to be copied. A discussion of copy distribution is provided in SOP AP-02.

CUSTODY SEAL

As security against unauthorized handling of the samples during shipping, affix two custody seals to each sample cooler. Place the custody seals across the opening of the cooler (front right and back left) prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

SHIPPING AIR BILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), the shipper provides an air bill or receipt. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting the sender's copy of all shipping air bills to be copied at an Integral office. A discussion of copy distribution is provided in SOP AP-02. Note the air bill number (or tracking number) on the applicable COC forms or, alternatively, note the applicable COC form number on the air bill to enable the tracking of samples if a cooler becomes lost.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is faxed to the project QA/QC coordinator the day the samples are received by the laboratory. The person receiving this form is responsible for reviewing it, making sure that the laboratory has received all the samples that were sent, and verifying that the correct analyses were requested. If an error is found, call the laboratory immediately, and document

any decisions made during the telephone conversation, in writing, on the Acknowledgment of Sample Receipt form. In addition, correct the COC form and fax the corrected version to the laboratory.

Submit the Acknowledgment of Sample Receipt form (and any modified COC forms) to be copied. A discussion of copy distribution is provided in SOP AP-02.

ARCHIVE RECORD FORMS

On the rare occasion that samples are archived at an Integral office, it is the responsibility of the project manager to complete an Archive Record form. This form is to be accompanied by a copy of the COC form for the samples, and will be placed in a locked file cabinet. The original COC form remains with the samples in a sealed Ziploc® bag.

STANDARD OPERATING PROCEDURE (SOP) AP-04

SAMPLE LABELING

SCOPE AND APPLICATION

This SOP describes the general Integral procedures for labeling samples, and the three kinds of labels that can be used on a project (i.e., sample labels, sample tags, and internal sample labels). Consult the project-specific sampling and analysis plan (SAP) to determine the exact sample identifiers and sample labels that are required for a given project. If they are not specified in the SAP, then follow the designations below.

SAMPLE IDENTIFIERS

Before field sampling begins, establish sample identifiers to be assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., replicates) to ensure proper data analysis and interpretation, 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples, and 3) to track individual sample containers to ensure that the laboratory receives all material associated with a single sample. To accomplish these purposes, each container may have three different codes associated with it: the sample identifier, the sample number, and the sample tag number. These codes and their use are described as follows:

- **Sample Identification Code**—The sample identification code (Sample ID) is a unique designation that identifies where and how the sample was collected. The sample identifier is recorded in the field logbook *only* and is not provided on the sample label or chain-of-custody (COC) form. The sample identifier is a multiple-part code. The first component begins with the letter abbreviation; for example, "SWNS" or "SWNB" to designate the surface water sample was collected from the near-surface or near-bottom of the water column. The second part could identify the sampling event; for example, "1" to designate Round 1 sampling. The third part could contain an abbreviation for whether the station is a single point (SP), a transect (TR), a composite (CO), or a vertically integrated station (VI). The station number would be the final component of the sample identifier. Use leading zeros for stations with numbers below 100 for ease of data management and correct data sorting.

  If appropriate, add a supplemental component to the sample identifier to code field

duplicate samples and splits. Use a single letter (i.e., a suffix of "A" and "B") to indicate field duplicates or splits in the final component of the sample identifiers. For equipment decontamination blanks, assign sequential numbers starting at 900 instead of station numbers. Use a sample type code that corresponds to the sample type for which the decontamination blank was collected. Additional codes may be adopted, if necessary, to reflect sampling equipment requirements (see project-specific SAP).

Examples of sample IDs are as follows:

- SWNS-1-SP-002: Surface water sample collected from the near-surface at a single point during Round 1 from Station 2.
- SWNB-1-TR-010-A: Duplicate surface water sample from the near-bottom transect during Round 1 from Station 10.

- **Sample Number**—The sample number is an arbitrary number assigned to each distinct sample or split that is shipped to the laboratory for separate analysis. The sample number appears on the sample containers and the COC forms. Each sample will be assigned a unique sample number. All aliquots of a composited field sample will have the same sample number. In cases where samples consist of multiple bottles from the same location, assign each bottle the same sample number and time. However, assign replicates from the same location different sample numbers and times. Sample numbers of related field replicates will not necessarily have any shared content.

  Each field split of a single sample will also have a different sample number and time. The sample number is generally a unique six-digit number that includes a two-digit media code and a four-digit number. The media code may be site-specific, but the Integral default codes are as follows:

  - SS—Surface soil
  - BH—Subsurface soil or rock (typically from borehole)
  - GW—Groundwater
  - SW—Surface water
  - PW—Pore water
  - SD—Sediment
  - BT—Biota or biological tissue

  The exact sample numbering scheme may vary from project to project. Variances in the sample numbering scheme will be described in the project-specific SAP for the field event. Example sample numbers are PW0001, PW0002, PW0003, etc.

- **Tag Number—**Attach a different tag number to each sample container. If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, assign each container the same sample number and a different sample tag. A sample will also be split between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted).

  The sample tag number is a unique five- or six-digit number assigned to each sample label (or "tag") for multiple bottles per sample. Integral sample labels come with a preprinted sample tag number. The tag number provides a unique tracking number to a specific sample bottle. This allows for greater flexibility in tracking sample bottles and assists in field quality control when filling out documentation and shipping. Sample tags are not used by many other consultants, and there may be resistance from such firms during teaming situations. However, experience has shown that tags can be very valuable, both in the field and while processing data from field efforts.

  Record tag numbers on the COC form. Laboratories use tag numbers only to confirm that they have received all of the containers that were filled and shipped. Data are reported by sample number.

Assign sample numbers sequentially in the field; sample labels are preprinted with sequential tag numbers.

SAMPLE LABELS

Integral sample labels are designed to uniquely identify each individual sample container that is collected during a sampling event. Field sampling teams are provided with preprinted sample labels, which must be affixed to each sample container used. Fill out the labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- A unique number (commonly referred to as the "Tag Number") that is preprinted on the label consisting of five or six digits; used to identify individual containers.

SAMPLE TAGS

Integral sample tags are designed to be affixed to each container that is used for a sample. Sample tags are required only for environmental samples collected in certain U.S.

Environmental Protection Agency (EPA) regions (e.g., EPA Region 5). Field crews are provided with preprinted sample tags. Attach sample tags to each individual sample container with a rubber band or wire through a reinforced hole in the tag. Mark all sample tag entries with indelible ink. Fill out the tags at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- Type of analysis.

A space for the laboratory sample number (provided by the laboratory at log-in) will also be provided on the sample tag.

INTERNAL SAMPLE LABELS

For benthic infaunal samples, wash away the sediment from the sample and collect the remaining benthic infauna into a sample container. Affix sample label (as discussed above) to the outside of the sample container. In addition, place an internal sample label inside the sample container. This internal sample label is made of waterproof paper; be sure to make all internal sample label entries with pencil. Fill out the internal sample labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservative used (e.g., formalin).

STANDARD OPERATING PROCEDURE (SOP) AP-06

NAVIGATION AND STATION POSITIONING

SCOPE AND APPLICATION

This SOP describes procedures for accurate station positioning required to ensure quality and consistency in collecting samples and in data interpretation and analysis. Station positioning must be both absolutely accurate in that it correctly defines a position by latitude and longitude, and relatively accurate in that the position must be repeatable, allowing field crew to reoccupy a station location in the future (e.g., for long-term monitoring programs).

This SOP describes the most commonly used station positioning method, differential global positioning system (DGPS). Integral uses a Trimble Pathfinder™ Pro XRS DGPS for station positioning for many field efforts. The Pro XRS offers the submeter accuracy often required for documenting sampling station locations and for re-locating previously sampled stations. A comprehensive discussion of the Trimble Pathfinder™ Pro XRS DGPS is provided in Attachments 1, 2, and 3 of this SOP.

SUMMARY OF METHOD

Global positioning system (GPS) navigation is used to position the sampler at the desired location. GPS is a satellite-based system that receives positioning data at 1-second intervals from multiple satellites at known positions in space. Standard GPS is calculated to an accuracy of about 10 m.

One can obtain a higher accuracy of approximately 2 m by applying differential corrections to the standard GPS positioning data using DGPS. These differential corrections are applied by sending GPS differential corrections to the GPS receiver via radio transmission. If the sampling location is near the coastal U.S, the U.S. Coast Guard generates differential corrections that are transmitted via radio link to the GPS receiver. If a Coast Guard station is out of range of the sampling area, then a receiver may be set up at a known (i.e., surveyed) reference point on land, or real-time satellite differential signals can be purchased from a private company (e.g., OmniSTAR).

With the Pro XRS, GPS data can be gathered to submeter accuracy using a choice of differential correction sources (i.e., free beacon differential signals such as Coast Guard beacons or OmniSTAR) without establishing a reference station. Data must be corrected to gain submeter accuracy. Free beacon or base station signals allow differential corrections to be

performed after data collection by using a nearby beacon or base station logging data files. (Note: The station must be within 300 miles of the data collection location.) For satellite-based signals, a built-in virtual base station allows for real-time data correction, eliminating the need for post-processing data in some cases. However, postprocessing data corrections can obtain accuracies in the range of 30–50 cm. These accuracies are for the horizontal (northing and easting) component only. The vertical component (elevation) accuracy ranges from submeter to 3 times larger than the horizontal accuracy.

The GPS receiver displays and transmits differentially corrected positioning data to the computer using an integrated navigation software package (e.g., HYPACK, Terrasync). The computer data are typically displayed and recorded in World Geodetic System of 1984 (WGS-1984) geographic coordinates (latitude/longitude). However, the integrated navigation system can display and record information in other datums (e.g., UTM, NAD83). The integrated navigation system, acting as a data manager, displays the sampler's position relative to a target station location in plan view on a video screen. The resulting pictorial screen presentation, as well as numeric navigation data (e.g., range and bearing to the target sampling location) assists the vessel operator (when sampling on-water) in approaching and maintaining the station position while sampling.

SUPPLIES AND EQUIPMENT

- Cable
- GPS antenna
- Telemetry antenna (for differential corrections)
- GPS receiver
- Differential corrections receiver
- Computer and monitor
- Navigation software (e.g., Terrasync)
- Logbook or log sheets.

PROCEDURES

Obtain latitude and longitude coordinates at the locations where samples are collected. An average positioning objective is to accurately determine and record the positions of all sampling locations to within 2 m. Positioning accuracies on the order of 1–3 m can be achieved by avoiding the few minutes per day when the satellites are not providing the same level of signal. The GPS provides the operator with a listing of the time intervals during the

day when accuracies are decreased. Avoiding these times allows for better positioning accuracy.

On-Land Sampling Event

A backpack DGPS unit may be used to direct the sampling team to the proposed sampling location. To expedite field activities, enter the target station coordinates into the navigation system database prior to beginning sampling. Place the DGPS antenna as close as possible to where the sampling will occur. Once the sample(s) have been collected at the appropriate location, record the horizontal coordinates of the station in the field logbook.

On-Water Sampling Event

Mount the GPS antenna vertically at the outboard end of the vessel's boom, with the GPS antenna cable extended along the boom into the cabin. Mount the telemetry antenna for receiving differential corrections on a convenient fixture outside the cabin. Locate the GPS receiver, the differential corrections receiver, and the computer in the cabin. Orient the video screen for the computer to allow the vessel operator to observe on-screen positioning data from the helm.

Alternatively, use a backpack DGPS unit to position the sampling vessel (e.g., barge) over a proposed sampling location. Place the DGPS beacon as close as possible to where the drilling will occur (i.e., moon pool). Using the DGPS unit, direct the sampling vessel operator to the sample station location.

Once the sampling vessel is anchored at the appropriate location, record the horizontal coordinates of the station in the field logbook. To expedite field activities, enter the target station coordinates in the navigation system database prior to beginning sampling.

Positioning System Verification

GPS requires no calibration, as all signal propagation is controlled by the U.S. government (the Department of Defense for satellite signals and the U.S. Coast Guard for differential corrections). Verifying the accuracy of the GPS requires coordinates to be known for one (or more) horizontal control point within the study area. The GPS position reading at any given station can then be compared to the known control point. Verify the GPS accuracy at the beginning and end of each sampling day.

Station Positioning Activities

Use a consistent routine for each day's positioning activities. After confirming successful reception of differential signals, turn on the computer on, and the boot the software. Verify the accuracy of the system at a horizontal control point, as described in the previous section.

The sampling team proceeds to a target station location selected by the team leader. That station location is then selected from a number of preselected station locations that have been entered into the integrated navigation system database. Once the station has been selected, the positioning data are displayed on the computer screen or hand-held unit to assist in proceeding to the station and in maintaining the station position during sampling. A confirmed position is recorded electronically each time a sample collection is attempted. (This means that during sediment grab sampling and coring, the locations of both accepted and rejected grabs or cores are recorded.) Upon recovery of the sampling device, read the station position northing (y) and easting (x) coordinates from the archived computer file and record them in the field logbook or on log sheets as a backup to the computer record. Also record time and water depth, if applicable. Ancillary information recorded in the field logbook may include personnel operating the GPS, tidal phase, type of sampling activity, and time when coordinates were collected.

REFERENCES

Trimble Navigation Limited. 2001. TSC1 Asset Surveyor operation manual. Version 5.20. http://trl.trimble.com/dscgi/ds.py/Get/File-8145/Oper.pdf.

Trimble Navigation Limited. 2007. GPS tutorial. Accessed on January 12, 2007. http://www.trimble.com/gps/index.shtml.

ATTACHMENT 1
PRO XRS DESCRIPTION

The Pro XRS combines a high-performance GPS receiver and antenna, beacon differential receiver, and satellite differential receiver in one compact unit. It also includes Trimble's advanced Everest™ technology, which allows users to collect accurate position data near walls, water, vehicles, or other surfaces that reflect satellite signals. Reflected signals, also called multipath signals, make it difficult for GPS receivers to accurately determine position. Everest™ uses a patented technique to remove multipath signals before measurements are used to calculate position.

Equipment Required

The GPS Pathfinder™ Pro XRS consists of the following:

- GPS receiver in backpack casing (with system batteries and cables)
- Hand-held data logger (TSC1) and cable, *or* laptop computer with Terrasync software installed and cable. (Note: Terrasync procedures are described under separate cover.)
- Pro XRS antenna, range poles, and cable
- Compass and tape measure
- Spare 12-volt camcorder and 9-volt batteries (minimum of two each) (use only Kodak, Duracell, or Energizer 9-volt batteries)
- Battery charger and power cord.

Pro XRS Setup

Follow these procedures for the proper setup of the Pro XRS:

1. Ensure that connections between batteries, receiver, and data logger are correct and secure. The coaxial antenna cable connects from the GPS receiver port "ANT" to the base of the antenna. The TSC1 cable (a "pig-tail"-type cable) connects from the bottom or top of the TSC1 to the receiver port "B," where a 9-pin serial port dongle is attached. The dual Y-clip cables should be connected from the receiver to the batteries. Alternatively, if AC power is available (e.g., aboard a vessel), then the power cable for the battery charger can be attached directly to the receiver on some models.
2. Screw the three long antenna poles together (the shorter pole may be added if necessary for taller users). Screw on the antenna and connect its cable.
3. Put backpack and/or shoulder strap on. The pouch for the data logger should be in place around the waist strap or in the backpack.

4. Screw antenna to the attachments on the top of the backpack. Wind cord around pole, and ensure the antenna is secure. Please be aware of overhead hazards, especially if working near low-hanging power lines. Severe injury or death can result.

Basic Operation of the Pro XRS

Recording a Feature

Before beginning field use, ensure that all GPS configurations and settings are set correctly for the particular use of the Pro XRS and that an appropriate data dictionary is loaded onto the TSC1 (see Attachments 2 and 3 for typical settings). These steps outline the basic use of the GPS to document a sample position or any other defined "feature." Note that the TSC1 has both hard and soft keys that allow for its operation. The hard keys comprise all of the keys (e.g., letters and numbers) on its surface. The soft keys are the F1 through F5 hard keys. The function of these changes depending upon the context. These keys will be referred to with brackets around them (<soft-key>).

