UPPER COLUMBIA RIVER

FINAL
2016 Residential Soil Study
Quality Assurance Project Plan

Addendum No. 1
to the
2014 Residential Soil Study
Quality Assurance Project Plan (SRC Inc. 2014)

Prepared for

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July 2016

A Note to Reviewers of this Quality Assurance Project Plan:

This Quality Assurance Project Plan (QAPP) represents an addendum to the U.S. Environmental Protection Agency (EPA)-approved Upper Columbia River (UCR) QAPP (SRC Inc. 2014), which was prepared under Scientific, Engineering, Response & Analytical Services (SERAS) work assignment SERAS 0-079 to the EPA Environmental Response Team. In 2015, EPA directed Teck American Incorporated (TAI) to conduct further study of UCR residential soils within and beyond the prior residential soils study boundary. This addendum addresses updates to the prior QAPP based on EPA's directive and related discussion between EPA and TAI. Specifically, this addendum addresses updates to the following:

1. Changing from EPA to TAI as the investigation study lead (and corresponding contractor changes).
2. Changing the timing of the field activities from 2014 to 2016.
3. Expanding the study area boundary.
4. Modifying the sampling design with regard to:
    a. The collection of dripline samples.
    b. The frequency of collecting triplicate samples.
    c. The frequency of samples submitted for in vitro bioaccessibility assay analyses.
    d. Collection of discrete core samples.

While the overall study purpose, target analytes, and sample collection approaches remain largely unchanged from the original residential soil study, the updates noted above have necessitated significant revision to many of the original QAPP worksheets and attachments. These revisions are due, in large part, to the change in study leadership and associated personnel who will execute the amended study QAPP, which affects most of the worksheets.

The QAPP format used for the original study was based on the Intergovernmental Data Quality Task Force (IDQTF) Uniform Federal Policy (UFP) for QAPPs (IDQTF 2005[1]). This format has been retained to facilitate the review of specific changes reflected in this addendum. More recent IDQTF QAPP guidance for "Optimized UFP-QAPP Worksheets" (IDQTF 2012[2]) has been considered in preparing this QAPP addendum. In some cases, detail provided in the original QAPP that is not expected to be needed by QAPP users executing the 2016 study has been removed to avoid unnecessary redundancy; however, reference to the location of such detail in the original QAPP is provided.

[1] IDQTF. 2005. Intergovernmental Data Quality Task Force Workbook for Uniform Federal Policy for Quality Assurance Project Plans. Part 2A: UFP-QAPP Workbook. Final. Version 1. March. Available online at: http://www2.epa.gov/sites/production/files/documents/part2ufp_wbk_0305.pdf.

[2] IDQTF. 2012. Intergovernmental Data Quality Task Force Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets. March. Available online at: http://www2.epa.gov/sites/production/files/documents/ufp_qapp_worksheets.pdf.

TABLE OF CONTENTS

LIST OF FIGURES iv
ACRONYMS AND ABBREVIATIONS v
INTRODUCTION 1
QAPP Worksheet #1: Title and Approval Page 5
QAPP Worksheet #2: QAPP Identifying Information 6
QAPP Worksheet #3: Distribution List 10
QAPP Worksheet #4: Project Personnel Sign-Off Sheet 11
QAPP Worksheet #5: Project Organizational Chart 12
QAPP Worksheet #6: Communication Pathways 13
QAPP Worksheet #7: Personnel Responsibilities and Qualification Table 15
QAPP Worksheet #8: Special Personnel Training Requirements Table 17
QAPP Worksheet #9: Project Scoping Session Participants Sheet 18
QAPP Worksheet #10: Problem Definition 19
QAPP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements 23
QAPP Worksheet #12-1: Measurement Performance Criteria Table 27
QAPP Worksheet #12-2: Measurement Performance Criteria Table 28
QAPP Worksheet #13: Existing Data Criteria and Limitations Table 29
QAPP Worksheet #14: Summary of Project Tasks 36
QAPP Worksheet #15: Reference Limits and Evaluation Table 40
QAPP Worksheet #16: Project Schedule Timeline Table 42
QAPP Worksheet #17: Sampling Design and Rationale 44
QAPP Worksheet #18: Sampling Locations and Methods[1] and SOP Requirements Table 52
QAPP Worksheet #19: Analytical SOP Requirements Table 68
QAPP Worksheet #20: Field Quality Control Sample Summary Table 69
QAPP Worksheet #21: Project Sampling SOP References Table 70
QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table 71
QAPP Worksheet #23: Analytical SOP References Table 72
QAPP Worksheet #24: Analytical Instrument Calibration Table 74
QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 79
QAPP Worksheet #26: Sample Handling System 80
QAPP Worksheet #27: Sample Custody Requirements 81
QAPP Worksheet #28: Quality Control Samples Table 84
QAPP Worksheet #29: Project Documents and Records Table 88
QAPP Worksheet #30: Analytical Services Table 89
QAPP Worksheet #31: Planned Project Assessments Table 90
QAPP Worksheet #32: Assessment Findings and Corrective Action Responses 91
QAPP Worksheet #33: QA Management Reports Table 92
QAPP Worksheet #34: Verification (Step I) Process Table 93
QAPP Worksheet #35: Validation (Steps IIa and IIb) Process Table 94
QAPP Worksheet #36: Validation (Steps IIa and IIb) Summary Table 95
QAPP Worksheet #37: Usability Assessment 96

Attachment A. Residential Soil Study Data Quality Objectives

Attachment B. Residential Soil Study Human Health Risk-Based Concentrations

Attachment C. Property-Specific Maps

Attachment D. Field Sampling Plan for the Upper Columbia River Residential Soil Study

Attachment E. Laboratory Analytical Methods

Attachment F. Laboratory Quality Assurance Manual

Attachment G. Decision Unit Sampling Design Templates

Attachment H. Cultural Resources Coordination Plan

LIST OF FIGURES

Figure 1. UCR Study Area for the 2016 Residential Soil Study

Figure 2. Overview of the 2016 Residential Soil Study IC sampling design applicable to collection of triplicate IC samples and a single replicate meeting IVBA analysis triggers

ACRONYMS AND ABBREVIATIONS

AED	automated external defibrillator
ALS	ALS Environmental
amu	atomic mass unit
BC	British Columbia
bgs	below ground surface
CCB	continuing calibration blank
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeter
COC	chain of custody
CPR	cardiopulmonary resuscitation
DOT	Department of Transportation
DQI	Data Quality Indicator
DQO	data quality objective
DSR	Data Summary Report
DU	decision unit
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERT	Environmental Response Team
FE	fundamental error
FSP	Field Sampling Plan
ftp	file transfer protocol
g	gram(s)
GPS	global positioning system
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHRA	human health risk assessment
IC	incremental composite
ICP/AES	inductively coupled plasma atomic emission spectroscopy
ICP/MS	inductively coupled plasma mass spectrometry
IDL	instrument detection limit
IDQTF	Intergovernmental Data Quality Task Force
IEUBK	Integrated Exposure Uptake Biokinetic Model
in.	inch/inches
ITRC	Interstate Technology and Regulatory Council
IVBA	in vitro bioaccessibility assay
MB	method blank
MEL	Manchester Environmental Laboratory
µm	microns

mg/kg	milligrams per kilogram
mL	milliliter
mm	millimeter(s)
MRL	Method Reporting Limit
NS	not specified
OSHA	Occupational Safety and Health Administration
PAL	project action level
PPE	personal protective equipment
PQO	Project Quality Objective
QA	quality assurance
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
QC	quality control
R10	Region 10
RBA	relative oral bioavailability
RBC	risk-based concentration
RI/FS	remedial investigation and feasibility study
RPD	relative percent difference
RQAM	Regional Quality Assurance Manager
RSD	relative standard deviation
SERAS	Scientific, Engineering, Response & Analytical Services
SHSP	site health and safety plan
SOP	standard operating procedure
sq. ft.	square feet
TAI	Teck American Incorporated
TAL	target analyte list
TL	Task Leader
TSA	Transportation Security Administration
TWIC	Transportation Worker Identification Credential
U.S.	United States
UCR	Upper Columbia River
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USDOL	U.S. Department of Labor
VSP	Visual Sampling Plan
WA	Washington