1. Turn data logger on outside in an open area. Wait for antenna to receive satellite signals. The display will read Recording Almanac, Too Few SVs, and PDOP Too High. Continue to wait until enough satellites (four) are acquired and the PDOP is below 5.0.
2. Ensure that the real-time settings are correct according to the parameters listed in Attachment 2.
3. Select **Data Collection**, and create a new rover file or open an existing file. This file should be named according to the format specified by the project GIS analyst. Note: If opening an existing file, press **<NEW>** to access the *Antenna Options* menu and *Start Feature* menu.
4. Enter the height of the antenna from the ground to the *Measurement Method* reference point shown in the *Antenna Options* menu and then press **ENTER** to bring up the *Start Feature* menu.
5. Pick the appropriate data dictionary to use with the rover file. Only one dictionary can be used with a rover file. Consult with the project GIS analyst to formulate the most appropriate data dictionary for the type of sampling you wish to perform. The data dictionary titled *Generic* contains only a comment field and is appropriate for simple navigation tasks. If using a data dictionary, make sure to become familiar with its attributes before recording information in the field.

6. Move to the location of the first feature for which you want to record the GPS position. Select the appropriate feature and press **ENTER** to begin logging. Log data points in accordance with the feature type. Point features should have at least 10 points collected at a stationary location. Line features should be collected while moving. If movement is stopped, press the **<PAUSE>** key. When movement starts again, press the **<RESUME>** key. Area features should be collected with enough points to define the outline of the area (e.g., a square building would have four single points, collected on each corner, and the **<PAUSE>** key would be used between each of the points).
7. Depending on the setup of the data dictionary, each feature may have one or more feature attributes. An attribute is used to record additional data associated with the feature. For example, the attributes assigned to a sediment sampling station could be the sample number, station ID, sampling gear, sediment color, odor, etc.
8. Use the **<PAUSE>** key while recording feature attributes to avoid too many data points being collected at one point feature. (Body movements while logging attributes for an extended time can decrease the accuracy of collection.) The **<PAUSE>** key must be used when recording attributes of a line or area feature because only one data point should be collected in a single location.
9. Once all attributes are entered and the feature data points are logged, press **ENTER** to complete and save the feature and move on to a new feature. Pressing **ESC** instead of **ENTER** will allow the user to abandon the logged feature without saving.
10. When all features in a given area have been recorded, from the *Data Collection* menu, press **ESC** to exit data capture and then press **<YES>** to close the file. Features are appended and saved to the file after each collection, so there is no need to "save" the file. When the Pro XRS is not in use, it should be turned off. If you need to come back to the same rover file later in the day, the rover file may be reopened at that time. Rover files may not be edited after 7 days from the first feature was created. Please consult the project GIS analyst for the best way to handle multi-week sampling projects.
11. At the end of each day, download the rover file to a PC using Pathfinder Office software.

Feature Collection Options

Offsets—The Pro XRS can collect a point or line feature while standing at a set distance away from the feature. This option may be necessary because of obstructions such as tree cover, buildings, or car traffic. For a point feature, measure the distance between the object you want recorded and the Pro XRS antenna. Use the compass to determine the bearing (e.g., west is 270°). The bearing is the direction the point should be moved for it to be located in the correct place (e.g., if you are due north of the feature, the bearing is south, or 180°; i.e., the position you want recorded is south of where you are standing). Estimate the inclination from the

feature to the GPS antenna (if altitude determination is critical, a clinometer should be used). The inclination is the degree angle up from the feature to the antenna (e.g., if the feature is 5° below the antenna position, enter −5°). During data capture, from within the feature, press the **<OFFSET>** button, and enter the distance, bearing, and inclination. Press **OK** to complete the feature. Note: This procedure describes an offset of a single feature. A constant offset may be applied to all features collected as well.

Nesting—While recording a line feature or an area feature, a point feature may be collected to avoid backtracking. While recording the line or area feature, press **<PAUSE>** and then **<NEST>**. The Pro XRS will prompt for collection of a new feature. Move to the feature, and collect data as for any other point feature. When the feature is complete, press **OK**. The Pro XRS is ready to resume collecting data as part of the line/area feature: press **<RESUME>**. (Remember to continue moving before pressing resume to avoid having multiple positions recorded in the same place in the line or area feature.)

Segmenting—While moving along a line feature, changing the attributes of that line may be necessary (e.g., because of a change in surface type from paved to dirt road). This change may be done without having to begin a new feature by pressing **<PAUSE>** and then ****. Change the appropriate attributes and then press **<RESUME>** to continue recording.

Repeat—This function allows the collection of a new feature with the same feature attributes as the previous feature. If features are not exactly the same, it also allows editing of the attributes.

Quickmark—Allows collection of point features while moving (e.g., from a car or a boat) by estimating the exact location. The use of this feature will not result in positionally accurate locations and is not recommended for most sampling operations.

Reviewing and Editing Features

It is possible to review or edit features collected in the field while still in the data capture mode. For example, it may be necessary to document the GPS location in the field logbook or to edit one of the feature's attributes. Without exiting data capture, press **<REVIEW>**. (If data capture is already complete, just press **<REVIEW>** and then select the appropriate rover file.) This step will display a list of data points including each feature collected. Scroll to the appropriate feature, and follow the steps below depending on the required action:

- To view the GPS location (e.g., lat/lon), press **<POS>.**
- To edit the attributes, press **ENTER**. Make any necessary edits to the attributes by scrolling through.
- To change or add an offset, press **<POS>** and then **<OFFSET>**. Make any necessary changes.
- To delete a feature collected in error, press **<DEL>**.

Navigating to an Existing Location

Waypoints

To use the Pro XRS to navigate to a previously established position, this position must be loaded into the data logger as a waypoint, present as a feature position in the data files, or generated in the field using the GPS unit. Waypoints may be entered into the TSC1 by:

- Entering coordinates manually
- Choosing previously recorded locations and importing them into the TSC1 by using Pathfinder Office
- Defining a location stored in a rover file saved to the TSC1 as a waypoint (see *Reviewing/Editing Features*, above)
- Creating a way point from the current position being shown by the operating GPS unit in the field.

Navigating

Usually you will use the *Navigation* module (accessed by pressing **MENU** followed by **Navigation**) to guide yourself to a target (waypoint or feature). You can also use the *Map* module (accessed by pressing **MENU** followed by **Map**) to:

1. Orient yourself in the area where you are working.
2. Get a general indication of the location of a feature or waypoint that you want to find.
3. Find or select features or waypoints to which you wish to navigate toward.
4. Plot a course from one place to another.
    a. While in the Map screen, the GPS cursor x shows the current position reported by the receiver and is always shown on the Map screen (Note: it may not always be within the visible part of the screen when panning or scrolling). The **<OPTIONS>** key can be used to hide or display the GPS trail (line of dots showing up to 60 previous positions), the heading showing the direction of travel, and other options on the map display.
    b. Select a feature by pressing **MENU**, Data Collection to reach the *Start Feature* screen, and then **<REVIEW>** to access all features contained in the data file. Highlight and select the desired feature by pressing the **<Target>** key, which adds a crossed flag to the feature. Reaccess the *Map* screen by selecting **MENU**, then **Map**, which will now show the highlighted feature with a crossed flag symbol on the Map screen. You can then start moving toward the feature, and the current position (shown by the x) will move closer to the target position as the user approaches.

c. There are two graphical modes of navigation with the Pro XRS in the TSC1 *Navigation* module. On both modes, text information appears on the right of the screen in the *Info* panels, which can be configured by the user. The graphical modes available are the *Directional Dial* screen or the *Road* screen, which can be toggled between using the **<Mode>** key.

d. To navigate, select a target and then a start position. Each of these positions can be features from an open data file or a waypoint. Access a list of available features or waypoints by pressing **<TARGET>** or **<START>**. Once the item has been chosen as a target, it will show the crossed flags symbol in the list. Once a target has been selected, *Distance to Go* appears at the bottom of the *Navigation* screen, which indicates the distance from the current GPS position to the target. Select a start position (not required but useful for calculating crosstrack error and other navigation information) by pressing **<START>**. A waypoint of the current GPS position can be created for use as the Start point by selecting **<CREATE>**. Once the Start position is selected, a flag symbol will appear next to the item in the list.

e. In the *Directional Dial* mode, an arrow will appear that will always point at the target. This is the bearing to go. (Note: You need to be moving for this to be accurate, as it will lock if you are moving too slowly or have stopped.) The triangle at the top represents the direction that you are going or heading. This triangle never moves, but by changing directions, you can line up the arrow with the triangle. When the two are aligned, you are heading in the direction of the target. When you are close to the target, a bull's-eye (two concentric circles) will appear at the edge of the screen. This is warning you that the unit will be switching to the close up screen. A proximity alarm will sound and the directional arrow will be replaced by the bull's-eye on the close up screen. Your current position will be shown by an x and the target by the bull's-eye. Move so that the x is in the same location as the bull's-eye.

f. In the *Road* mode, navigate by walking down a road. Your position is shown by a stick figure and is always positioned in the center of the screen. The target (crossed flags) shows the point to which you are navigating toward. Your heading is shown by the top center of the screen and the bearing to go is shown by the direction of the road, which will rotate as you change your heading. Change your heading until the road is pointing at the top of the screen (*Target* is also at the top of the screen) and the edges are parallel to the sides of the screen. As you move toward the target the screen zooms in, so the road appears to get wider.

Downloading Rover Files

Upon returning to the office, download all rover files from the TSC1 to a PC for post-processing. You will need the Trimble Pathfinder software installed on your computer. If you

are not using a field laptop that already has the program installed, contact your project GIS analyst for instructions on how to install the software.

Connect the TSC1 to your computer using the appropriate cables. In addition to the "pigtail" cable, you will also need a null modem (a 9-pin female-to-female cable) to plug into a PC serial port. Once connected, power up the TSC1 unit and navigate to *MENU>File Manager>File Transfer*. Then, open the Pathfinder software and navigate to the *Utilities>Data Transfer…* window from the menu bar. Select **GIS Datalogger** on COM1 (for most computer systems), and press the green **Connect** button. Download files from the TSC1 by selecting the **Receive** tab and choosing the data file type from the *Add* pulldown menu (Figure 1).

After downloading, remove all rover files and waypoints from the TSC1 to conserve memory. Rover files may be deleted from the *File Manager* menu as follows:

1. Select **MENU>File Manager>Delete File(s)**
2. Select the rover file to be deleted, and press **<ENTER>**
3. Confirm the deletion of this file by pressing **<YES>**.

Delete data dictionaries in the same manner by selecting **Data Dictionaries** from the *File Manager* menu. Delete waypoints by selecting **Utilities** from the *Main* menu and then by selecting **Waypoints,** followed by **<DEL>**.

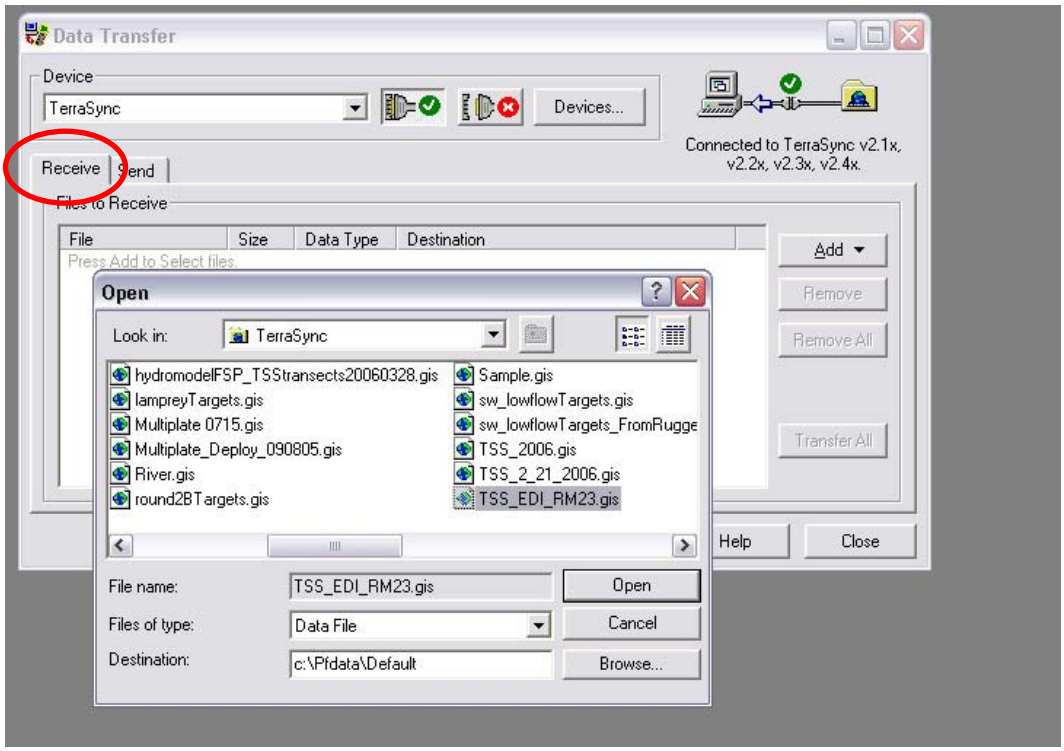


Figure 1. Transferring File from Terrasync

ATTACHMENT 2
TSC1 SETTINGS

The following are lists of menus that can be accessed through the TSC1 keypad. Please ensure that settings are correct before proceeding. Do not make changes to the settings unless necessary. Each menu will list all available subheadings, the correct setting, and the available **<soft-keys>** to access additional menus. Comments are included only where necessary.

GPS Rover Options

To access this menu, select **Configuration** from the main menu and then select **GPS Rover Options**. The table below lists logging options and settings.

Logging Options	Setting	Comment
Logging intervals		
Point feature	1s	
Line/area feature	2s–5s	depending upon speed of movement
Not in feature	None	
Velocity	None	
Confirm end feature	No	
Minimum pos	10	
Carrier Mode	Off	
Carrier phase min. time	10 minutes	
Dynamics code	Land	May be changed to sea or air, as appropriate
Audible click	Yes	
Log DOP data	Yes	
Log PPRT data	Yes	
Log QA/QC data	Yes	
Allow GPS update	Warn First	
Warning Distance	Any	
Position Mode Manual	3D	
Elevation Mask	15°	Should not go below 13° (accuracy decreases)
SNR Mask	6.0	Can raise to 7 if multi-path filtering is poor
PDOP Mask	5.0	Can be raised up to 8; reduces accuracy
PDOP Switch	6.0	

Real-Time Input Options

Access this menu from the GPS Rover *Options* menu by selecting **Real-Time Input**. The table below shows options and settings for real-time input.

Options	Setting	Comment
Preferred Correction Source		
	Choice 1	Integrated Beacon
	Choice 2	Integrated WAAS
	Choice 3	Use uncorrected GPS
Correction Age Limit	20s	

Antenna Options

Access this menu from the GPS rover *Options* menu by selecting **Antenna Options**. The table below shows antenna options and settings.

Option	Setting	Comment
Height	6 ft	Enter correct user antenna height using measurement method indicated below
Measure	Uncorrected	
Type	Integrated GPS/Beacon/Satellite	
Confirm	Per file	Can be changed to “Per feature” if antenna height varies and elevation is critical
Part Number	33580-50	Auto selected based on TYPE selected
Measurement	Bottom of Antenna	
Method	Mount	

ATTACHMENT 3
ADDITIONAL SETTINGS FOR THE TSC1

Additional TSC1 settings can be found in the *Configuration* menu. Items of particular importance are indicated in italics.

Configuration

This menu can be accessed by selecting **Configuration** from the main menu. The table below lists options and descriptions for the *Configuration* menu.

Options	Description
GPS base station options	For using a land base station or beacon for real time corrections
NMEA/TSIP output	Consult manual
Coordinate system	Changes coordinate system among latitude/longitude, UTM, and other coordinate systems. System can be converted, if necessary, after data capture by using Pathfinder Office software.
Map Display options	Change layers, scale, background files and items shown on the TSC1 screen during data collection
Navigation options	Changes Navigation parameters
Units and display	Changes various units, for example: length (e.g., feet, meters), altitude reference (e.g., MSL), *North reference* (i.e., true or magnetic). Units can be converted, if necessary, after data capture by using Pathfinder Office software.
Time and date	Changes to *local time*, 24-hour clock, date format, and other options
Quickmarks	Set-up parameters for use with Quickmarks.
Constant offset	Set-up parameters for use with a constant offset.
External sensors	Connections with external sensors.
Hardware (TSC1)	TSC1 settings such as beep volume, contrast, *internal and external battery status*, software version, free space.

Contrast and Backlighting

The TSC1 display can be viewed in various light settings. Press **FUNC,** then **L** to turn on the display backlight for viewing in dim lighting. Adjust the contrast by pressing **FUNC**, then **E** or **F**.

ATTACHMENT 4
PRE-SAMPLING ACTIVITIES BEFORE USE OF THE PRO XRS

Determination of Optimal Satellite-Use Time

Positioning accuracies on the order of ±1 to 3 m can be achieved by avoiding the few minutes per day when the satellites are not providing the same level of signal. The GPS unit provides the operator with a listing of the time intervals during the day when accuracies are decreased. Avoiding these time intervals permits the operator to maintain better positioning accuracy.

ATTACHMENT 5
MANAGING GPS DATA FROM TERRASYNC—A TUTORIAL

Currently, positional data collected in the field is most often done with a Trimble GPS unit (usually rented) interfaced with a laptop via Trimble's Terrasync software. The Terrasync software sometimes exhibits quirks that interfere with the smooth operation of data collection in otherwise stressful field conditions. This tutorial is meant to supplement the Terrasync software documentation and serve as a guide to field personnel to help them retrieve and collect geographic data as efficiently as possible with existing software.

Scope

This document is intended to be a reference for procedures involving the following:

- Fixing files that are more than 7 days old so that they can be updated
- Adding features in GPS Pathfinder software (companion to Terrasync) and then importing them as base files in Terrasync..

This document is not intended to be a comprehensive manual for using Terrasync or Pathfinder software. It is assumed that the reader has received at least some training on how to use the basic features of Terrasync and is competent at using MS Windows.

The Basics

GPS data collection currently relies on two pieces of complementary software:

- Terrasync—the interface for GPS navigation and data collection.
- Pathfinder Office—a multiuse piece of software that acts as a conduit between GIS data files (shape files) and Terrasync GPS files. Pathfinder can also be used as a simple map editor.

Installing the Correct Versions of Terrasync and Pathfinder

Important Note: This tutorial uses Pathfinder Office v. 3.00 and Terrasync v. 2.50. It is very important to use the proper versions of this software to avoid compatibility issues. These software versions should be included in the same folder as this tutorial, or can be obtained from GIS staff.

http://www.trimble.com/terrasync_ts.asp?Nav=Collection-4576

Key code for TerraSync
499043-00110-05273-EDD049BC

Pathfinder v.3.00
001533-00300-04152-0ee4d11f

Initial Setup of Terrasync/Pathfinder

Certain settings and configuration setups are needed before Pathfinder can talk to Terrasync. Whether you are installing this software for the first time or have an existing installation, check to make sure that these settings are in place.

1. Open Pathfinder Office and go to the *Utilities>Data Transfer...* menu. A dialog box should appear. This is the interface for communicating with Terrasync.
2. Click the **Devices** button, and then **New…** (Figure 1).
3. Click on **GIS Folder**.
4. Browse to the Terrasync data folder on your computer, which in most cases will be *C:\My Documents\TerraSync*.
5. In the next box, *Type* will be **Terrasync**, and *Version* will be **v. 2.1x, v.2.2x, v.2.3x,** and **v2.4x**.
6. At the prompt for a name that will display in the device list, enter **Terrasync**.
7. Go back to the Data Transfer dialog box, select **Terrasync** from the dropdown menu, press the **Connect** icon, and look for a green check mark indicating success.

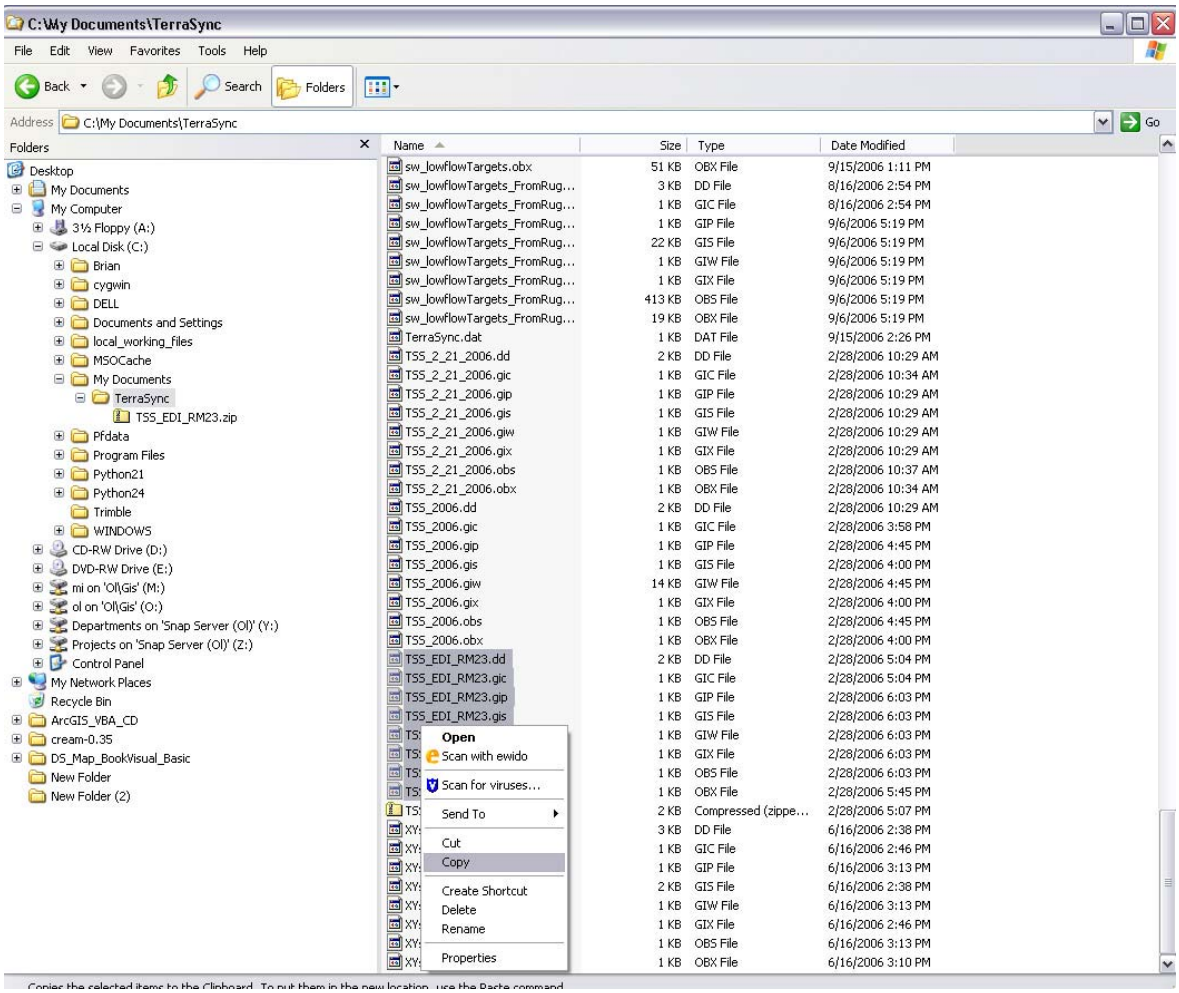


Figure 2. Selecting Files To Copy to a Different Directory

If this procedure does not work for you, you may have the wrong version of Pathfinder. For some unknown reason, with each version upgrade of Pathfinder, connectivity to older versions of Terrasync is lost. You can check what version of Pathfinder you have installed by going to the *Help>About GPS Pathfinder Office...* menu. To find out what version of Terrasync you have, go to *C:\Program Files\TerraSync*, right-click on **Terrasync.exe**, and choose the **Version** tab.

Handling Expired Files in Terrasync

One of the most common problems that field personnel will have to deal with is the 1-week expiration date when trying to collect data with Terrasync. This is a built-in function of Terrasync, and there is no simple way to work around it. The following instructions will guide you through the process to make the files usable. See Figure 3.

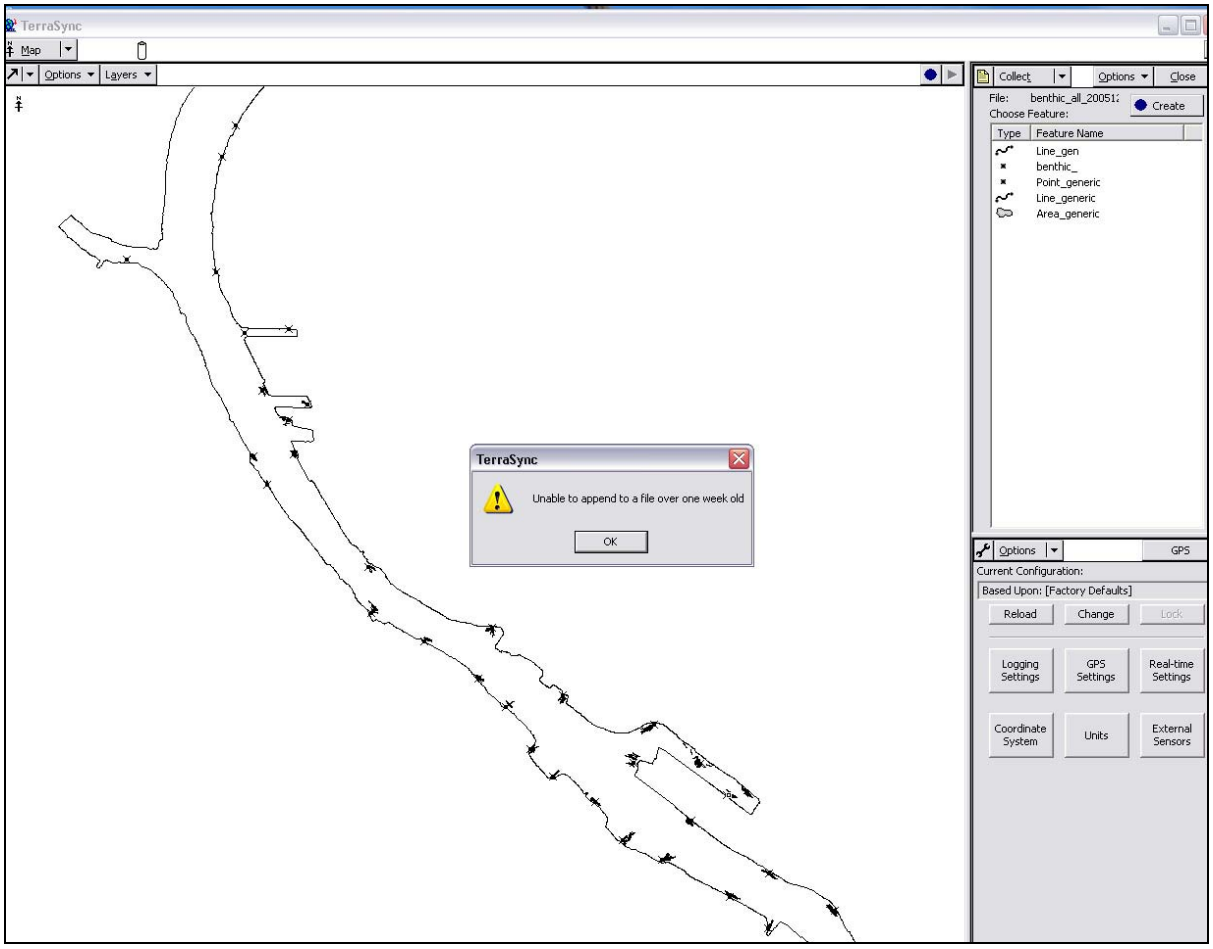


Figure 3. Notice That Terrasync File Older Than 1 Week Will Not Allow User To Collect Features (time begins to elapse when first feature is collected in the field, not when file is created)

Two options are available, depending on your needs. If you do not need to see the previously logged locations and need only to see the targets, use the original files provided by GIS staff (Option 1). If you need to see previously occupied locations in order to make decisions about where to go next, then transfer the file to Pathfinder and back again (Option 2).

Option 1: Move and replace logged files with original targets.

At the beginning of the field effort, you should receive a set of files with the target locations, most likely in a zip archive (.zip file extension). There will be six to eight files with the same name but with different extensions (Figure 4). These files will have to go into the *C:\My Documents\TerraSync* folder in order to be available to Terrasync.

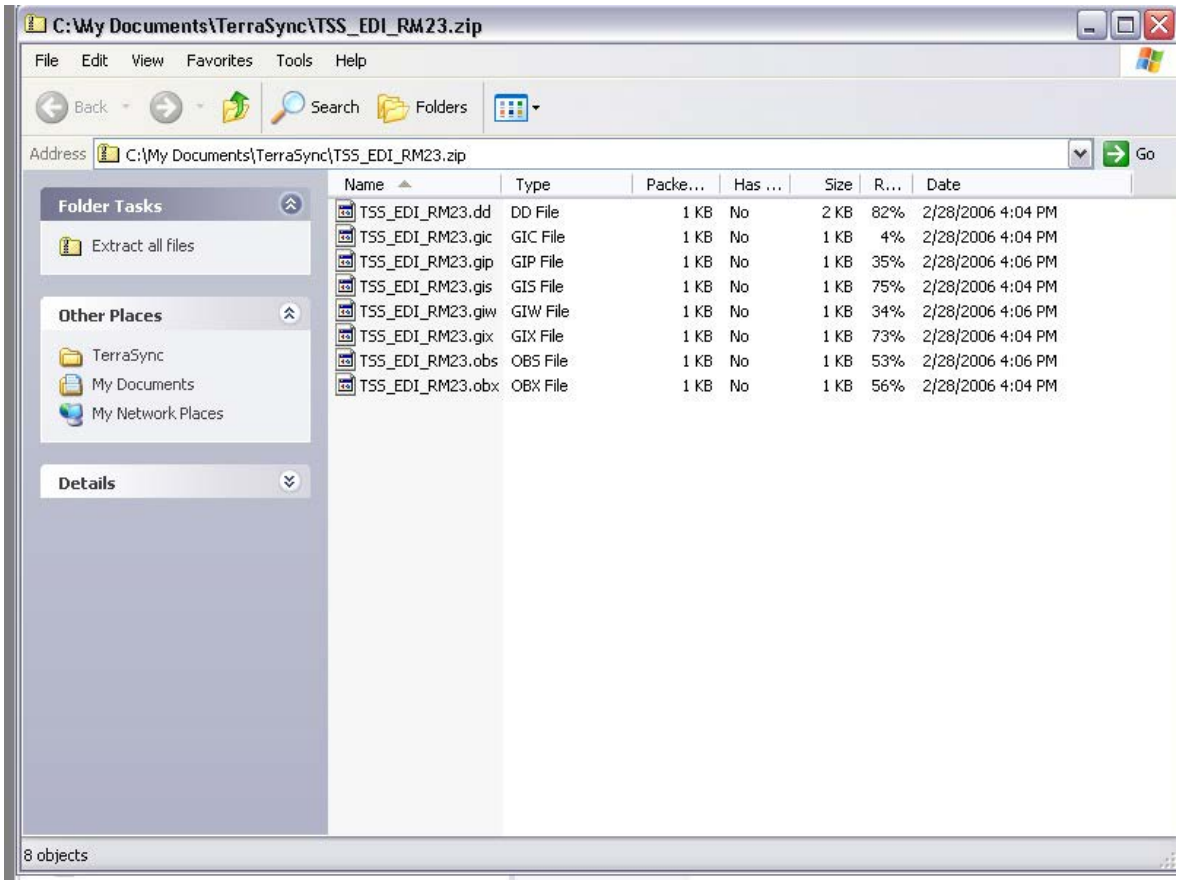


Figure 4. Example of File Set To Be Unzipped into the Terrasync Folder

After you unzip these files to Terrasync, keep this zip archive around in an easy-to-find place, such as your computer desktop, because the 1-week clock does not start until you begin collecting your first point in the field. You can use this unadulterated file again, as long as you make a copy of the work you did the previous week. The detailed steps are as follows:

1. Make sure you have the original files with the target locations available in a handy place. This will probably be the original zip archive. Also, be sure to close Terrasync while performing this process.
2. Navigate to C:\My Documents\TerraSync\ in Windows Explorer. Locate the files that you have been using the previous week. Note: It is crucial to get all of the small files associated with the data set. While it is useful to sort the files by date modified, you can miss some of the small files—it is highly recommended that you sort the files alphabetically.