INTRODUCTION

This document presents Addendum No. 1 to the 2014 Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for the Upper Columbia River (UCR) Residential Soil Study (SRC Inc. 2014), which was led by the U.S. Environmental Protection Agency (EPA) in 2014. In 2015, EPA directed Teck American Incorporated (TAI) to conduct further study of UCR residential soils within and beyond the prior residential soils study boundary. The current study (hereafter, the "2016 Residential Soil Study") is being led by TAI and extends the southern boundary of EPA's 2014 residential soil study to approximately the intersection of Williams Lake Road and Highway 25 on the east side of the river (Figure 1). The 2016 Residential Soil Study represents one of the tasks that will be completed as part of the UCR remedial investigation and feasibility study (RI/FS). The RI/FS is being conducted under a Settlement Agreement between TAI and EPA.

Consistent with the prior study, the objective of the 2016 Residential Soil Study is to collect data to support refinement of exposure estimates for residents in the UCR Study Area (Figure 1) to support the human health risk assessment (HHRA). Surface soils will be collected from rural residential properties not previously sampled within the UCR Study Area. Surface soil concentrations for target analyte list (TAL) metals[3] (no mercury) will be determined. At 20 percent of decision units (DUs) where non-dripline increment composite samples have a lead or arsenic concentration greater than or equal to 100 or 20 milligrams per kilogram (mg/kg), respectively, these samples will be submitted for in vitro bioaccessibility assay analysis. Concentrations for TAL metals (no mercury) will also be determined in soils from 0 to 1 inches (in.) and 1 to 6 in. below ground surface at a randomly selected subset of DUs. The properties to be sampled were identified through voluntary participation.

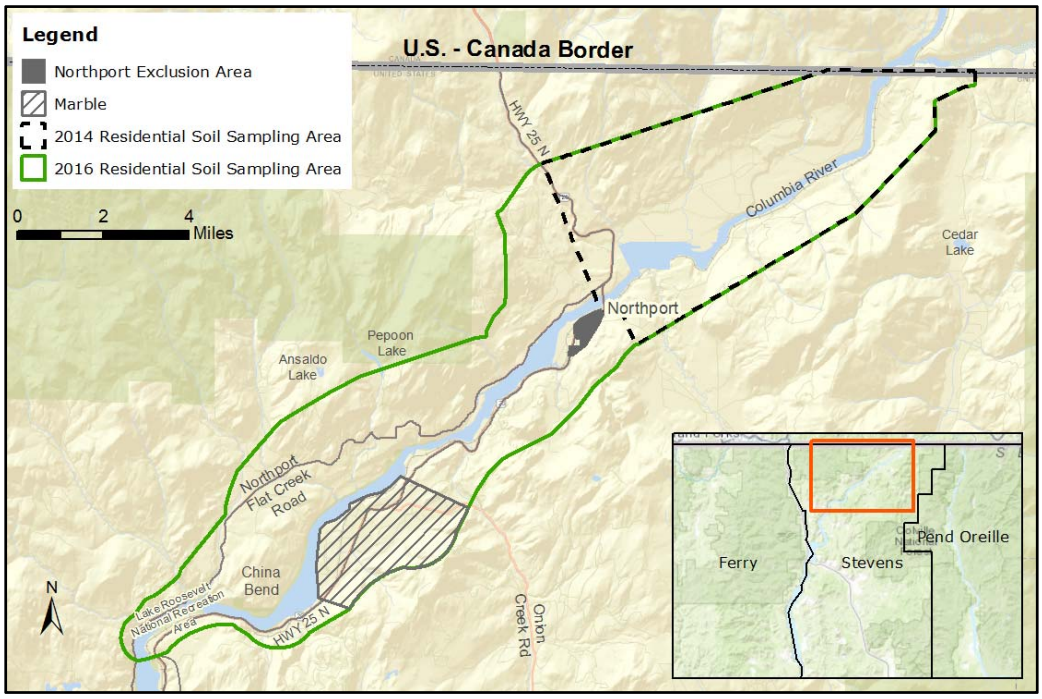

Figure 1. UCR Study Area for the 2016 Residential Soil Study

[3]TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. Risk-based concentrations (RBCs) for each TAL metal are available in Attachment A.

This addendum addresses updates to the prior study quality assurance project plan (QAPP) based on EPA's directive to TAI (USEPA 2015a, 2015b). Specifically, the directive necessitates updates to the 2014 study with regard to the following:

1. Changing the investigation study lead from EPA to TAI (with corresponding changes to contractors supporting the investigation).
2. Changing the timing of field activities associated with the study from 2014 to 2016.
3. Changing the study area boundary as shown in Figure 1. Assuming landowner consent is secured, sampling will include all residential properties within the 2014 sampling area that were not previously sampled and sampling residential properties within the expanded sampling zone. EPA's directive (2015a)[4] also specifies the following conditions:
    a. The 2016 study area will not include the "Northport Exclusion Area" (Figure 1).
    b. Sampling in the area of Marble, Washington (WA), will be at a representative subset of the 120 properties identified within this area. Based on a review of data from previously collected soil samples in the Marble area, EPA has concluded that the study objectives may be adequately met by sampling at least 34 spatially distributed properties within the Marble area. To achieve this target number, EPA and TAI agreed to initially send access agreements to one-half of the property owners in Marble. However, due to a low response rate from property owners in Marble, all property owners in the Marble community were sent access agreements.
4. Eliminating collection of soil samples from driplines of structures unless there is concern of lead-based paint, based on interviews, home age, and reconnaissance. As detailed in the directive (USEPA 2015b), dripline samples were initially collected to determine if lead-based paint or enhanced fallout adjacent to structures had the potential to enrich concentrations of metals in soil. Because dripline sample concentrations were, on average, less than adjacent house DUs, samples are no longer needed from the driplines of houses that do not have a history of potential lead-based paint.
5. Reducing the frequency of collecting triplicate incremental composite (IC) samples such that DUs will be sampled in triplicate with a frequency of 20 percent of the total number of DUs and a minimum of one triplicate per property. As detailed in the directive (USEPA 2015b), with very few exceptions, triplicate results from the 2014 study met the QAPP-specified measurement performance criteria by a wide margin; the exceptions were limited to two DUs for arsenic results and three DUs for lead results.
6. Reducing the frequency of samples submitted for in vitro bioaccessibility assay (IVBA) analysis to 20 percent of DUs while maintaining the same concentration triggers (arsenic and/or lead concentrations equal to or greater than 20 mg/kg and 100 mg/kg, respectively) used in the 2014 study. As detailed in the directive (USEPA 2015b), bioaccessibility was analyzed frequently for the 2014 study and the results indicate low variability without differences by DU type, with the exception of beaches versus all other DU types.

In addition to the above, based on discussion between EPA and TAI, collection of discrete core samples (i.e., grab samples) has been reduced to a frequency of one DU from 20 percent of properties. Selected DUs were designated for IC sampling of the 0 to 1 in. depth interval and were randomly selected to be spatially representative of the study area. Data quality objectives (DQOs) for the 2014 study specified collection of discrete soil samples from the 1 to 6 in. depth interval at each property to provide additional information on the vertical nature and extent of contamination at selected DUs. Evaluation of the 2014 discrete soil sample results suggests a high degree of variability among core samples within the same DU and weak correspondence with IC sample results at the same DU. Because the IC sample depth at most of the DUs

[4] The summary under 3b reflects the directive and subsequent modifications and additions requested by EPA during planning for this study.

designated for discrete sample collection was 0 to 1 in., the lack of discrete data for the 0 to 1 in. depth interval contributed to uncertainty regarding correspondence of the IC and discrete sample results, further limiting the interpretive value of the 1 to 6 in. discrete sample data regarding the vertical nature and extent of contamination. Given these factors, discrete samples from the 0 to 1 in. and 1 to 6 in. depth intervals in a randomly selected subset of DUs where the IC sampling depth is 0 to 1 in. will be collected during the 2016 Residential Soil Study. Collection of these samples will allow for comparison to data collected in the 2014 study and are expected to support evaluation of uncertainty regarding interpretation of the 2014 discrete sample results in the evaluation of the vertical nature and extent of contamination.

While the overall study purpose, target analytes, and sample collection approaches remain largely unchanged from the original residential soil study, the updates noted above have necessitated significant revision to many of the original QAPP worksheets and attachments. These revisions are due, in large part, to the change in study leadership and associated personnel who will execute the amended study QAPP, which affects most of the worksheets. Corresponding changes to the QAPP attachments have also been made.

The QAPP format used for the original study was based on the Intergovernmental Data Quality Task Force (IDQTF) Uniform Federal Policy (UFP) for QAPPs (IDQTF 2005). This format has been retained to facilitate the review of specific changes reflected in this addendum. More recent IDQTF QAPP guidance for "Optimized UFP-QAPP Worksheets" (IDQTF 2012) has been considered in preparing this QAPP addendum. In some cases, detail provided in the original QAPP that is not expected to be needed by QAPP users executing the 2016 study has been removed to avoid unnecessary redundancy; however, reference to the location of such detail in the original QAPP is provided.

QAPP Worksheet #1: Title and Approval Page

Site Name and Location: UCR, WA State

Project: 2016 Residential Soil Study *Document Control Reference:* Addendum No. 1 to SRC Inc. 2014

Lead Organization: TAI

Document Title: 2016 Residential Soil Study QAPP Addendum No. 1

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Preparation Date: 07/26/2016

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EPA Regional Quality Assurance Manager (RQAM)	Donald M. Brown	for Donald Brown	Date: 7/27/16
TAI Project Coordinator	Kris McCaig		Date: 7/26/16
TAI Principal Investigator	Dina Johnson		Date: 7/26/16
TAI Analytical Chemistry Laboratory Coordinator	Dave Enos		Date: 7/26/16
TAI Task Quality Assurance (QA) Coordinator	Rock Vitale		Date: 7/26/2016
TAI Chemistry Laboratory Project Manager	Jeff Coronado		Date: 7/26/16
TAI Chemistry Laboratory QA Manager	Lee Wolf	for Lee Wolf	Date: 7/26/16
TAI Database Administrator	Randy O'Boyle		Date: 7/26/16

QAPP Worksheet #2: QAPP Identifying Information

Site Name and Location: UCR, WA State

Project: 2016 Residential Soil Study *Document Control Reference:* Addendum No. 1 to SRC Inc. 2014

Lead Organization: TAI

Document Title: 2016 Residential Soil Study QAPP Addendum No. 1

Guidance used to prepare QAPP: This document presents Addendum No. 1 to the 2014 UFP-QAPP for the UCR Residential Soil Study (SRC Inc. 2014), which was led by EPA in 2014. The 2014 QAPP was prepared by SRC Inc. under Scientific, Engineering, Response & Analytical Services (SERAS) work assignment SERAS 0-079 to the EPA Environmental Response Team (ERT). SRC Inc. (2014) prepared the 2014 QAPP based on IDQTF UFP-QAPP guidance (IDQTF 2005). This QAPP addendum also considers more recent IDQTF guidance regarding Optimized UFP-QAPP Worksheets (IDQTF 2012).

1. **Regulatory program:** Comprehensive Environmental Response and Compensation Liability Act; RI/FS Settlement Agreement (DOJ 2006)
2. **Approval entity:** Region 10 (R10) Project Managers and RQAM
3. **The QAPP is (select one):** ☐Generic ☒Project Specific
4. **Dates of scoping sessions that were held:** October 8 and 26, 2015; November 30, 2015
5. **Dates and titles of QAPP documents written for previous site work, if applicable:**

Title	**Approval Date**
Quality Assurance Project Plan Upper Columbia River Human Health Risk Assessment Washington State SERAS-079-DQAPP-011311	01/13/11
Quality Assurance Project Plan Upper Columbia River Residential Soil Study Washington State SERAS-079-DQAPP-081214	08/13/14

6. **Other stakeholders/organizational Partners:** U.S. Department of the Interior, Washington State Department of Ecology, Confederated Tribes of the Colville Reservation, and the Spokane Tribe of Indians
7. **Data users:** EPA, R10 Project Managers and designees; EPA/ERT; TAI Project Coordinator and designees.

QAPP Worksheet #2: QAPP Identifying Information *(continued)*

Required QAPP Element(s) and Corresponding QAPP Section(s)		Required Information	Crosswalk to Related Documents
Project Management and Objectives			
2.1	Title and Approval Page	- Title and Approval Page	1
2.2	Document Format and Table of Contents	- Table of Contents - QAPP Identifying Information	2
2.2.1	Document Control Format		
2.2.2	Document Control Numbering System		
2.2.3	Table of Contents		
2.2.4	QAPP Identifying Information		
2.3	Distribution List and Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-off Sheet	3 4
2.3.1	Distribution List		
2.3.2	Project Personnel Sign-Off Sheet		
2.4	Project Organization	- Project Organizational Chart	5
2.4.1	Project Organizational Chart	- Communication Pathways	6
2.4.2	Communication Pathways	- Personnel Responsibilities and Qualifications Table	7
2.4.3	Personnel Responsibilities and Qualifications	- Special Personnel Training Requirements Table	8
2.4.4	Special Training Requirements and Certification		
2.5	Project Planning/Problem Definition	- Project Planning Session Documentation (including Data Needs tables)	9
2.5.1	Project Planning (Scoping)		
2.5.2	Problem Definition, Site History, and Background	- Project Scoping Session Participants Sheet	
		- Problem Definition, Site History, and Background	10 (SRC Inc. 2014; Worksheet #10)
		- Site Maps (historical and present)	
2.6	Project Quality Objectives and Measurement	- Site-Specific Project Quality Objectives (PQOs)	11 Attachment A
2.6.1	Performance Criteria Development of Project Quality Objectives Using the Systematic Planning Process	- Measurement Performance Criteria Table	12
2.6.2	Measurement Performance Criteria		
2.7	Secondary Data Evaluation	- Sources of Secondary Data and Information	13 (SRC Inc. 2014; Worksheet #13)
		- Secondary Data Criteria and Limitations Table	