3. Copy all of these files to a different directory, preferably one that is named appropriately to reflect the data and time period that you were collecting. For example: C:\Documents and Settings\bpointer\Desktop\lampreyTargets_20060925. These files contain the data you have collected the previous week and should be backed up and/or emailed to the appropriate project manager or GIS staff.
4. You can now safely replace the files you just copied with the ones from the original zip file. Right-click the zip archive, and click Extract All. When prompted to Select a folder to extract files to, browse to C:\My Documents\TerraSync. (Figure 5). If prompted about replacing existing files, select Yes to All. Note: It is crucial to make copies of the files first (see Step 3 above)—otherwise, you may lose the data.
5. You should now be able to open the file in Terrasync and begin logging as normal.

Figure 5. Extract (or copy) Original Target Files into the Terrasync Directory

Option 2: Transfer files back and forth from Terrasync.

If you need to be able to see the previously occupied positions from last week while positioning this week, you need to use Pathfinder to reset the file. This process will essentially combine the targets and actuals from last week into one file. However, this method has its drawbacks; once converted, the actuals from last week will not be able to be corrected, so a backup procedure similar to the one in the previous option should be carried out to maintain data integrity.

The steps for file transfer are as follows:

1. For good data management, back up the data files from the previous week using the procedure laid out in steps 1 through 3 in Option 1 above.
2. Close Terrasync and open up Pathfinder Office.
3. Go to the Utilities>Data Transfer menu or just click the icon on the left (Figure 6).
4. Ensure that the device listed is Terrasync. If not, follow the initial setup instructions at the beginning of this document. Most of the computers used for GPS logging are already setup for this.
5. There are two tabs, Receive and Send. Make sure that Receive is selected and then go to Add>Data File. Select the file(s) that you are using and select Open. The file should now be in the Files to Receive box. Click Transfer All and wait for the transfer to take place. If you have made the recommended backups, it is fine to replace any files.
6. Now select the Send tab (Figure 7), and go to Add>Data File. Select the file you just transferred (it will have the same name as the Terrasync file) and click Open. Now click Transfer All to move the file back to Terrasync.

   By transferring the file back and forth from Terrasync to Pathfinder, you have "reset the clock" and can now update the file for an additional 7 days. This file will have your targets and actual positions from the last week, so it is important to be aware of the features you are selecting for navigation.

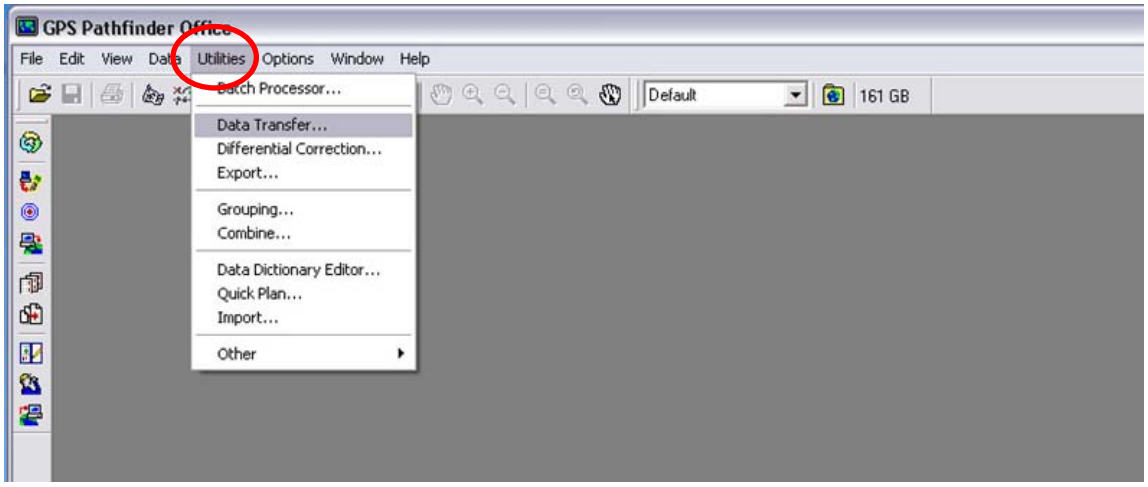


Figure 6. Data Transfer Menu

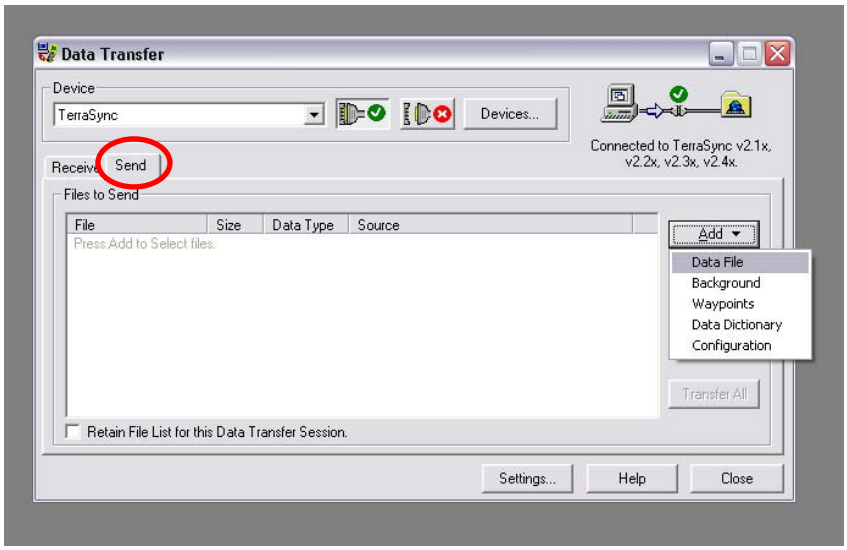


Figure 7. Sending Data File

STANDARD OPERATING PROCEDURE (SOP) SD-01

DECONTAMINATION OF SEDIMENT SAMPLING EQUIPMENT

SCOPE AND APPLICATION

This SOP describes procedures for decontaminating sampling and processing equipment contaminated by either inorganic or organic materials. To prevent potential cross contamination of samples, all reusable sediment sampling and processing equipment is decontaminated before each use. At the sample collection site, a decontamination area is established in a clean location that is upwind of actual sampling locations, if possible. All sediment sampling and processing equipment is cleaned in this location. Decontaminated equipment is stored away from areas that may cause recontamination. When handling decontamination chemicals, field personnel must follow all relevant procedures and wear protective clothing as stipulated in the site-specific health and safety plan (HSP).

Sampling equipment (e.g., van Veen, Ekman, Ponar, core tubes) may be used to collect samples that will 1) undergo a full-suite analysis (organics, metals, and conventional parameters) or 2) be analyzed for metals and conventional parameters only. Decontamination of sampling equipment used for both analyte groups should follow the order of a detergent wash, site water rinse, organic solvent rinses, and final site water rinse. Sample processing equipment (e.g., bowls, spoons) has a final rinse with distilled/deionized water rinse instead of site water. If the surface of stainless steel equipment appears to be rusting (possibly due to prolonged contact with organic-rich sediment), it should undergo an acid rinse and a site-water rinse at the end of each sampling day to minimize corrosion.

EQUIPMENT AND REAGENTS REQUIRED

Equipment required for decontamination includes the following:

- Polyethylene or polypropylene tub (to collect solvent rinsate)
- Plastic bucket(s) (e.g., 5-gal bucket)
- Tap water or site water
- Carboy, distilled/deionized water (analyte-free; received from testing laboratory or other reliable source)
- Properly labeled squirt bottles

- Funnels
- Alconox®, Liquinox®, or equivalent industrial detergent
- Pesticide-grade acetone and hexane (consult the project-specific field sampling plan [FSP], as the solvents may vary by EPA region or state)
- 10 percent (v/v) nitric acid (reagent grade) for inorganic contaminants
- Baking soda
- Long-handled, hard-bristle brushes
- Extension arm for cleaning core liners
- Plastic sheeting, garbage bags, and aluminum foil
- Core liner caps or plastic wrap and rubber bands
- Personal protective equipment as specified in the health and safety plan.

PROCEDURES

Decontamination Procedures for Full Suite Analysis (Organic, Metal, or Conventional Parameters)

Two organic solvents are used in this procedure. The first is miscible with water (e.g., ethanol) and is intended to scavenge water from the surface of the sampling equipment and allow the equipment to dry quickly. This allows the second solvent to fully contact the surface of the sampler. Make sure that the solvent ordered is anhydrous or has a very low water content (i.e., < 1 percent). If ethanol is used, make sure that the denaturing agent in the alcohol is not an analyte in the samples. The second organic solvent is hydrophobic (e.g., hexane) and is intended to dissolve any organic chemicals that are on the surface of the equipment.

The exact solvents used for a given project may vary by EPA region or state (see project-specific FSP). Integral uses ethanol and hexane as preferred solvents for equipment decontamination. If specified in the project-specific FSP, isopropanol or acetone can be substituted for ethanol, and methanol can be substituted for hexane in the decontamination sequence. The choice of solvents is also dependent on the kind of material from which the equipment is made (e.g., acetone cannot be used on polycarbonate), and the ambient temperature (e.g., hexane is too volatile in hot climates). In addition, although methanol is sometimes slightly more effective than other solvents, its use is discouraged due to potential toxicity to sampling personnel.

The specific procedures for decontaminating sediment sampling equipment and sediment compositing equipment are as follows:

1. Rinse the equipment thoroughly with tap or site water to remove visible sediment. Perform this step onsite for all equipment, including core liners that will not be used again until the next day of sampling. After removing visible solids, set aside sampling equipment that does not need to be used again that day; this equipment should be thoroughly cleaned in the field laboratory at the end of the day.
2. Pour a small amount of concentrated laboratory detergent into a bucket (i.e., about 1–2 tablespoons per 5-gal bucket) and fill it halfway with tap or site water. If the detergent is in crystal form, make sure all crystals are completely dissolved prior to use.
3. Scrub the equipment in the detergent solution using a long-handled brush with rigid bristles. For the polycarbonate core liners, use a round brush attached to an extension arm to reach the entire inside of the liners, scrubbing with a back-and-forth motion. Be sure to clean the outside of core liners, bowls, and other pieces that may be covered with sediment.
4. Double rinse the equipment with tap or site water and set right-side-up on a stable surface to drain. The more completely the equipment drains, the less solvent will be needed in the next step. Do not allow any surface that will come in contact with the sample to touch any contaminated surface.
5. If the surface of stainless steel equipment appears to be rusting (this will occur during prolonged use in anoxic marine sediments), passivate[1] the surface as follows (if no rust is present, skip to next step). Rinse with a 10 percent (v/v) nitric acid solution using a squirt bottle, or wipe all surfaces using a saturated paper towel. Areas showing rust may require some rubbing with the paper towel. If using a squirt bottle, let the excess acid drain into the waste container (which may need to be equipped with a funnel). Double-rinse equipment with tap or site water and set right-side-up on a stable surface to drain thoroughly.
6. Carefully rinse the equipment with ethanol from a squirt bottle, and let the excess solvent drain into a waste container (which may need to be equipped with a funnel). Hold core liners over the waste container and turn them slowly so the stream of solvent contacts the entire surface. Turn the sample apparatus (e.g., grab sampler) on its side and open it to wash it most effectively. Set the equipment in a clean location and allow it to air dry. Use only enough solvent to scavenge all of the water and flow off the surface of the equipment (i.e., establish sheet flow) into the waste container. Allow equipment to drain as much as possible. Ideally, the equipment will be dry. The more thoroughly it drains, the less solvent will be needed in the next step.

[1] Passivation is the process of making a material less reactive relative to another material. For example, before sediment is placed in a stainless-steel container, the container can be passivated by rinsing it with a dilute solution of nitric acid and deionized water.

7. Carefully rinse the drained or air-dried equipment with hexane from a squirt bottle, and let the excess solvent drain into the waste container (which may need to be equipped with a funnel). If necessary, widen the opening of the squirt bottle to allow enough solvent to run through the core liners without evaporating. (Hexane acts as the primary solvent of organic chemicals. Ethanol is soluble in hexane but water is not. If water beading occurs, it means that the equipment was not thoroughly rinsed with acetone or that the acetone that was purchased was not free of water.) When the equipment has been rinsed with hexane, set it in a clean location and allow the hexane to evaporate before using the equipment for sampling. Use only enough solvent to scavenge all of the acetone and flow off the surface of the equipment (i.e., establish sheet flow) into the waste container.
8. Do a final rinse with site water for the sampling equipment (i.e., van Veen, Ekman, Ponar, core tubes) and with distilled/deionized water for processing equipment (i.e., stainless-steel bowls and spoons). Equipment does not need to be dried before use.
9. If the decontaminated sampling equipment is not to be used immediately, wrap small stainless-steel items in aluminum foil (dull side facing the cleaned area). Seal the polycarbonate core liners at both ends with either core caps or cellophane plastic and rubber bands. Close the jaws of the Ekman and Ponar grab samplers and wrap in aluminum foil.

   If the sample collection or processing equipment is cleaned at the field laboratory and transported to the site, then the decontaminated equipment will be wrapped in aluminum foil (dull side facing the cleaned area) and stored and transported in a clean plastic bag (e.g., a trash bag) until ready for use, unless the project-specific FSP lists special handling procedures.
10. Rinse or wipe with a wetted paper towel all stainless-steel equipment at the end of each sampling day with 10 percent (v/v) normal nitric acid solution. Follow with a freshwater rinse (site water is okay as long as it is not brackish or salt water).
11. After decontaminating all of the sampling equipment, place the disposable gloves and used foil in garbage bags for disposal in a solid waste landfill. When not in use, keep the waste solvent container closed and store in a secure area. The waste should be transferred to empty solvent bottles and disposed of at a licensed facility per the procedures listed in the project-specific FSP. When not in use, keep the waste acid container closed and store in a secure area. The acid waste should be neutralized with baking soda and disposed of per the procedures listed in the project-specific FSP.

Decontamination Procedures for Metals and Conventional Parameters Only

The specific procedures for decontaminating sediment sampling equipment and sediment processing equipment are as follows:

1. Rinse the equipment thoroughly with tap or site water to remove the visible sediment. Perform this step onsite for all equipment, including core liners that will not be used again until the next day of sampling. Set aside pieces that do not need to be used again that day; these pieces should be and thoroughly cleaned in the field laboratory at the end of the day.
2. Pour a small amount of concentrated laboratory detergent into a bucket (i.e., about 1–2 tablespoons per 5-gal bucket) and fill it halfway with tap or site water. If the detergent is in crystal form, make sure all crystals are completely dissolved prior to use.
3. Scrub the equipment in the detergent solution using a long-handled brush with rigid bristles. For the polycarbonate core liners, use a round brush attached to an extension arm to reach the entire inside of the liners, scrubbing with a back-and-forth motion. Be sure to clean the outside of core liners, bowls, and other pieces that may be covered with sediment.
4. Double-rinse the equipment with tap or site water and set right-side-up on a stable surface to drain. Do not allow any surface that will come in contact with the sample to touch any contaminated surface.
5. If the surface of stainless steel equipment appears to be rusting (this will occur during prolonged use in anoxic marine sediments), passivate[2] the surface as follows (if no rust is present, skip to next step). Rinse with a 10 percent (v/v) nitric acid solution using a squirt bottle, or wipe all surfaces using a saturated paper towel. Areas showing rust may require some rubbing with the paper towel. If using a squirt bottle, let the excess acid drain into the waste container (which may need to be equipped with a funnel). Double-rinse sampling equipment with tap or site water and set right-side-up on a stable surface to drain. Double-rinse processing equipment with distilled/deionized water and allow to drain.
6. If the decontaminated sampling equipment is not to be used immediately, wrap small stainless-steel items in aluminum foil (dull side facing the cleaned area). Seal the polycarbonate core liners at both ends with either core caps or cellophane plastic and rubber bands. Close the jaws of the Ekman and Ponar grab samplers and wrap in aluminum foil.

   If the sample collecting or processing equipment is cleaned at the field laboratory and transported to the site, then the decontaminated equipment will be wrapped in aluminum foil (dull side facing the cleaned area) and stored and transported in a clean plastic bag until ready for use, unless the project-specific FSP lists special handling procedures.

[2] Passivation is the process of making a material less reactive relative to another material. For example, before sediment is placed in a stainless-steel container, the container can be passivated by rinsing it with a dilute solution of nitric acid and deionized water.

7. After decontaminating all of the sampling equipment, place the disposable gloves and used foil in garbage bags for disposal in a solid waste landfill. When not in use, keep the waste acid container closed and store in a secure area. The acid waste should be neutralized with baking soda and disposed of per the procedures listed in the project-specific FSP.

STANDARD OPERATING PROCEDURE (SOP) SD-02

PREPARATION OF FIELD QUALITY CONTROL SAMPLES FOR SEDIMENTS

SCOPE AND APPLICATION

This SOP describes the purpose, preparation, and collection frequency of field duplicate samples, field replicate samples, matrix spike/matrix spike duplicates, equipment rinsate blanks, bottle blanks, trip blanks, temperature blanks, environmental blanks, and reference materials (i.e., a standard reference material, a certified reference material, or other reference material; for the purposes herein, all types of reference materials are referred to as standard reference material, or SRM) for sediment sampling efforts. Not all of the field quality control samples discussed in this SOP may be required for a given project. The specific field quality control samples will be identified in the project-specific field sampling plan (FSP) and quality assurance project plan (QAPP). For most projects, Integral's recommended field quality control samples are an equipment rinsate blank, a field duplicate, and trip blanks if samples are to be analyzed for volatile organic compounds (VOCs). Definitions of all potential quality control samples are described below.

As part of the quality assurance/quality control (QA/QC) program, all field quality control samples will be sent to the laboratories "blind." To accomplish this, field quality control samples will be prepared and labeled in the same manner as regular samples, with each quality control sample being assigned a unique sample number that is consistent with the numbering for regular samples. All of the containers with preservatives that are required to complete the field quality control sample for the applicable analyte list shall be labeled with the same sample number. The sample ID for field quality control samples should allow data management and data validation staff to identify them as such and should be recorded only in the field logbook. Under no circumstances should the laboratory be allowed to use reference materials, rinsate blanks, or trip blanks for laboratory quality control analysis (i.e., duplicates, matrix spike, and matrix spike duplicates). To prevent such an occurrence, regular samples should be selected and marked on the chain-of-custody/sampling analysis request (COC/SAR) form or the laboratory should be instructed to contact the project QA/QC coordinator to select appropriate samples for each sample group.

Field quality control samples will be prepared at least once per sampling event, and certain types will be prepared more often at predetermined frequencies. If the number of samples taken does not equal an integer multiple of the intervals specified in this SOP, the number of

field quality control samples is specified by the next higher multiple. For example, if a frequency of 1 quality control sample per 20 is indicated and 28 samples are collected, 2 quality control samples will be prepared. Field quality control samples for sediment sampling activities should be prepared consistent with the requirements discussed below and at the frequency indicated unless different frequency requirements are listed in the FSP and QAPP.

The following table lists the quality control sample types and suggested frequencies for sediment sampling programs. Because sediment quality control sampling may require assessment of site cross-contamination, additional blanks may be required. A detailed explanation of each quality control sample type with the required preparation follows.

Table 1. Field Quality Control Sample Requirements

Quality Control Sample Name	Abbreviation	Preparation		Frequency[a]
		Location	Method	
Duplicate	DUP	Sampling site	Additional natural sample	One per 20 samples. May not be applicable if REP is being collected.
Replicate	REP	Sampling site	Additional natural sample	One replicate per 20 samples. May not be applicable if DUP is being collected.
Matrix spike/matrix spike duplicate	MS/MSD	Sampling site	Additional sample bottles filled for laboratory quality control requirements	One per 20 samples.
Equipment rinsate blank	ER	Sampling site	Deionized water collected after pouring through and over decontaminated equipment	Minimum of one per sampling event per type of sampling equipment used and then 1 per 20 thereafter.
Filter wipe	FW	Sampling site	Whatman filter papers (organic analysis) and Ghost Wipes (metals/mercury analysis) will be wiped over decontaminated equipment	Minimum of one per sampling event per type of sampling equipment used and then 1 per 20 thereafter.
Filter paper blank	FB	Sampling site	Clean, unused Whatman filter papers (organic analysis) and Ghost Wipes (metals/mercury analysis) will be sent to the analytical laboratory	Minimum of one for each lot number of filter papers used.
Bottle blank	BB	Field	Unopened bottle	One per sample episode or one per bottle type.
Trip blank	TB	Laboratory	Deionized water with preservative	One pair per each VOC sample cooler shipment.

Quality Control Sample Name	Abbreviation	Preparation		Frequency[a]
		Location	Method	
Temperature blank	TMB	Laboratory	Deionized water	One per sample cooler.
Environmental blank	EB	Field	Bottle filled at sample site with deionized water	One per 20 samples.
Standard reference material	SRM	Field laboratory or sampling site	SRM ampules or other containers for each analyte group	One set per 50 samples or one per episode.

[a] Frequencies provided here are general recommendations; specific frequencies should be provided in the project-specific FSP or QAPP.

FIELD DUPLICATE SAMPLES

Field duplicate (or split) samples are collected to assess the homogeneity of the samples collected in the field and the precision of the sampling process. Field duplicates will be prepared by collecting two aliquots for the sample and submitting them for analysis as separate samples. Field duplicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of field duplicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

FIELD REPLICATE SAMPLES

Field replicate samples are co-located samples collected in an identical manner over a minimum period of time to provide a measure of the field and laboratory variance, including variance resulting from sample heterogeneity. Field replicates will be prepared by collecting two completely separate samples from the same station and submitting them for analysis as separate samples. Field replicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. If field duplicate samples are collected, then it is unlikely that field replicate samples will also be collected during a sampling event. The actual number of field replicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

MATRIX SPIKE/MATRIX SPIKE DUPLICATES

The matrix spike/matrix spike duplicate (MS/MSD) analyses provide information about the effect of the sample matrix on the design and measurement methodology used by the laboratory. To account for the additional volume needed by the laboratory to perform the analyses, extra sample volumes may be required to be collected from designated sediment stations. MS/MSDs may be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of extra bottles collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements may vary by analyte group).

EQUIPMENT RINSATE BLANKS

Equipment rinsate blanks will be used to help identify possible contamination from the sampling environment and/or from decontaminated sampling equipment. Equipment rinsate blanks will be prepared by pouring laboratory distilled/deionized water through, over, and into the decontaminated sample collection equipment, and then transferring the water to the appropriate sample containers and adding any necessary preservatives. Equipment rinsate blanks will be prepared for all inorganic, organic, and conventional analytes at least once per sampling event per the type of sampling equipment used. The actual number of equipment rinsate blanks prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of equipment rinsate blank collection may vary by EPA region or state).

FILTER WIPES

Filter wipe samples will be used to help identify possible contamination from the sampling environment or from the decontaminated sediment sampling equipment (e.g., sediment grab sampler, stainless-steel bowls and spoons, shovel, trowel).

Filter wipe samples will be prepared by grasping a piece of clean, ashless filter wipe/paper with decontaminated tongs and/or tweezers and wiping down all surfaces of dry, decontaminated equipment that comes into contact with the sediment sample (e.g., stainless-steel spoon, inside of sediment grab sampler). Whatman filter papers will be used for organic analysis and Ghost Wipes will be used for metals/mercury analysis. The filter wipes/papers will be from the same lot used to prepare the filter paper blanks (see below), and the filter lot number will be clearly noted in the field logbook. One filter wipe/paper will be used for each equipment type, solid matrix type, and analysis type. For example, if two pieces of equipment were used for sediment sampling (trowel and stainless-steel spoon) and both metals and

organic compounds were being analyzed, then a total of four filter wipes/papers would be sent to the analytical laboratory.

Tongs and/or tweezers will be used to handle the filter wipe/paper, and all sediment sample-exposed surfaces will be thoroughly wiped down using one piece of filter wipe/paper (per equipment type and for each analysis). The filter wipe sample will then be placed into a labeled certified pre-cleaned sample jar provided by the analytical laboratory. The filter wipe/paper box will be stored in a clean glass container and must NOT be stored in a plastic bag. In moist environments, the filters should be wrapped thoroughly in aluminum foil to protect them from moisture.

Filter wipe samples will be prepared for all inorganic and organic analytes at least once per sampling event per the type of sampling equipment used. The actual number of filter wipe samples prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of filter wipe sample collection may vary by EPA region or state).

FILTER PAPER BLANKS

Whenever a filter wipe sample is prepared in the field, a filter paper blank will also be prepared in the field to evaluate potential background concentrations present in the filter paper used for the equipment filter wipe sample.

Filter paper blanks will be prepared by using tongs and/or tweezers to remove the clean ashless filter paper from its box. Whatman filter papers will be used for organic analysis and Ghost Wipes will be used for metals/mercury analysis. The filter papers will be from the same lot used to prepare the filter wipe samples (see above), and the filter lot number will be clearly noted in the field logbook. One filter wipe/paper will be sent to the analytical laboratory for each type of analysis to be performed (i.e., inorganic or organic analytes). The filter paper blank will be placed into a labeled certified pre-cleaned sample jar provided by the analytical laboratory.

Filter paper blanks will be collected at a minimum frequency of one for each filter lot number. The actual number of filter paper blanks prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of filter paper blank collection may vary by EPA region or state).

BOTTLE BLANKS

The bottle blank is an unopened sample bottle. Bottle blanks are submitted along with sediment samples to ensure that contaminants are not originating from the bottles themselves because of improper preparation, handling, or cleaning techniques. If required, one bottle

blank per lot of prepared bottles will be submitted for analysis. If more than one type of bottle will be used in the sampling (e.g., high-density polyethylene or glass), then a bottle blank should be submitted for each type of bottle and preservative. The actual number of bottle blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP as the requirements on frequency of bottle blank analysis may vary by EPA region or state).

To prepare a bottle blank in the field, set aside one unopened sample bottle from each bottle lot sent from the testing laboratory. Label the bottle as "Bottle Blank" on the sample label (and in the "Remarks" column on the COC/SAR form), and send the empty bottle to the laboratory with the field samples.

TRIP BLANKS

Trip blanks will be used to help identify whether contaminants may have been introduced during the shipment of the sediment samples from the field to the laboratory for VOC analyses only. Trip blanks are prepared at the testing laboratory by pouring distilled/ deionized water into two 40-mL VOC vials and tightly closing the lids. Each vial will be inverted and tapped lightly to ensure no air bubbles exist.

The trip blanks will be transported unopened to and from the field in the cooler with the VOC samples. A trip blank is labeled and placed inside the cooler that contains newly collected VOC samples and it remains in the cooler at all times. A trip blank must accompany samples at all times in the field. One trip blank (consisting of a pair of VOC vials) will be sent with each cooler of samples shipped to the testing laboratory for VOC analysis.

TEMPERATURE BLANKS

Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank shall be included with each sample cooler shipped to the testing laboratory.

ENVIRONMENTAL BLANKS

The environmental (field) blank is prepared in the field to evaluate potential background concentrations present in the air and in the distilled/deionized water used for the final decontamination rinse. If unpreserved bottles are to be used, then the appropriate preservative (i.e., for metals samples use a 10 percent nitric acid solution to bring sample pH

to 2 or less) must be added, as may be required. Environmental blanks should be collected at a minimum frequency of 1 in 20 samples. The actual number of environmental blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of environmental blank analysis may vary by EPA region or state).

To prepare an environmental blank in the field, open the laboratory-prepared sample bottle while at a sample collection site, fill the sample bottle with distilled/deionized water, and then seal it. Assign the environmental blank a unique sample number, label the bottle, and then send the bottle to the laboratory with the field samples.

REFERENCE MATERIALS

SRMs are samples containing known analytes at known concentrations that have been prepared by and obtained from EPA-approved sources. The SRMs have undergone multi-laboratory analyses using a standard method that provides certified concentrations. When available for a specific analyte, SRMs provide a measure of analytical performance and/or analytical method bias (i.e., accuracy) of the laboratory. Several SRMs may be required to cover all analytical parameters. For all analytes where available, one SRM will be analyzed at a frequency of one per 50 samples. The actual number of SRMs analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of SRM analysis may vary by EPA region or state).

STANDARD OPERATING PROCEDURE (SOP) SD-04

SURFACE SEDIMENT SAMPLING

SCOPE AND APPLICATION

This SOP defines and standardizes the methods for collecting surface sediment samples from freshwater or marine environments. Surface sediments are defined as those from 0 to at most 10 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and depends on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

This SOP utilizes and augments the procedures outlined in USEPA (1996) and ASTM (2003) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow the USEPA (1996) guidelines.

SUMMARY OF METHOD

Sediment samples for chemical and toxicity analysis are collected using a surface sediment sampling device (e.g., grab sampler) or hand implements (i.e., spoons, scoops, shovels, or trowels). If a sample meets acceptability guidelines, overlying water is carefully siphoned off the surface in a grab sampler, and the sediment is described in the field logbook. Depending upon the type of analysis to be performed, sediment samples for chemical analysis may be collected directly from an undisturbed surface (e.g., volatile organic compounds and sulfides), or may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts or exposed sediment locations may also be composited and homogenized prior to being placed in sample jars.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device
  - Grab sampler or box corer (see examples below in procedures for “Sediment Sample Collection”)

  - Stainless-steel spoon, scoop, shovel, or trowel
- Field equipment
  - Siphoning hose
  - Stainless-steel bowls or containers
  - Stainless-steel spoons, spatulas, and/or mixer
  - Stainless-steel ruler
  - Project-specific decontamination supplies (e.g., Alconox™ detergent, 0.1 N nitric acid, methanol, hexane, distilled/deionized water)
  - Personal protective equipment for field team (e.g., rain gear, safety goggles, hard hats, nitrile gloves)
  - First aid kit
  - Cell phone
  - Camera
  - Sample containers
  - Ziploc® bags
  - Bubble wrap
  - Sample jar labels
  - Clear tape
  - Permanent markers
  - Indelible black-ink pens
  - Pencils
  - Coolers
  - Ice
- Documentation
  - Waterproof field logbook
  - Field sampling plan
  - Health and safety plan
  - Correction forms
  - Request for change forms
  - Waterproof sample description forms.

PROCEDURES

Sediment Sample Collection with a Grab Sampler

Use a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. The sampler should be composed of a material such as stainless steel or aluminum, or have a noncontaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (e.g., van Veen, Ekman, Smith-McIntyre, Young grab, Power Grab and modified-ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m^2). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially van Veen grab and Ekman grab, are the most commonly used samplers to collect surface sediment. Power Grab samplers are often used for programs requiring collection of sediment deeper than 10 cm (4 in.) or in areas with debris.