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule and Timeline Table	14 15 16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods, and Standard Operating Procedure (SOP) Requirements Table - Analytical Methods and SOP Requirements Table - Field Quality Control (QC) Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 (SRC Inc. 2014; Worksheet #17) Figure 2 Attachment C 18 19 20 Attachment D 21 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Attachment E 23 24 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain of Custody (COC) Form and Seal	26 Attachment D 27

Required QAPP Element(s) and Corresponding QAPP Section(s)		Required Information	Crosswalk to Related Documents
3.4	QC Samples	- QC Samples Table - Screening and Confirmatory Analysis Decision Tree	28
3.4.1	Sampling QC Samples		
3.4.2	Analytical QC Samples		
3.5	Data Management Tasks	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	29 30
3.5.1	Project Documentation and Records		
3.5.2	Data Package Deliverables		
3.5.3	Data Reporting Formats		
3.5.4	Data Handling and Management		
3.5.5	Data Tracking and Control		
Assessment/Oversight			
4.1	Assessments and Response Actions	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	31 32
4.1.1	Planned Assessments		
4.1.2	Assessment Findings and Corrective Action Responses		
4.2	QA Management Reports	- QA Management Reports Table	33
4.3	Final Project Report		
Data Review			
5.1	Overview		
5.2	Data Review Steps	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34 35 36 37
5.2.1	Step I: Verification		
5.2.2	Step II: Validation		
5.2.2.1	Step IIa: Validation Activities		
5.2.2.2	Step IIb: Validation Activities		
5.2.3	Step III: Usability Assessment		
5.2.3.1	Data Limitations and Actions from Usability Assessment		
5.2.3.2	Activities		
5.3	Streamlining Data Review		
5.3.1	Data Review Steps To Be Streamlined		
5.3.2	Criteria for Streamlining Data Review		
5.3.3	Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3: Distribution List

☐ Worksheet Not Applicable (State Reason)

QAPP Recipient	Title	Organization	Telephone Number	Fax Number	Email Address	Document Control Number
Laura Buelow	Project Manager	EPA R10	509-376-5466	N/A	buelow.laura@epa.gov	Addendum No. 1 to SRC Inc. 2014
Dustan Bott	Project Manager	EPA R10	206-553-5502	N/A	bott.dustan@epa.gov	Addendum No. 1 to SRC Inc. 2014
Donald M. Brown	RQAM	EPA R10	206-553-0717	N/A	brown.donaldm@epa.gov	Addendum No. 1 to SRC Inc. 2014
Marc Stifelman	Human Health Risk Assessor	EPA R10	206-553-6979	N/A	stifelman.marc@epa.gov	Addendum No. 1 to SRC Inc. 2014
Kris McCaig	Project Coordinator	TAI	509-623-4501	N/A	kris.mccaig@teck.com	Addendum No. 1 to SRC Inc. 2014
Dave Enos	Analytical Chemistry Laboratory Coordinator	TAI	509-623-4505	N/A	dave.enos@teck.com	Addendum No. 1 to SRC Inc. 2014
Dina Johnson	Principal Investigator	Ramboll Environ	206-336-1662	N/A	dljohnson@ramboll.com	Addendum No. 1 to SRC Inc. 2014
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Jeff Coronado	Chemistry Laboratory Project Manager	ALS Environmental (ALS)	360-501-3316	N/A	jeff.coronado@alsglobal.com	Addendum No. 1 to SRC Inc. 2014
Randy O'Boyle	Database Administrator	Exponent	425-519-8727	N/A	roboyle@exponent.com	Addendum No. 1 to SRC Inc. 2014

QAPP Worksheet #4: Project Personnel Sign-Off Sheet

☐ Worksheet Not Applicable (State Reason)

Organization: TAI

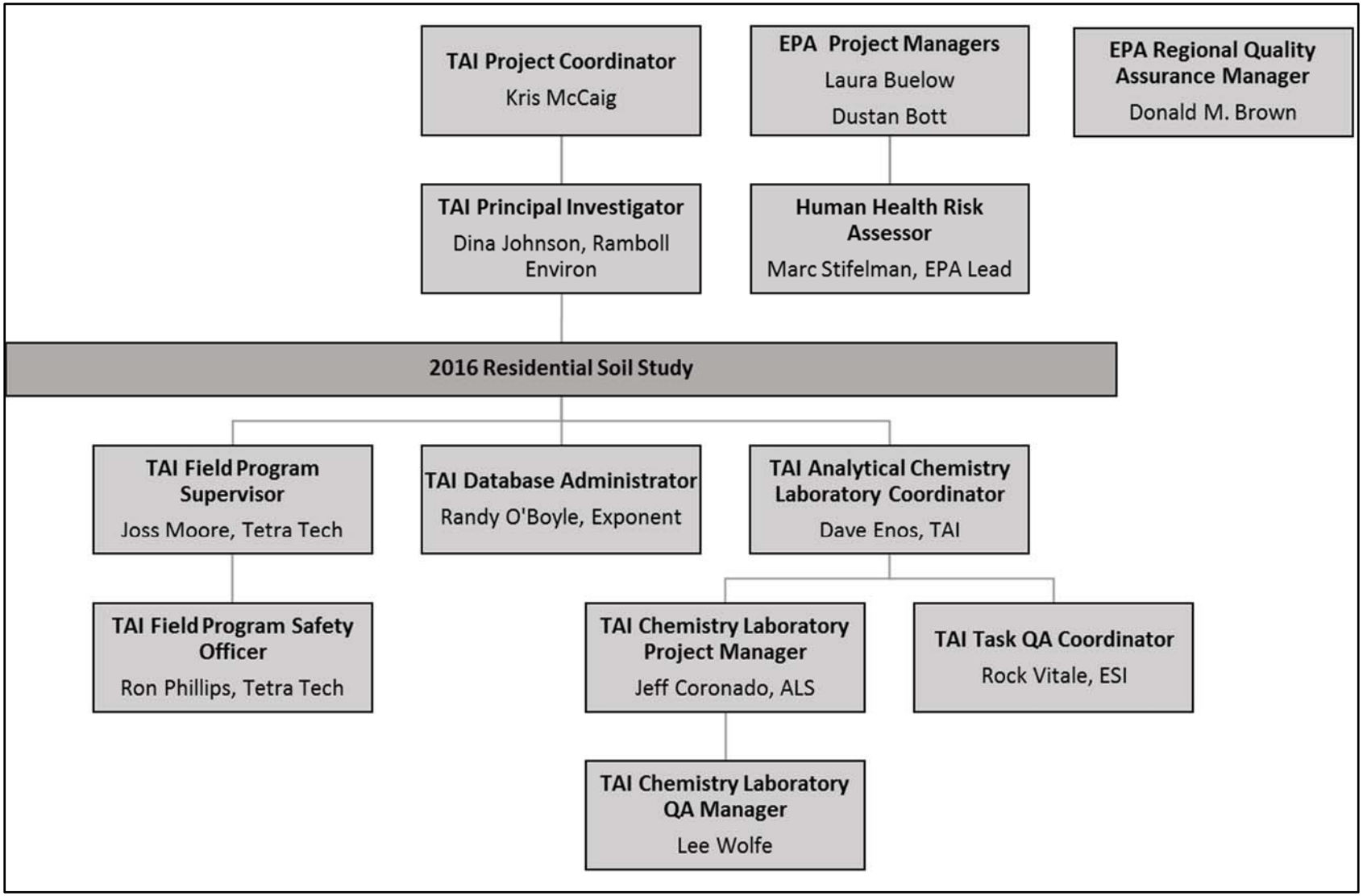
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Joss Moore	Field Program Supervisor*	503-320-1796		
Ron Phillips	Field Program Safety Officer**	208-891-1928		

*The Field Program Supervisor is responsible for overseeing the planning and coordination of the soil sampling efforts and for all aspects of sample collection activities to ensure that appropriate sampling, QA, and documentation procedures are used. In the event that changes in the QAPP or Field Sampling Plan (FSP) are needed, the field supervisor will ensure that proposed changes are coordinated with EPA's Project Managers or other designated EPA staff according to the established lines of communication among the TAI technical team, TAI, and EPA.