Depending on grab weight and water depth, use a hydraulic winch system to deploy the heavier samplers at a rate not exceeding 1 m/second to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, close the jaws slowly and bring the sampler to the deck of the vessel at a rate not exceeding 1 m/second to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, record the time, water depth, and location of sample acquisition in the field logbook.

Retrieve and secure the sampler, and carefully siphon off any overlying water. Inspect the sample to determine acceptability using the criteria detailed in USEPA (1996), except when noted in the project-specific field sampling plan. These criteria include but are not limited to the following:

- There is minimal or no excessive water leakage from the jaws of the sampler
- There is no excessive turbidity in the water overlying the sample
- The sampler is not over-penetrated
- The sediment surface appears to be intact with minimal disturbance
- There is no anthropogenic (i.e., man-made) debris in the sampler
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, record the sample collection location using a global positioning system (GPS) and enter observations onto a sample collection form or the field logbook. Depending on programmatic goals, remove the sampling interval specified in the field sampling plan. Use a decontaminated stainless-steel ruler to measure the sample collection depth (0 to 10 cm) within the sampler. To prevent possible cross-contamination, do not use sediments touching the margins of the sampler.

Take a photograph of the sediment in the grab sampler and in the stainless-steel bowl in the field. Verify that the station number or sample ID, time, and date are shown in the photograph.

Typically, sediment from a minimum of three separate casts of the sampler is composited at each station (see project-specific field sampling plan). Once the sample has been characterized, subsample the sediment for chemical and biological analyses using a decontaminated stainless-steel spoon.

Sediment Sample Collection with Hand Implements

Obtain a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. Hand implements (e.g., spoons, scoops, shovels, or trowels) must be composed of stainless steel.

Use GPS to locate the sampling site and approach the location carefully to avoid disturbing the area of sediment to be sampled. Prior to sample collection, describe and characterize the undisturbed surface sediment in the field logbook. If necessary, expose the sediment surface by clearing an approximately 1-ft^2 area at the sampling site of any rocks greater than approximately 5 in. Remove any anthropogenic (i.e., man-made) debris and organic material on the sediment surface. Note any material removed from the sampling site in the field logbook.

Using a decontaminated, stainless-steel hand implement (i.e., spoon, scoop, shovel, or trowel), excavate the sediment to 10 cm. Place the sediment in a decontaminated stainless-steel bowl and use a decontaminated stainless-steel ruler to confirm that the correct sampling interval has been collected. If the full sample collection interval (i.e., 10 cm) has not been reached, collect additional sediment, place it in the stainless-steel bowl, and reconfirm the sampling interval. Continue this process until the full sample collection interval (0 to 10 cm) has been reached.

Take a photograph of the excavated hole from where the sediment sample was removed. Verify that the station number or sample ID, time, and date are shown in the photograph.

Sample Processing

Complete all sample collection forms, labels, custody seals, and chain-of-custody forms, and record sample information in the field logbook.

Collect samples for volatile compounds (either organics or sulfides) using a decontaminated stainless-steel spoon while sediment is still in the grab sampler or, if the sample is collected using a hand implement, in the stainless-steel bowl. Sediments for volatile analysis are not homogenized. Tightly pack the volatile organics sample jar with sediment (to eliminate obvious air pockets) and fill it so that no headspace remains in the jar. Alternatively, if there is adequate water in the sediment, fill the container to overflowing so that a convex meniscus forms at the top, and then carefully place the cap on the jar. Once sealed, the jar should contain no air bubbles.

Place the remaining sediment in the grab sampler in a precleaned, stainless-steel bowl; sediment collected using hand implements are already in a stainless-steel bowl. Once a sufficient amount of sediment has been collected, mix the sediment using a decontaminated stainless-steel spoon until it is of uniform color and texture throughout.

If required for analysis, collect samples for grain-size tests before any large rocks are removed from the homogenized sediment. Identify any rocks that are greater than 0.5 in. in diameter. Determine their percentage contribution to the homogenized sediment volume, note it on the sediment field collection form or in the field logbook, and then discard the rocks.

Dispense the sediment into precleaned sample jars for the various chemical or biological analyses. For toxicity testing, fill sample jars to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. For chemical analysis, sample containers may be frozen for storage. Leave enough headspace to allow for sediment expansion.

After dispensing the sediment, place the containers into coolers with ice and either ship them directly to the analytical laboratories or transport them to a storage facility.

REFERENCES

ASTM. 2003. *Standard Practice for Collecting Benthic Macroinvertebrates with Ekman Grab Sampler*. ASTM Standards on Disc, Volume 11.05.

USEPA. 1996. Puget Sound Estuary Program: Recommended protocols for measuring selected environmental variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA.

ATTACHMENT A4

FIELD FORMS

-CORRECTIVE ACTION RECORD
-FIELD CHANGE REQUEST
-SAFETY BRIEFING
-EMPLOYEE EXPOSURE/INJURY/ILLNESS INCIDENT REPORT
-CHAIN OF CUSTODY FORM
-SURFACE SEDIMENT COLLECTION FORM
-VISUAL INSPECTION FORM

CORRECTIVE ACTION RECORD

Page ____ of ____ Audit Report No.: _____ Date: _____

Report Originator: _____ Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____

Date of Actual Occurrence: _____ By: _____

Analyte: _____ Analytical Method: _____

Cause of Problem:

CORRECTIVE ACTION PLANNED:

Person Responsible for Corrective Action: _____ Date of Corrective Action: _____

Corrective Action Plan Approval: _____ Date: _____

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: _____ Date of Follow-up Activity: _____

Final Corrective Action Approval: _____ Date: _____

FIELD CHANGE REQUEST

Page _____ of _____ Field Change No.: _____ Project Number: _____

Project Name: _____

CHANGE REQUEST

Applicable Reference: _____

Description of Change:

Reason for Change:

Impact on Present and Completed Work:

Requested by: _____ Date: _____
(Field Scientist)

Acknowledged by: _____ Date: _____
(Field Task Leader)

SAMPLING AND ANALYSES COORDINATOR RECOMMENDATION

Recommended Disposition:

Recommended by: _____ Date: _____

CERCLA COORDINATOR APPROVAL

Final Disposition:

Approved/Disapproved by: _____ Date: _____

EPA PROJECT MANAGER APPROVAL

Approved/Disapproved by: _____ Date: _____

integral consulting inc.

SAFETY BRIEFING

CHSM: Eron Dodak (503) 943-3614

Date: _____ Project Name: _____ Project Number: _____

Meeting Conductor: _____ Site Safety Officer: _____ Project Manager: _____

- ☐ HASP Review & Location
- ☐ Lines of Authority
- ☐ Chemical Hazards & Exposure Routes
- ☐ Flammable Hazards
- ☐ Lifting Techniques
- ☐ Buddy System
- ☐ Self & Coworker Monitoring
- ☐ Biological/Plant/ Animal Hazards
- ☐ Slips, Trips, & Falls
- ☐ Heat & Cold Stress
- ☐ Overhead Hazards
- ☐ Vessel Safety Protocols
- ☐ Proper Use of PPE
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Emergency Procedures & Evacuation Route
- ☐ Directions to Hospital
- ☐ Emergency Decontamination Procedures
- ☐ Site Communication
- ☐ Work Zones
- ☐ Site Security
- ☐ Vehicle Safety & Driving/Road Conditions
- ☐ Equipment Safety & Operation
- ☐ Other

Field Staff H&S Concerns: _____

Weather Conditions: _____

Daily Work Scope: _____

Site-Specific Hazards: _____

ATTENDEES

Printed Name	Signature

Integral Consulting Inc.
Employee Exposure/Injury/Illness Incident Report

Employee: _____ Employee ID No._____

Sex: M ____ F ____ Office location: _____

Incident:

Possible exposure: _____ Known exposure: _____

Physical injury/illness: _____

Check only **one** below for **illness**:

____ Occupational skin diseases or disorders ____ Disorders due to physical agents

____ Dust diseases of the lungs ____ Disorders associated with repetitive motion

____ Respiratory conditions due to toxic agents ____ All other occupational illnesses

Location: _____ Contract or Overhead No. _____

Date of incident: _____ Time of incident: _____

Date incident reported: _____ Person to whom incident was reported: _____

Date of initial medical diagnosis: _____

Weather condition during incident: Temperature: _____ Humidity: _____

Wind speed and direction: _____ Cloud cover: _____

Clear: _____ Precipitation: _____

Name of materials potentially encountered:

Chemical (liquid, solid, gas, vapor, fume, mist): _____

_____

Radiological: _____

_____

Biological or Other: _____

_____

Describe the exposure/injury/illness in detail, the parts of the body affected, and how the incident occurred (attach extra sheets if necessary):

_____

_____

_____

_____

_____

_____

Was medical treatment given? Yes ___ No ____ If so, when? _____

By whom? Name of paramedic: _____

Name of physician: _____

Other: _____

Where? Onsite ___ Offsite ___

If offsite, name of hospital or clinic: _____

Length of inpatient stay (dates): _____

Was corporate management notified? No ___ Yes ___ When? _____

Name and title of manager(s) notified: _____

Did the exposure/injury/illness result in death? No ___ Yes ___ Date: _____

Did the exposure/injury/illness result in permanent disability? No ___ Yes ___ If yes, explain:

_____

Days away from work: _____ Days of restricted work activity: _____

Has the employee returned to work? No ____ Yes ____ If yes, date: _____

Name of other persons affected during the incident:

_____ _____

_____ _____

Names of persons who witnessed the incident:

_____ _____

_____ _____

Name and title of field team leader or immediate supervisor at the site:

_____

Was the operation being conducted under an established safety plan? No ____ Yes ____

If yes, attach a copy. If no, explain: _____

_____

Were protective equipment and clothing used by the employee? No ___ Yes ___ If yes, list items:

_____

Did any limitations in safety equipment or protective clothing affect or contribute to exposure? If so, explain:

_____

_____

What was the employee doing when the exposure/injury/illness occurred? (Describe briefly as site reconnaissance, site categorization, sampling, etc.):

_____

_____

_____

_____

_____

_____

Describe exact onsite or offsite location where the incident occurred:

_____

_____

How did the incident occur? Describe fully the factors that led to or contributed to the incident:

_____

_____

_____

_____

_____

Attachments to this report: ___ Medical report(s) if not confidential ___ Site safety plan ___
Other relevant information ____

_____ _____
Employee's signature Date

_____ _____
Project Manager's signature Date

_____ _____
Site safety officer's signature Date

_____ _____
Corporate health and safety officer's signature Date

Management review and comments:

Medical consultant's comments:

Physician's signature Date

Corporate health and safety officer review and comments

Action required? No ____ Yes ____ If yes, what action?

Follow-up action carried out:

Corrective actions to be taken to prevent similar incidents:

Corporate health and safety officer's signature Date

Employee's signature	Date
Field team leader's signature	Date
Site safety officer's signature	Date
Project manager's signatures	Date
Supervisor's signature	Date

CHAIN OF CUSTODY FORM

Project: _____

Samplers: _____

Integral Contact: _____

Office _____

Phone _____

Ship to: Lab Name _____

Address _____

Contact _____

Phone _____

integral consulting inc.

Sample No.	Date	Time	Matrix	ANALYSES REQUESTED								Extra Container	Archive	Comments

Analysis Turn Time: **Normal** **Rush** **Rush Results Needed By:**

Shipped by: **Shipping Tracking No.**

Condition of Samples Upon Receipt: **Custody Seal Intact?**

Matrix Code: GW - Groundwater
SL - Soil SW - Surface water
SD -Sediment Other:

Relinquished by: _____ **Date/Time:** _____ **Received by:** _____ **Date/Time:**_____
(signature) *(signature)*

Relinquished by: _____ **Date/Time:** _____ **Received by:** _____ **Date/Time:**_____
(signature) *(signature)*

Special Instructions:

Annapolis
200 Harry S. Truman Pkwy
Suite 330
Annapolis, MD 21401

Denver
285 Century Place
Suite 190
Louisville, CO 80027

Portland, Oregon
319 SW Washington St
Suite 1150
Portland, OR 97204

Honolulu
3465 Waialae Ave
Suite 380
Honolulu, HI 96816

Seattle
411 1st Ave S
Suite 550
Seattle, WA 98104

Portland, Maine
45 Exchange St
Suite 200
Portland, ME 04101

Olympia
1205 West Bay Dr NW
Olympia, WA 98502

SURFACE SEDIMENT COLLECTION FORM

Project Name: _____ **Project No.:** _____ Pg. ___of ___
Date: _____ **Crew:** _____
Weather: _____
Sampling Method: _____

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No
Bottom Depth: _____ (cm) **Penetration Depth:** _____ (cm) **RPD Depth:** _____ (cm)
Fines overlying cap material: ☐ Yes ☐ No **Fines Thickness:** _____ (cm)
Analyses before homogenization: ☐ **VOC** ☐ **Sulfides** ☐ **Other** **Photo ID:** _____
Sample ID: _____
Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments:

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No
Bottom Depth: _____ (cm) **Penetration Depth:** _____ (cm) **RPD Depth:** _____ (cm)
Fines overlying cap material: ☐ Yes ☐ No **Fines Thickness:** _____ (cm)
Analyses before homogenization: ☐ **VOC** ☐ **Sulfides** ☐ **Other** **Photo ID:** _____
Sample ID: _____
Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments:

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No
Bottom Depth: _____ (cm) **Penetration Depth:** _____ (cm) **RPD Depth:** _____ (cm)
Fines overlying cap material: ☐ Yes ☐ No **Fines Thickness:** _____ (cm)
Analyses before homogenization: ☐ **VOC** ☐ **Sulfides** ☐ **Other** **Photo ID:** _____
Sample ID: _____
Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments:

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No
Bottom Depth: _____ (cm) **Penetration Depth:** _____ (cm) **RPD Depth:** _____ (cm)
Fines overlying cap material: ☐ Yes ☐ No **Fines Thickness:** _____ (cm)
Analyses before homogenization: ☐ **VOC** ☐ **Sulfides** ☐ **Other** **Photo ID:** _____
Sample ID: _____
Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments:

VISUAL INSPECTION FORM

Project Name: _____ **Project No.:** _____ Pg. ___of ___
Date: _____ **Crew:** _____
Weather: _____
Equipment: _____

Station: _____ **Photo ID:** _____ **Azimuth:** _____ **Time:** _____
Marker Type/Condition: _____

Classification: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Stratification: _____
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface ☐ other _____
Evidence of Pollution (sheen, etc.): _____
Organic matter accumulation (e.g., leaf litter, logs, woody debris): _____

Presence/description of debris/litter/garbage: _____

Estimated thickness of fine sediment deposit: _____
Assessment of the re-establishment of intertidal aquatic habitat: _____

Observations of wildlife use (including avifauna and macroinvertebrates): _____

Assessment of the cap integrity: _____

Other observations: _____

Station: _____ **Photo ID:** _____ **Azimuth:** _____ **Time:** _____
Marker Type/Condition: _____

Classification: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Stratification: _____
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface ☐ other _____
Evidence of Pollution (sheen, etc.): _____
Organic matter accumulation (e.g., leaf litter, logs, woody debris): _____

Presence/description of debris/litter/garbage: _____

Estimated thickness of fine sediment deposit: _____
Assessment of the re-establishment of intertidal aquatic habitat: _____

Observations of wildlife use (including avifauna and macroinvertebrates): _____

Assessment of the cap integrity: _____

Other observations: _____

ATTACHMENT A5

FIELD ENGINEERING SPECIFICATIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall provide all materials, items, operations, or methods specified, listed, or scheduled on the Drawings or in the Specifications, including all materials, labor, equipment, and incidentals necessary to conduct proper surveys required to determine seafloor and shore elevations within the area of the Work.

B. The Contractor shall employ an independent, licensed professional land surveyor qualified in hydrographic surveying, with an ACSM Hydrographer Certification to perform hydrographic and topographic surveys for layout of the Work, to verify dredge depths and obtain final quantity for dredging, and to verify the grades of final "as-built" construction for acceptance of completed work as stipulated in this **Section 01 71 23, Part 3**.

C. The Contractor shall perform hydrographic and topographic surveying as a way of accurately monitoring dredging and capping activities. Topographic surveys shall be performed to tie in the hydrographic survey to the top of slope and provide verification of hydrographic survey data.

1.02 RELATED SECTIONS

A. Section 01 78 39 – Project Record Documents

B. Section 35 20 23 – Dredging and Excavation

C. Section 35 23 24 – Sediment Capping

1.03 REFERENCE STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the reference applies.

1. U.S. Army Corps of Engineers (USACE) - EM 1110-2-1003 (Jan 2002) USACE Hydrographic Surveying Engineering Manual http://www.usace.army.mil/publications/eng-manuals/em1110-2-1003/toc.htm

1.04 CONTRACTOR QUALIFICATIONS

A. All survey, layout, and related work for progress surveys shall be performed under the supervision of and sealed by a professional land surveyor or civil engineer registered in the State of Washington. The surveyor(s) shall have actively engaged in hydrographic and land survey operations during the past three (3) years. The surveyor or engineer shall have at least five (5) years experience in computing earthwork quantities.

1.05 INDEPENDENT SURVEYOR QUALIFICATIONS AND RESPONSIBILITIES

A. Contractor shall retain an independent surveying firm that will be responsible for conducting certain surveying, field engineering, and related reporting activities, as specified in this section. Contractor's independent surveyor shall satisfy the following minimum qualification requirements:

1. Specified surveying and related field engineering and reporting shall be performed under the supervision of a professional land surveyor with current registration in the State of Washington.
2. Marine surveys shall be supervised by a hydrographer certified by the American Congress of Surveying and Mapping.
3. Surveying firm shall utilize, and be proficient in the use of, the survey equipment and methods specified in this section.
4. Surveying firm and project personnel shall have performed hydrographic surveying services for at least five dredging projects of similar size and complexity (provide list of projects, reference contacts and phone numbers).
5. Surveying firm shall provide proof of insurance as required by **Section 00 73 16 paragraph 1.01.A.1.p**

B. Contractor's proposed independent surveying firm will be subject to review and approval by the Engineer.

C. The responsibilities of the Contractor's independent surveyor shall include, but not be limited to the following:

1. Verification of existing monuments, benchmarks, and control points established for the Work.
2. Establishment of supplemental benchmarks, control points, staff gauges, etc., as needed to conduct the Work.
3. Installation of automatic recording tide gauge for dredging operations.
4. Initial layout of all Work elements.
5. Daily calibration and verification of survey system accuracy.
6. Sediment excavation, dredging, and backfill daily progress surveys and reporting.
7. As-built surveys of all completed Work.
8. Calculation of construction quantities for Contractor's progress payment requests.
9. Maintenance of the "Project Record" Drawings.
10. Preparation of as-built construction record drawings.

D. Contractor shall assume full responsibility for the coordination, scheduling, accuracy, and quality of the independent surveyor's work. The independent surveyor shall coordinate with Contractor's QC manager as necessary to fulfill project QC requirements, in accordance with **Section 01 45 00 – Quality Control**.

E. In addition to the submittals specified in this section, Owner reserves the right to request at any time, copies of all other survey data, calculations, and supporting documentation generated by the independent surveyor in support of the Work.

1.06 SUBMITTALS

A. A Survey Plan shall be submitted to the Engineer for review and acceptance in accordance with **Section 01 33 10 – Submittals** and **Section 01 40 00 – Removal Action Work Plan**. The Survey Plan shall include:

1. A schedule for all survey work and drawings that show the survey vessel tracklines for each hydrographic survey, if using single-beam sonar methods.

2. Specifications and calibration certificates for all proposed survey equipment.

3 The name, address, telephone number and qualifications of the surveyor, crew chief, superintendent, and all other persons who are proposed to perform survey or survey-related duties.

4. Independent Surveyor Subcontractor Qualifications. Contractor shall submit with the Survey Plan and the bid proposal the qualifications of Contractor's independent surveyor subcontractor. Contractor's independent surveyor shall meet the minimum qualifications specified in Article 1.05 of this Section.

B. Independent Surveys: Contractor shall submit to the Engineer within 24 hours of completing Independent Surveys. Include AutoCAD electronic file, plan view drawings with 1-ft contour intervals and spot elevations depicting high and low points plotted at 1" = 50 feet. The AutoCAD electronic file shall include the Digital Terrain Model (DTM) as 3D-polylines. ASCII-format processed survey data shall be provided in x, y, z (easting, northing, elevation) format. Each data file shall include a descriptive header including, but not limited to: software and equipment information, client, project, horizontal and vertical datum, units, tidal correction, survey type, alignment, and stations surveyed.

C. On the day the Contractor submits request for progress payment, the Contractor shall furnish to the Engineer copies of all field notes, computations, any records relating to the quantity survey or to the layout of the work, and PC-compatible versions of any computer software required to interpret the finished data and records. The Contractor is responsible for converting data and drawing files to a standard software version approved by the Engineer. Standard ASCII format is pre-approved for data files. Survey data shall be provided in x, y, z (easting, northing, elevation) format. Each data file shall include a descriptive header including, but not limited to: software and equipment information, client, project, horizontal and vertical datum, units, tidal correction, survey type, alignment, and stations surveyed.

D. The Contractor shall maintain on site a complete, accurate log of control of survey work as it progresses.

E. The Contractor shall keep updated survey field notes in a standard field book. These field notes shall include all survey work performed by the Contractor's surveyor in establishing line, grade, and slopes for the construction work. Copies of these field notes shall be provided to the Engineer upon request and, upon physical completion of the Contract Work, the field books shall be submitted to the Engineer and become the property of the Engineer.

F. Sediment Excavation, Dredging, and Backfill Progress Surveys. Contractor shall submit to the Engineer within 12 hours of completing excavation or backfill activity, the results of ongoing progress surveys and records (Windows Offshore Positioning Software (WINOPS); DREDGEPACK by Hypack, Inc.; or equivalent) required to document compliance with the minimum sediment excavation, dredging, and capping limits shown on the Drawings. The progress surveys shall be conducted in accordance with **Part 3 of this Section**, and the results shall be reported in a format consistent with **Paragraph 3.07**, or as approved by the Engineer, and as described in Contractor's field engineering and surveying plan.

1.07 PROJECT RECORD DOCUMENTS

A. The Contractor shall maintain on site a complete, accurate log of control of survey work as it progresses. Upon completion of the Work, the Contractor shall submit Record Documents to the Engineer under the provisions of **Section 01 78 39 –Project Record Documents**

PART 2 – PRODUCTS

Not applicable

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall exercise care during the execution of the Work to minimize any disturbance to existing property and to the landscape and waters in the areas surrounding the work Site. Survey crews shall comply with all provisions of the Contractor's Health and Safety Plan when traversing into controlled or contaminated areas.

1. If the survey work provided by the Contractor does not meet the standards of the Engineer, the Contractor shall, upon the Engineer's Written Notice, remove the individual or individuals doing the survey work. Thereafter, the survey work will be completed by the Engineer at the Contractor's expense. Costs for completing the survey work required by the Engineer will be deducted from moneys due or to become due the Contractor.
2. The Engineer reserves the right to check all work laid out by the Contractor during the progress of the work, as deemed necessary to verify conformance with the plans and specifications. The Contractor shall allow a reasonable time to permit such checks before completing the work. These checks will be made during the regular working hours.
3. All survey Work shall be based on MLLW as the vertical datum, and Washington State Plane Coordinate System NAD83 (1991), North zone, U.S. Feet as the horizontal datum.

3.02 SURVEY CONTROL AND REFERENCE POINTS

A. The benchmark used for the design is noted on the Drawings and shall be used by the Contractor for establishing survey control points. For all surveys, the horizontal datum that shall be used by the Contractor is Washington State Plane Coordinate System NAD83 (1991), North zone, U.S. Feet. All surveys shall be shown in mean lower low water (MLLW), in U.S. feet.

B. The Contractor shall protect all survey control points prior to starting site work and preserve permanent reference points during construction. The Contractor shall not relocate site reference points without prior written approval from the Engineer.

C. The Contractor shall promptly report to the Engineer the loss, damage, or destruction of any reference point or relocation required because of changes in grades or other reasons. The Contractor shall replace dislocated survey control points based on original survey control at no additional cost to the Engineer. Replacement of dislocated survey control points shall be done by a land surveyor licensed in the State of Washington.

3.03 INSPECTION

A. The Contractor shall verify locations of Site reference and survey control points prior to starting work. The Contractor shall promptly notify the Engineer of any discrepancies discovered. The Contractor shall also verify layouts periodically during Construction.

3.04 SURVEY REQUIREMENTS

A. The Contractor shall reference survey and site reference points to the provided control monuments and record locations of survey control points, with horizontal and vertical data, on Project Record Documents.

B. Topographic Surveys.

1. Topographic surveys for areas above 0 feet MLLW shall be done before and after all dredging and capping activities. These surveys shall be done to supplement the hydrographic surveys required for the in-water work. Surveys shall be done with cross-section intervals not to exceed 20 feet on center, including grade breaks from which a 1-foot contour map will be required in an electronic format. The topographic surveys shall cover all work areas from the top of the bank down to 0 feet MLLW, or sufficiently low to tie in with bathymetric survey data.

2. The Contractor shall, with its own forces, obtain working or construction lines or grades as needed. All control surveys for elevation shall be +/-0.01 foot and, for horizontal, control angles shall be to the nearest 20 seconds +/-10 seconds, and measured distances shall be to +/-0.01 foot.

   All upland measurement surveys shall be within the following accuracies:

   Horizontal: +/- 0.033 feet +1 ppm at 1 RMS (67% confidence level)

   Vertical: +/- 0.066 feet +1 ppm at 1 RMS (67% confidence level)

   RTK-GPS methods are acceptable during PDOP values of 7.0 or less and the utilization of a Geoid model or site calibration. The RTK-GPS system shall be verified on at least 3 survey control points near the limits of the site, established by differential leveling methods from a project benchmark. Multi-path environments shall be avoided.

   Range pole tips should be equipped with a “topo shoe” or device to prevent the tip of the range pole from penetrating the ground surface, or a conscious effort made to capture the ground surface and prevent the tip of the range pole from sinking into the ground.

3. The Contractor shall provide all materials as required to properly perform surveys, including but not limited to: instruments, tapes, rods, measures, mounts and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else required. All material shall be of good professional quality and in first-class condition.

4. All lasers, transits, and other instruments shall be calibrated and maintained in accurate calibration throughout the execution of the work. Calibration certificates shall be submitted to the Engineer prior to the use of any instrument.

5. The Contractor shall furnish all materials and accessories (i.e., grade markers, stakes, pins, spikes, etc.) required for proper location of grade points and line. All marks given shall be carefully preserved and, if destroyed or removed without

the Engineer's approval, they shall be reset, if necessary, at the Contractor's expense.

C. Hydrographic Surveys.

1. Hydrographic survey procedures (positioning modes, electronic positioning system [EPS] calibration, data reduction, adjustment, processing, and plotting) shall conform to industry standards. Horizontal location observations shall compensate for errors, geodetic corrections, and atmospheric variations. Data recordation, annotation, and processing procedures shall be consistent with recognized hydrographic survey standards, in accordance with USACE Hydrographic Surveying Engineering Manual, for Navigation and Dredging Support Surveys [USACE EM 1110-2-1003 (Jan 2002)]. Failure to perform and process such surveys in accordance with recognized standards will result in a rejection and nonpayment for work performed. Tide data from National Oceanic and Atmospheric Administration (NOAA) tide gauge #9447130 shall be used to adjust the survey data to MLLW and to compare with real-time kinematic (RTK) vertical data or a tide board established at the site, monitored on an interval of every 5 minutes or 0.05 foot change.

2. The Contractor shall conduct hydrographic surveys using a real-time kinematic differential global positioning system (RTK-GPS) and a single-beam, single frequency echosounder system or multi-beam echosounder sonar system to obtain soundings. The survey vessel shall be equipped with the RTK-GPS for determining the horizontal and vertical location of the soundings. The system shall be capable of sub-meter horizontal positioning accuracy and 3 inches vertical positioning accuracy. The sounding equipment shall produce a high-resolution, permanent record that accurately depicts bottom profiles. All sonar collection methods and equipment shall be in accordance with the USACE Hydrographic Surveying Engineering Manual, for Navigation and Dredging Support Surveys [USACE EM 1110-2-1003 (Jan 2002)]. All proposed surveying equipment shall be approved by the Engineer prior to the beginning the Work, as required by Section 01400 – Removal Action Work Plan.

3. The Contractor shall conduct and document the quality control procedures recommended by the equipment manufacturer.

4. Soundings.

   a. For pre-construction, final post-dredging and excavation, cap completion, and Record Document surveys, if single-beam sonar methods are used sounding and survey lines shall be generally perpendicular to the shoreline and shall intersect the baseline at intervals of no greater than 20 feet, with the survey vessel not exceeding 5 feet from the planned survey line. In addition, the sounding and survey lines shall be co-located with the sections shown on the Drawings.

   b. Sounding lines shall extend a minimum of 50 feet beyond the project survey boundaries or as otherwise approved by the Engineer. Intervals between soundings on each line shall not exceed 1 foot during raw data collection and the data shall not be decimated more than 5 feet for the digital Terrain Modeling (DTM). In areas that there are toes and tops the 5 foot decimated data may need to be augmented at a denser interval, to accurately depict the toes or tops of cut slopes.

c. All cap completion surveys and the post-dredging and excavation surveys shall be completed on the same sounding lines as the pre-construction survey. Soundings shall not deviate more than 5 feet left or right from the initial survey line.

d. Soundings shall be based on MLLW datum. The sounding and survey lines shall be field marked on the single-beam echosounder chart during data acquisition. The location, time of survey, tide height, and direction that line is surveyed shall also be marked on the single-beam echosounder chart.

e. All sonar collection procedures, methods and equipment specifications shall be in accordance with the USACE Hydrographic Surveying Engineering Manual, for Navigation and Dredging Support Surveys [USACE EM 1110-2-1003 (Jan 2002)].

f. Cross-line checks, vessel squat tests, position latency, bar checks, and sonar patch tests (as applicable) shall be submitted with the Pre-Construction Baseline Survey.

5. Field notes shall indicate the location of each sounding line, the date and time (hour and minutes) each sounding line is taken, and explanation for any line terminated early. The tide shall be recorded for each line surveyed and noted on the section during the survey or a time and tide reading correlation table or field notes. Notes shall include tidal data (i.e., height of tide [MLLW datum]), bar checks or sound velocity cast, position check on a known project control monument, time of the tide readings, and date and location of the tide gauge used for each area surveyed.

6. At the pre-construction conference, the Contractor's chief surveyor and independent surveyor subcontractor shall meet with the Engineer to discuss the survey proceedings, methods, and equipment to be employed for the Contractor's surveys.

D. Positioning Control During Dredging and Capping.

1. A short- to medium-range electronic positioning system (EPS) shall be activated during all in-water operations. This EPS shall be established, operated, and maintained by the Contractor during the period of the contract when in-water work is actively underway. The EPS shall display and record the barge and bucket locations continuously (i.e., real-time positioning) during all in-water operations. The Contractor may also propose, for approval by the Engineer, alternate methods for monitoring the bucket position. The Engineer shall have access to the monitoring equipment to determine the location of capping and dredging equipment during the Work.

2. A continuous graphic printout plotter and/or graphic monitor shall be on any vessel using an EPS. A complete record copy of the position data (vessel track and bucket position history), including date, time, coordinates, and root-mean-square (RMS) (i.e., quality of position closure) shall be submitted to the Engineer as part of the Daily Contractor Quality Control Report, in accordance with **Section 01 45 00 –Quality Control**.