**The Field Program Safety Officer will be responsible for implementing the site health and safety plan (SHSP) and will act to correct any safety deficiencies. Responsibilities will include but are not limited to: 1) conducting an initial site safety orientation prior to start of work, and as new project staff arrive on-site; 2) ensuring team leaders conduct daily safety briefings during the length of site activities; 3) managing, reporting, and documenting all on-site injuries and serious near misses; 4) assisting team leaders in investigating incidents and near misses to determine the cause and make recommendations to prevent recurrence; 5) verifying necessary safety equipment and personal protective equipment (PPE) is available, in proper working order, and properly used; and 6) suspending site activities if conditions arise that present an imminent danger and, following the suspension of work, immediately notifying the field supervisor.

QAPP Worksheet #5: Project Organizational Chart

☐ Worksheet Not Applicable (State Reason)



QAPP Worksheet #6: Communication Pathways

☐ Worksheet Not Applicable (State Reason)

Communication Drivers	Organization	Name	Contact Information	Procedure (Timing, Pathways, etc.)
Regulatory agency interface	EPA R10	Laura Buelow Dustan Bott Donald M. Brown	509-376-5466 buelow.laura@epa.gov 206-553-5502 bott.dustan@epa.gov 206-553-0717 brown.donaldm@epa.gov	Field activities will be communicated to the EPA Project Manager by the EPA field oversight personnel daily.
Field progress reports	TAI	Kris McCaig	509-623-4501 kris.mccaig@teck.com	Progress should be reported to the TAI Project Coordinator.
Stop work due to safety issues	Tetra Tech	Ron Phillips Joss Moore	208-891-1928 Ron.Phillips@tetratech.com 503-320-1796 Joss.Moore@tetratech.com	Any employee may stop work in the event of a safety issue. The Field Program Safety Officer and Field Program Supervisor should be contacted as soon as possible after incident.
QAPP changes prior to or during project execution	Tetra Tech	Joss Moore	503-320-1796 Joss.Moore@tetratech.com	Contact the Field Program Supervisor as soon as possible regarding changes to the QAPP. The field supervisor will coordinate with EPA or its designee in the field and communicate to the TAI Project Coordinator who will contact the EPA Project Manager to confirm agreement and document via a change request.
Field corrective actions	Tetra Tech Ramboll Environ	Joss Moore Dina Johnson	503-320-1796 Joss.Moore@tetratech.com 206-336-1662 dljohnson@ramboll.com	The Field Program Supervisor will consult with EPA field oversight personnel and contact the TAI Project Coordinator to discuss actions. The TAI Project Coordinator will communicate a decision to the EPA Project Manager and confirm agreement.

Communication Drivers	**Organization**	**Name**	**Contact Information**	**Procedure (Timing, Pathways, etc.)**
Sample receipt variances	TAI Ramboll Environ	Dave Enos Dina Johnson	509-623-4505 dave.enos@teck.com 206-336-1662 dljohnson@ramboll.com	Reported in writing within 24 hours of receipt of samples.
Laboratory QC variances	TAI	Dave Enos	509-623-4505 dave.enos@teck.com	The laboratory coordinator will communicate problems that may affect the outcome of the task to the TAI Project Coordinator.
Analytical corrective actions	TAI	Dave Enos	509-623-4505 dave.enos@teck.com	The laboratory coordinator will provide information to the TAI Project Coordinator after review.
Data verification and/or validation issues, e.g., non-compliance with procedures	ESI TAI	Rock Vitale Dave Enos	610-935-5577 rvitale@envstd.com 509-623-4505 dave.enos@teck.com	Problems that may affect the final outcome of the task will be reported to EPA by the TAI Project Coordinator.
Data review corrective actions	Exponent Ramboll Environ TAI	Randy O'Boyle Dina Johnson Kris McCaig	425-519-8727 roboyle@exponent.com 206-336-1662 dljohnson@ramboll.com 509-623-4501 kris.mccaig@teck.com	Problems that may affect the final outcome of the task will be reported to EPA by the TAI Project Coordinator.

QAPP Worksheet #7: Personnel Responsibilities and Qualification Table

☐ Worksheet Not Applicable (State Reason)

Organization: TAI

Name	Project Title/Role	Education/Experience
Kris McCaig	TAI Project Coordinator	Manager of Environment and Public Affairs at TAI, B.S. in Environmental Engineering, over 20 years of experience in environmental project management
Dave Enos	TAI Analytical Chemistry Laboratory Coordinator	Dormant Property Manager at TAI, B.A. in Geology, over two decades experience as an environmental geologist

Organization: Ramboll Environ

Name	Project Title/Role	Education/Experience
Dina Johnson	TAI Principal Investigator	Senior project manager with more than 20 years of experience conducting human health exposure and risk assessment studies

Organization: Tetra Tech, Field Program

Name	Project Title/Role	Education/Experience
Walt Vering	Project Manager	B.A. in Biology, M.S. in Natural Resources, over 20 years of experience in biology and environmental consulting, extensive experience in managing large field crews conducting various types of surveys and large-scale natural resource data collection
Joss Moore	Field Program Supervisor	B.S. in Geology, over 15 years of experience, both nationally and internationally, as a geologist in the environmental field, managed site investigations that include complex upland and over-water site work
Ron Phillips	Field Program Safety Officer	B.S. in Geophysics, over 26 years of experience in providing project management and technical support for projects
Debora Kutsal	Technical Advisor/QA/QC	B.S. in Environmental Chemistry and Aquatic Sciences, over 23 years of experience as an Environmental Chemist and QA Manager, including QA and QC-related analytical support on CERCLA pre-remedial and remedial investigations
Randy Bassett	Technical Advisor	PhD in Environmental Geochemistry, an accomplished geochemist who has directed and managed research groups of professional scientists and staff
Sara Woolley	Technical Advisor/Analytical QA/QC	B.S. in Political Economy of the Natural Resources, over 22 years of professional experience in the field of environmental consulting, 5 years of experience in a laboratory, and a 15-year management background, Tetra Tech's lead chemist for all incremental sampling methodology

Name	Project Title/Role	Education/Experience
		sampling programs
Jason Brodersen	Technical Advisor/Incremental Composite Sampling Methodology	B.S. in Geophysics, 27 years of professional environmental consulting experience, has been a project and program manager for complex environmental investigation and cleanup projects