3. The EPS system shall be, at a minimum, similar or equal in design, performance, accuracy, operation characteristics, and frequency to those identified in the

USACE Hydrographic Surveying Engineering Manual (Hydrographic Manual), listed in paragraph 1.1 References.

4. The Contractor shall be responsible for maintaining the established horizontal control to locate active and/or passive shore-based EPS transmitter/receiver devices. All control shall meet Third Order, Class I, accuracy standards as defined under paragraph 1.3 of the Hydrographic Manual.

5. EPS calibration techniques shall conform to standard hydrographic surveying practice consistent with minimization of systematic errors inherent to and consistent with the selected EPS system, as specified under Chapters 1 and 4 of the Hydrographic Manual. The Contractor shall be responsible for accurate and reliable EPS calibration for the duration of this contract, and shall document calibration records as part of the Daily Contractor Quality Control Report.

6. The Contractor shall have a backup system in the event that the primary system is rendered inoperable. In the event that both the primary and backup systems are rendered inoperable, the Contractor shall make provisions within 36 hours to be operational. No additional cost to either the Owner or increase in the Contract time will be allowed. In the event of a failure in either shore-based or ship-based electronic equipment, the Engineer shall be immediately notified of the time of failure and time of repair.

7. The Contractor shall establish and maintain a tide gauge where it can clearly be seen by the operator, and check the tide gauge against the NOAA tide gauge at the beginning of each day. To establish vertical control to the MLLW datum, the Contractor shall adjust data to MLLW using tide data from the NOAA tide gauge. The tide data shall also be used to compare to the RTK vertical data. Tidal changes shall be recorded in MLLW datum, with these changes visually provided to the capping or dredging operator at all times during capping or dredging. A printed record of the tidal changes shall become part of the Daily Contractor Quality Control Report in accordance with **Section 01 45 00 – Quality Control**.

E. Independent Survey Events. The Contractor shall employ an independent licensed professional surveyor with an ACSM Hydrographer Certification to perform hydrographic and topographic surveys as specified at the below listed events during this Contract. These surveys shall verify that all Contract dredging depths and cap grades and thicknesses are being obtained as specified, and to determine pay volumes for dredging. The areal coverage of Independent surveys shall encompass the entire project area plus an additional area of at least 20 ft beyond the outside perimeter of the Work above +12 ft MLLW and at least 100 ft beyond the outside perimeter of the work below +12 ft MLLW.

Independent Survey Events

Event	Method
Pre-Construction Baseline	Single-beam echo sounding, with topographic survey above MLLW.
Final Dredging and Excavation Acceptance	Single-beam echo sounding, with topographic survey above MLLW.
Final Cap Acceptance	Single-beam echo sounding, with topographic survey above MLLW.
Record Document Survey	Multi-beam echo sounding, with topographic survey above MLLW.

1. Pre-Construction Baseline Survey. The data derived from this survey shall be used in establishing initial conditions, for computing the quantities for dredging in accordance with **Section 35 20 23 – Dredging and Excavation**, and for verifying required cap thicknesses, in accordance with **Section 35 23 24 – Sediment Capping**. No dredging, excavation, or capping shall be permitted before the Engineer has approved the Pre-Construction Baseline Survey plan drawing and CAD files.
2. Final Dredging and Excavation Acceptance Survey(s). The data derived from these surveys shall be used in verifying required dredge/excavation depths and grades, and for computing the quantities for dredging in accordance with **Section 35 20 23 – Dredging and Excavation**. This survey shall be repeated at no cost to the Owner should additional work be required to attain the required dredge/excavation depths and grades.
3. Final Cap Acceptance Survey(s). The data derived from these surveys shall be used in verifying required cap thicknesses and grades, in accordance with **Section 35 23 24 – Sediment Capping**. This survey shall be repeated at no cost to the Owner should additional work be required to attain the required cap thicknesses and grades.
4. Record Document Survey. This survey shall document the final accepted constructed cap, in accordance with Article 3.07 of this Section. The data derived from this survey shall be used in preparing the Record Drawings in accordance with **Section 01 78 39 – Project Record Documents**.
5. All independent surveys shall be accomplished with the same independent licensed professional surveyor and equipment, and use the same data processing and interpolation methods.

3.05 SEDIMENT EXCAVATION, DREDGING, AND CAPPING PROGRESS SURVEYS

A. Progress surveys for excavation, dredging, and capping activities shall be conducted on a daily basis, using the equipment and methods specified in Article 3.05, and elsewhere in this Section.

B. The point spacing and track-line spacing for land-based and marine-based progress surveys, respectively, shall be conducted on a maximum 20 by 20 ft grid system, generally oriented orthogonal to the sediment contours, with additional points at grade breaks, as specified in Contractor's field engineering and survey plan, and as approved

by the Engineer. Once established, the same grid system shall be utilized for all progress surveys.

C. The areal coverage of daily progress surveys for land-based sediment excavation and backfill areas shall encompass the entire area of that day's work, plus an additional area of at least 10 ft beyond the outside perimeter of the excavation (including areas that have been previously excavated and backfilled). Survey and record the toe, crest, and corners of all cut and fill slopes.

D. The areal coverage of daily progress surveys for marine-based sediment dredge areas shall encompass the entire area of that day's dredging, plus an additional area of at least 20 ft beyond the outside perimeter of the dredge excavation (including areas that have been previously dredged). WINOPS, DREDGEPACK by Hypack, Inc. or equivalent, shall be used to monitor dredging progress.

E. The results of daily progress surveys shall be submitted to the Engineer within 12 hours of completing the daily dredging, excavation or backfilling activity, as applicable. The Engineer will utilize the daily progress survey submittals to verify that dredging, excavation, and backfill limits are within the specified tolerances. The Owner reserves the right to direct Contractor to cease sediment excavation, dredging, and/or backfill activities, at no expense to Owner, in the event that Contractor fails to submit the results of progress surveys within the specified time frame.

F. The progress surveys shall be submitted in the form of a grid plan and cross-section drawings, prepared by the Contractor. The grid plan shall indicate the location of each cross-section. The cross-sections shall be computer generated, and shall conform to the following format and informational requirements:

1. Plot cross-sections at a horizontal scale of 1 in = 10 ft (maximum) and vertical scale of 1 inch =5 ft (maximum), with axes shown on margins.
2. Note grid line identification number and/or coordinates for each cross-section
3. Show existing grade, specified neatline dredging and excavation, allowable overdepth limits, actual excavation grades, and final cap grades.
4. Show survey point locations.
5. Indicate applicable dates for excavation, dredging, capping, and associated surveying activities.
6. Date and sign each cross-section prior to submitting to the Engineer.

G. The Contractor shall conduct progress computations for any period for which progress payments are requested. For progress payments, dredge/excavation quantity calculations shall be prepared by the Contractor using the Triangulated Irregular Network (TIN) volume technique, and using Autodesk Civil 3D, Autodesk Land Development Desktop, HYPACK™ MAX, Terramodel or other commercially available software as approved by the Engineer. Additionally, the Engineer will make such computations as are necessary to verify the quantities of progress payments. Final measurement of dredge/excavation quantities will be made by the Engineer and will be based on the Final Dredging and Excavation Acceptance survey in accordance with **Section 01 22 10 – Measurement and Payment**.

H. Survey Records. On the day the Contractor submits request for progress payment, the Contractor shall furnish the Engineer originals of all field notes, computations, any records relating to the quantity survey (dredging) or to the layout of the Work, and a PC-compatible version of any computer software required to interpret the finished data and records. The Engineer will use them as necessary to verify the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Engineer.

I. The Owner may conduct independent progress surveys for quality assurance purposes. The Owner will notify the Contractor if review of the survey data indicates a discrepancy between Contractor's and the Owner's progress survey, and the Owner may request that the Contractor re-survey the area(s) where discrepancies are present. Any re-surveying and associated re-work required due to surveying error(s) on the part of the Contractor or Contractor's independent surveyor shall be provided at no additional cost to the Owner.

J. In the event that the Contractor's or Owner's progress surveys indicate that the Work is out of compliance with the Contract Documents, the Owner may direct Contractor to adjust excavation, dredging, and/or backfilling procedures until compliance is achieved, at no additional expense to the Owner. The Owner further reserves the right to direct Contractor to stop sediment excavation, dredging, and/or capping activities if it is determined, in the opinion of the Owner, that Contractor's methods are not suitable to achieve the specified construction tolerances. In the event that the Owner stops the work, the Contractor shall take whatever measures are required, including mobilization of alternative equipment, to achieve the specified construction tolerances, at no additional cost to the Owner.

3.06 PAYMENT AS INCIDENTAL

A. Payment for all survey work is as specified in **Section 01 22 10 – Measurement and Payment.**

B. The cost to the Contractor of all Work and delays occasioned by giving lines and grades, or making other necessary measurements, will be considered as having been included in and incidental to the lump sum prices and unit prices for other items of the Work.

3.07 FINAL AS-BUILT SURVEY

A. Upon completion of the Work, Contractor shall complete a final as-built survey and plan drawings of the Work for inclusion in the construction records report to be prepared by the Engineer.

B. The as-built survey shall include a topographic survey and a hydrographic survey of all final grades within the project limits. A separate plan drawing shall also be prepared showing the final dredge/excavation grades within the work area. The accuracy of the topographic and hydrographic surveys shall be consistent with the requirements of Article 3.05 for surveying, respectively. The as-built survey shall include the location of all existing structures within the project limits, any cut or broken piling stubs that remain, as well as any structures installed or modified as part of the Work.

C. The results of the as-built survey shall be presented in the form of contour plan drawings with 1- ft contour intervals. The location of installed utilities and structures shall be clearly indicated with appropriate symbols. Toe and catch points shall be indicated for all slopes. Spot elevations shall be indicated in areas of limited topographic relief, as appropriate. The associated survey data shall also be submitted to the Engineer, in accordance with the requirements of Article 1.06 of this Section.

End of Section 01 71 23

ATTACHMENT A6

REGION 10 CHECKLIST FOR THE ASSESSMENT OF EXISTING INFORMATION/SECONDARY DATA FOR EPA'S USE

Region 10 Checklist for the Assessment of Existing Information/Secondary Data for EPA's Use

Title of Information			
Criteria		Yes – Supply Information	No
Traceability	Source/Author		
	Contractor		
	Publication Info		
	Publisher		
	Year Published		
Accessibility	Publication Location		
	Report Format		
	Data Format		
Documentation	QAPP/Equivalent		
	3rd Party Independent Review		
	Quality Assurance Summary Report		
	Source/Author of QA Report		
	Information/Data Integrity		
	Usability and Limitations		
	Objectivity		
	Reproducibility		

* To be legally defensible, the quality, usability and integrity of information and supporting data must be assessed and documented by an independent third party reviewer. To be objective, bias must be known and the veracity of the conclusions confirmable through sound and acceptable data. Given the same conditions and following the same methodologies, a third party must be able to reach and reproduce the same results obtained and that is reproducibility.

ATTACHMENT A7

EPA DATA SUBMISSION REQUIREMENTS

EPA Data Submission Requirements
Provided to Karen Keeley, EPA from Matt Gubitosa, EPA

Superfund Monitoring and Analytical Data Deliverables
EPA R10 Data Submission Process for WQX Compatible Deliverables
(PRP Data Deliverable Options)

WQX (formerly: *STORET*) is EPA's national database for long-term storage of environmental monitoring data. Data that is placed in WQX is available to the public via both table-downloading functionality and map viewing applications deployed by EPA-HQ. Region 10 maintains a local version of WQX (called AWQMS) from which project-specific data mapping applications are served. Together these databases and mapping applications provide critical data-sharing and archiving functionality to project teams, external partners and stakeholders, and the public.

Region 10 project managers can ask external entities (such as PRP contractors) to submit data to EPA in one of two ways, both described in detail below. The first, Option 1, involves having contractors load data directly to WQX, with minimal involvement by Region 10. Option 2 entails direct transfer of data to Region10 in ready-to-load format; this option would be used for data that is not to be made available to the public within 120 days of data collection. For some projects it may be necessary to use a combination of both options, depending on project needs, and as specified by the project manager.

The data deliverables must contain the information specified in the Region 10 WQX electronic Data Deliverable Specifications document (R10WQXEDD).

The language from Option 1 and/or Option 2 (below) can be included in the Data Management Procedures section of a SAP, QAPP or SOW. This language must reference an appendix that includes:

1. The Data Format Guidance for Submission of WQX Compatible Data section (below);
2. The template files that describe the Region 10 WQX Electronic Data Deliverable Specifications (R10WQXEDD), contained in the file Region10WQXEDD.zip.

Data Submission Process - Monitoring and Analytical Data Deliverables

Option 1 - Public Data Submission to WQX for Fully Finalized, Validated and Qualified Data

Within 120 calendar days from the date of collection of the last sample from each sampling event, all verified field data, validated analytical data results, QA/QC sample results and associated sample location and project descriptive information shall be submitted to EPA.

The submission process will consist of uploading the data to the Water Quality Exchange (WQX) through the Central Data Exchange (CDX). The data submitters are responsible for the correctness and completeness of the data submitted to WQX. The data submitted to WQX will be identified with a status of "FINAL"; and will be fully qualified according to the QAPP(s). Data will be submitted in accordance with specifications referenced in the Region 10 WQX Electronic Data Deliverable (R10WQXEDD) which accompanies this document in zip file format (R10WQXEDD.zip). Note that, shortly after upload to WQX, data will be available to the public at http://www.waterqualitydata.us or http://www.epa.gov/storet.

Option 2 - Region 10 Data Submission Process for WQX Compatible Data
(This option pertains to data that will not be made available to the public through WQX within 120 days of collection.)

Monitoring and Analytical Data should be submitted in tab-delimited text files prepared in accordance with specifications in the Region 10 WQX Electronic Data Deliverable (R10WQXEDD) which accompanies this document in zip file format (R10WQXEDD.zip). Unless otherwise directed, completed data files should be sent to EPA Region 10 via email. Each submittal should be accompanied by a cover letter that includes the following information:

- Submitting Contractor/ Agency Name, and Physical Address
- Point of Contact Name, Phone Number, and E-mail Address
- Date of Submittal
- Data File Type, Data File Name, Number of Records
- Project, Contract or Other Information to Identify Dataset
- Comments Regarding Data Submittal

Data Format Guidance for Submission of WQX Compatible Data

All electronic data deliverables should be reviewed for completeness as well as compliance with the R10WQXEDD specifications prior to submittal to EPA Region 10 or to WQX. The submitting entity is responsible for the content and quality of the data provided. If the deliverable is incomplete or erroneous, corrected data will need to be re- submitted.

There are three general categories of data that are addressed in R10WQXEDD: projects; stations; and physical and chemical results data. The R10WQXEDD provides detailed specifications on how each category of data should be formatted, identifies allowable values for the data fields (also known as data codes or valid values), and provides example data submittals. If data to be submitted includes a fourth category of data, biological and habitat results or observations, it should be reported in a format that complies with the EPA Office of Water WQX biological and habitat templates, which are downloadable at: http://www.epa.gov/storet/wqx/wqxweb_downloads.html.

General Format of Electronic Data Deliverables

Data should be prepared as tab-delimited text files with column headers. Many software products allow for export of tab delimited text files (including Excel, Access, Notepad, and

Open Office products). No other delimiters, such as quotation marks, commas, colons, or semi-colons should be included in the files. No tabs should be included in the actual data values themselves, and additional limitations on the use of special characters are identified in the R10WQXEDD. A set of allowable values are identified in the R10WQXEDD, however, because these may have been updated since release of the R10WQXEDD, so referencing the most current list is recommended. It is available at: http://www.epa.gov/storet/wqx/wqx_getdomainvalueswebservice.html.

The R10WQXEDD.zip file contains the R10 WQX Electronic Data Deliverable (R10W QXEDD). It includes the following three templates which specify the format of data deliverables:

- R10WQXEDDPart1-ProjectandMonitorLocationTemplate.xlsx
- R10WQXEDDPart2-ActivitiesAndResultsTemplate.xlsx
- R10WQXEDDTemplate-Examples.xlsx