Organization: ALS, Analytical Chemistry Laboratory

Name	Project Title/Role	Education/Experience
Jeff Coronado	Chemistry Laboratory Project Manager	B.S. in Chemistry/B.A. in Business Management, 27 years commercial lab experience specializing in trace metals analysis.
Lee Wolf	Chemistry Laboratory QA Manager	B.S. in Chemistry, 31 years of experience in contract laboratories (28 years with CAS/ALS)
Jeff Grindstaff	Director of Kelso Laboratory location	B.S. in Chemistry, 26 years of experience in contract laboratories (24 years with CAS/ALS)

Organization: ESI, Data Validation

Name	Project Title/Role	Education/Experience
Rock Vitale	TAI Task QA Coordinator	Technical Director of Chemistry and Chief Executive Officer at ESI, M.S. in Chemistry, expert in analytical chemistry and QA, with particular emphasis on laboratory auditing, methods development, and critical data validation

Organization: Exponent, Data Management

Name	Project Title/Role	Education/Experience
Randy O'Boyle	Database Administrator	Managing scientist at Exponent

QAPP Worksheet #8: Special Personnel Training Requirements Table

☐ Worksheet Not Applicable (State Reason)

Organization: Tetra Tech, Field Program

Name	Project Title/Role	Specialized Training/Certifications
Joss Moore	Field Program Supervisor	40-hour OSHA HAZWOPER Training, 8-hour Hazardous Waste Supervisor Training, American Red Cross First Aid, CPR and AED, TSA National TWIC Card
Ron Phillips	Field Program Safety Officer	DOT Hazardous Materials 49 CFR, Subpart H Training, Adult CPR/AED/First Aid, 40-hour OSHA HAZWOPER Training, 8-hour OSHA Site Supervisor Training
Chris Ansari	Field Lead	40-hour OSHA HAZWOPER Training, Wetland Delineation Training
Rachael Katz	Field Lead	40-hour OSHA HAZWOPER Training, River Restoration Analysis Tools (River RAT); Portland State University Environmental Professional Program
Rhianna Reed	Field Lead	40-hour OSHA HAZWOPER Training
Hilary Heist	Field Lead	USDOL Mine Safety and Health Administration Annual Refresher Training

Organization: ALS, Analytical Chemistry Laboratory

Name	Project Title/Role	Specialized Training/Certifications
Jeff Coronado	Laboratory Project Manager	Numerous internal and external training courses and activities (technical, IT, ethics, management, safety, etc.). Records available at ALS.
Lee Wolf	Laboratory QA Manager	Numerous external specialized technical training seminars and classes, numerous external quality assurance management training seminars and classes, numerous internal training activities (technical, ethics, management, safety, etc.), including the lead role as the trainer.

Organization: ESI, Data Validation

Name	Project Title/Role	Specialized Training/Certifications
Tom Weinmann	Senior Quality Assurance Chemist	EPA Contract Laboratory Program Data Validation Training provided by ESI. Records available at ESI.

QAPP Worksheet #9: Project Scoping Session Participants Sheet

☐ Worksheet Not Applicable (State Reason)

Project Name: 2016 Residential Soil Study

Site Name: UCR

Projected Date(s) of Sampling: Summer/Fall 2016

Site Location: WA

Project Manager: Kris McCaig

Dates of Sessions: October 2015 through July 2016

Scoping Session Purpose: To discuss project scope and relationship to 2014 study, schedule, and logistics

Name	Title	Affiliation	Phone Number	Email Address	Project Role
Kris McCaig	Manager	TAI	509-623-4501	Kris.McCaig@teck.com	TAI Project Coordinator
Becky Henselen	Environmental Coordinator (until June 15, 2016)	TAI (until June 15, 2016)			TAI Coordinator (until June 15, 2016)
Dina Johnson	Senior Manager	Ramboll Environ	206-336-1662	dljohnson@ramboll.com	TAI Principal Investigator
Emma Handziuk	Associate Health Scientist	Ramboll Environ	206-336-1657	ehandziuk@ramboll.com	Participant Tracking and Field Planning Support
Laura Buelow	Project Manager	EPA R10	509-376-5466	Buelow.Laura@epa.gov	EPA Project Manager
Dustan Bott	Project Manager	EPA R10	206-553-5502	bott.dustan@epa.gov	EPA Project Manager
Marc Stifelman	Human Health Risk Assessor	EPA R10	206-553-6979	Stifelman.Marc@epa.gov	EPA Human Health Risk Assessor
Bill Thayer	Environmental Engineer	SRC Inc.	315-452-8424	Thayer@srcinc.com	2014 EPA Study Contractor; field activities
Gary Diamond	Senior Toxicologist	SRC Inc.	716-542-7140	Diamond@srcinc.com	2014 EPA Study Contractor; field activities
Mark Follansbee	Toxicologist	SRC Inc.	207-883-2605	follansbee@srcinc.com	2014 EPA Study Contractor; field activities
Marilyn Gauthier	Project Manager	CH2M HILL	503-872-4800	Marilyn.Gauthier@ch2m.com	2014 EPA Study Contractor; field activities

QAPP Worksheet #10: Problem Definition

☐ Worksheet Not Applicable (State Reason)

Problem to be addressed by the project:

The UCR Site consists of the areal extent of hazardous substances contamination within the United States in or adjacent to the UCR, including the Franklin D. Roosevelt Lake, from the border between the United States and Canada downstream to the Grand Coulee Dam and all suitable areas in proximity to such contamination necessary for implementation of the RI/FS. The RI/FS is currently underway to investigate the nature and extent of contamination that has resulted from historical and continuing discharges of hazardous substances into the Columbia River, including, but not limited to, releases from smelting processes and facility operations by Teck Metals, Ltd. at the Trail facility located in Trail, British Columbia (BC). This QAPP addendum concerns residential soil sampling in the UCR Study Area located along the UCR from the U.S.–Canada border to approximately the intersection of Williams Lake Road and Highway 25 on the east side of the river (Figure 1).

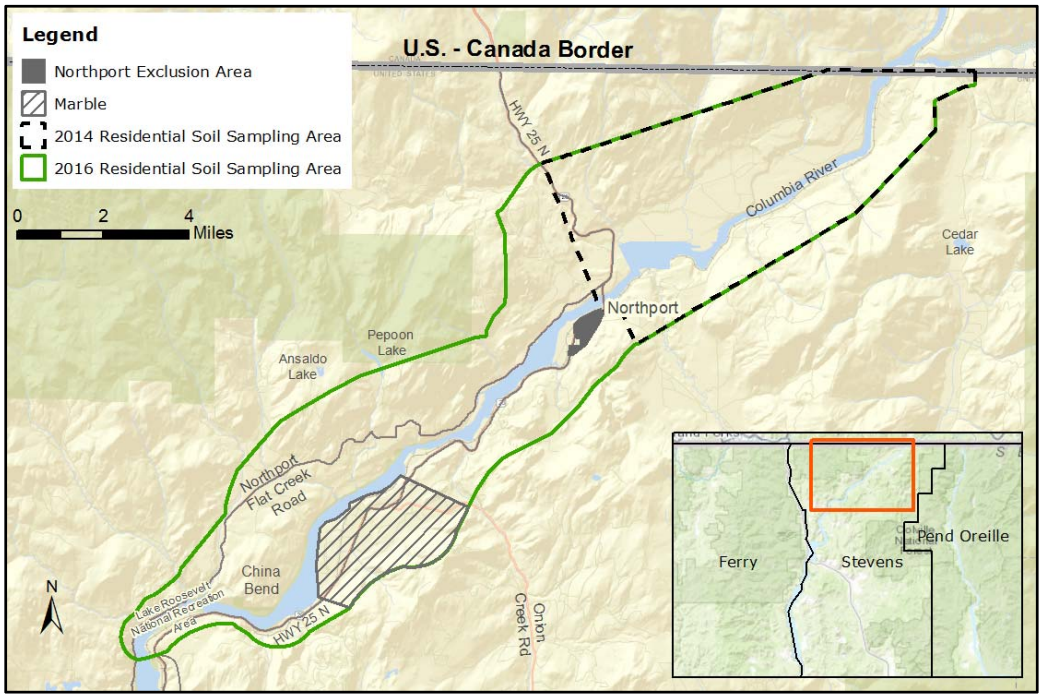


Figure 1. UCR Study Area for the 2016 Residential Soil Study

Historic emissions from the Trail smelting facility in Trail, BC have included metal-enriched particulates and aerosols. These airborne contaminants were deposited at varying distances from the smelter and became incorporated into the soil horizon. Various studies and soil sampling activities have been conducted in the Columbia River valley corridor south of the U.S.-Canada border and were described previously in the approved QAPP for the 2014 residential study (e.g., Hart Crowser 2013; see Worksheet #10 of SRC Inc. 2014). More recently, based on the results of EPA's 2014 study of residential soils, EPA determined that additional information is needed regarding the concentrations of lead and arsenic in residential soils from properties not previously sampled within the UCR Study Area (Figure 1).

The areal extent of contamination for the UCR Study Area has not been fully delineated; exposure point concentrations (EPCs) for Washington residents living within the study area, including gardeners and tribal members, need to be refined. As directed by EPA, TAI is planning a focused rural residential investigation of the northernmost reaches of the Columbia River valley (south of China Bend, WA to

the U.S.-Canada border; Figure 1) to collect data that may be used to refine estimates of exposure to metals in soils by existing residents within the study area.

This residential soil investigation is intended to produce data representative of potential exposure, based on activities of residents, associated with metal-enriched soil particles and to support risk management decision making.

Surface soil samples will be collected from residential properties in locations where there is a high potential for exposure by residents, especially young children, based on activities determined from interviews and site visits. Young children and gardeners are most likely to be exposed to metals via ingestion of fine soil particles that adhere to skin. Additionally, in a randomly selected subset of DUs with an IC sample depth of 0 to 1 in. below ground surface, discrete core samples will be collected from depths of 0 to 1 in. and 1 to 6 in. below ground surface to allow for comparison to discrete soil sample data collected in the 2014 study, and to support evaluation of uncertainty regarding interpretation of the 2014 discrete sample results in the evaluation of the vertical nature and extent of contamination.

Data collection activities presented in this addendum are designed to satisfy DQOs presented in Worksheet #11 and Attachment A.

The environmental questions being asked:

The principal environmental question that will be addressed by the data to be collected in this study is: Do lead and arsenic concentrations (and possibly other TAL metals) in the fine-grained fraction of soils (for soils, <150 microns [µm] representative of dry conditions [Ruby and Lowney 2012]; for beach sand < 250 µm because it is representative of dermal adherence under wet conditions, consistent with previous beach sampling efforts [Kissel et al. 1996]) from rural residential parcels pose an unacceptable risk to human health, particularly to children who live within the UCR Study Area?

Secondarily, the discrete soil sample data to be collected in this study will also allow for comparison to data collected in the 2014 study, and are intended to support evaluation of uncertainty regarding interpretation of the 2014 discrete sample results for evaluation of the vertical nature and extent of contamination.

A synopsis of existing data or information from site reports:

A synopsis of existing data or information that was considered by EPA in preparation of the QAPP for the 2014 residential study was provided in Worksheet #10 of SRC Inc. 2014 and is not reproduced in this addendum.

The current study expands upon EPA's 2014 investigation of residential soils, the purpose of which was to collect data to support refinement of exposure estimates for residents of properties within the study area. As reported by CH2M HILL (2015) in the Draft Final Data Summary Report, a total of 541 IC samples (mostly from the 0 to 1 in. depth interval) and 402 discrete core samples (from the 1 to 6 in. depth interval) were collected from 235 residential DUs at 74 properties. Samples were analyzed for TAL metals, except mercury. Additionally, a total of 122 IC samples from a total of 114 DUs were selected for IVBA analysis for arsenic and lead. After adjustment for relative oral bioavailability (RBA), DU-specific arsenic concentrations ranged from 2.2 to 62 mg/kg based on IC samples. DU-specific RBA-adjusted lead concentrations ranged from 24 to 1,936 mg/kg in IC samples. Project action limits for target analytes in the prior study are the same as those specified in this QAPP addendum (see

Worksheet #15) and are based on RBCs[5] summarized in Attachment B to this addendum. In the 2014 study, project action limits for arsenic (20 mg/kg) and lead (400 mg/kg) were exceeded by the DU with the highest RBA-adjusted arsenic and lead concentrations at 18 and 24 properties, respectively. To identify DUs sampled in 2014 for soil removal actions, EPA set action levels of 90 m/kg for arsenic and 700 mg/kg for lead. None of the DU-specific adjusted arsenic results exceeded the arsenic action level. There were 13 properties where the highest adjusted lead result for any of the DUs exceeded the 700 mg/kg action level for lead. Considerable variability observed in concentrations of both arsenic and lead in discrete samples collected from within the same DU limited interpretation of these data regarding the vertical nature and extent of contamination.

In another 2014 study that included the area covered by EPA's 2014 residential soil study, TAI conducted an investigation of upland soils potentially affected by point sources (e.g., aerial deposition of smelter particulates), historical fluvial deposition of sediment onto relict floodplains, and re-deposition of windblown sediment (Windward et al. 2015). The upland soil data were collected for use in assessing risk to ecological and human receptors from exposure to metals in the upland soil adjacent to the UCR. A total of 215 IC samples (from the 0 to 3 in. depth interval) were collected at 171 DUs. Only arsenic and lead concentrations exceeded the human health screening levels in any of the upland DUs. For arsenic, the screening level was 9.39 mg/kg and for lead the screening level was 400 mg/kg.

The possible classes of contaminants and affected matrices:

Chemicals of interest:

- TAL metals (no mercury), particularly lead and arsenic; bioaccessibility of lead and arsenic in soil

Media of interest:

- The exposure pathway of concern is contact with soil. The sampling depth will be based on the soil depth interval that people are most likely to come into contact with and will vary by DU. "With respect to risk assessment, the top inch of soil best represents current exposure to contaminants (USEPA 1989, 1996) and is the source of data used in the Integrated Exposure Uptake Biokinetic (IEUBK) model to represent exposure from soil" (USEPA 2003). Surface soil will be collected from the entire 0 to 1 in. depth interval (top 2 centimeters [cm]) below the organic litter or sod (USEPA 2003) in house, dripline, agriculture, and other unspecified DUs. In locations where there is a concern of lead-based paint, dripline soils may represent a combination of aerial deposition and lead-based paint contribution. Soil located within the driplines of structures will not be sampled unless there is a concern of lead-based paint. The sampling depth for gardens, inclusive of produce and ornamental plants, will be the tilled depth because it is reasonable to expect that people routinely come into contact with soil throughout the tilled depth (typically 0 to 12 in.; may change based on property-specific interviews). Sampling depth for play areas will generally be 0 to 1 in. Areas where soil disturbance is deeper than 1 in. (based on observations made during the site visit) will generally be sampled at a depth of 0 to 3 in. (e.g., animal activity areas). Sampling depth for beaches will generally be 0 to 6 in. Sampling areas and depths were based on interviews with residents and observations from site visits.

[5] The project action limit for arsenic is the Washington unrestricted land use value (Ecology 2007), which is different from the arsenic RBC. For all other analytes, project action limits and RBCs are the same.

The rationale for inclusion of chemical and nonchemical analyses:

This study represents expansion of the prior residential soil study led by EPA in 2014. The chemical analyses included in the 2016 Residential Soil Study were selected for consistency with the 2014 study.

Information concerning various environmental indicators: N/A

Project decision conditions ("If..., then..." statements):

If the exposure of human receptors to surface soil under current UCR Study Area conditions results in unacceptable health risks, then EPA will take action to address such exposures.

QAPP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements

☐ Worksheet Not Applicable (State Reason)

Who will use the data?

TAI and EPA R10, as well as designated personnel from their respective project teams.

What will the data be used for?

The areal extent of contamination for the UCR Study Area has not been fully delineated; EPCs for Washington residents living within the study area, including gardeners and tribal members, need to be refined. A focused rural residential soil investigation will be conducted to refine estimates of exposure to metals in soils by existing residents within the study area. This residential soil investigation is intended to produce data representative of potential exposure, based on activities of residents, associated with metal-enriched soil and beach sediment particles and to support EPA's HHRA and risk management decision making.

Additionally, in a randomly selected subset of DUs with an IC sample depth of 0 to 1 in. below ground surface, discrete samples will be collected from depths of 0 to 1 in. and 1 to 6 in. below ground surface to allow for comparison to discrete soil sample data collected in the 2014 study, and to support evaluation of uncertainty regarding interpretation of the 2014 discrete sample results in the evaluation of the vertical nature and extent of contamination.

What types of data are needed?

Site-specific data are needed for the HHRA to determine the level of risk to humans exposed to soils in residential areas. These data should be reliable and representative measurements of the concentration of metals that are present in the soils to which residents, especially children, may be exposed.

As with the 2014 study of residential soil led by EPA, surface soil data will be collected to inform this data need. These data will be used in EPA's HHRA for the UCR Site to calculate residential soil EPCs for rural residents and to determine whether concentrations of metals present in surface soils pose an unacceptable risk to residents.

Surface soil will be sampled in locations where there is a high potential for exposure by residents, especially young children. The locations selected for soil sampling will consider inferred exposure areas based on communications with residents; accessibility of soil; and the presence of gardens, play areas, beach areas, pastures, animal pens, riding areas, or other property-specific visual information (see Attachment C, Property-Specific Maps). Surface soil samples will be collected following an IC sampling design from DUs for which areal extents were defined by property-specific estimated exposure categories (e.g., gardens, play areas, beach areas, animal activity areas). Each IC sample will consist of 30 increments. Three IC samples (triplicates) will be collected from some of the DUs; the DUs will be sampled in triplicate with a frequency of 20 percent (of DUs) and a minimum of 1 triplicate per property. The increments for each sample will be collected using a systematic grid with a random start to provide uniform spatial coverage (ITRC 2012). Driplines will not be sampled unless there is a concern of lead-based paint; for all other DU types, care will be taken to locate increments outside the dripline of the residence, and away from influences of any other painted surfaces. Areas near paved or compacted gravel roadways and railways (represented by a 50-foot buffer from the center line of these features in either direction) will also be avoided to prevent sampling soil that may be contaminated by non-air sources of TAL metals. Sample collection from unpaved roads and driveways will also be avoided unless the resident identifies such an area as having high potential use. In such cases, the unpaved road or driveway area will be established as a separate DU for sampling.

Metals will be measured in the fine particle fraction, which is the fraction expected to adhere to skin. The target particle size for soil is <150 µm, representative of dermal adherence as a proxy for inadvertent soil ingestion (Ruby and Lowney 2012); the target particle size for beach sand is <250 µm (Kissel et al. 1996). The exposure pathway to be assessed is incidental ingestion of surface soil resulting from contact with surface soils. This could occur as a result of direct skin contract with soil (e.g., during play or gardening), or as a result of inhaling surface dusts entrained to the breathing zone that are ultimately swallowed (e.g., during dirt biking and all-terrain vehicle use).

Estimates of lead and arsenic RBA in surface soils are also needed to inform this data need. At 20 percent of DUs where non-dripline IC samples have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively, these samples will be submitted for in vitro bioaccessibility assay analysis. These concentration "triggers" for lead and arsenic bioaccessibility testing are the same as those used in EPA's 2014 study of residential soil (SRC Inc. 2014).

In the HHRA, EPA's estimates of the amount and duration of resident exposures to surface soils at residential properties will follow methods described in the HHRA Work Plan (USEPA 2009b). Data will be used to support risk management decisions based on human health risk at the UCR Study Area.

Discrete samples will be collected at a frequency of 20 percent (of properties) and at one DU per randomly selected property where the IC sampling depth is 0 to 1 in. (Attachment D). Discrete samples will be collected from the 0 to 1 in. depth interval and the entire 1 to 6 in. depth interval at five locations within each selected DU. Discrete samples will be submitted for TAL metal analysis (no mercury). Metals will be measured in the fine particle fraction for soil.

How "good" do the data need to be in order to support the environmental decision?

Data must provide a representative estimate of the mean concentration of TAL metals (no mercury) for each DU and representative estimates of bioaccessibility of arsenic and lead in surface soils collected from the study area.

Worksheets #12 and #28 show the measurement performance criteria that are needed for the quality indicators. Worksheet #20 shows the field QC samples required.

Data should allow for reliable risk management decision-making within the specified tolerance limits as identified by EPA Project Managers for the UCR Study Area (see Worksheet #15).

How much data are needed? (number of samples for each analytical group, matrix, and concentration):

Residential parcels were identified within the UCR Study Area. Based on access agreements received from individual property owners, sampling will occur on 141 residential properties in the UCR Study Area. The number of DUs sampled on each property was determined based on the size, features, and layout of each property, which were identified following an initial site visit in spring 2016. For each property included in the study, the following data are needed:

- An IC soil sample will be collected from each identified DU. Triplicate IC soil samples will be collected with a frequency of 20 percent of DUs and a minimum of 1 triplicate per property. All IC soil samples will be submitted to the analytical laboratory for TAL metals analysis (no mercury).
- At 20 percent of DUs where non-dripline IC samples have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively, these samples will be submitted for in vitro bioaccessibility assay analysis. If a DU selected for bioaccessibility testing has one or more replicate IC soil samples with concentrations that are greater than or equal to 100 mg/kg lead or 20 mg/kg arsenic, one of the replicate IC soil samples will be randomly selected for testing.

Discrete samples will be collected at a frequency of 20 percent (of properties) and at one DU per randomly selected property where the IC sampling depth is 0 to 1 in. (Attachment D). Discrete samples will be collected from the 0 to 1 in. and 1 to 6 in. depth intervals at five locations within each selected DU. All discrete soil samples will be submitted to the laboratory for TAL metals analysis (no mercury). Selection of the subset of DUs was determined by the EPA Project Manager in consultation with the TAI Project Coordinator (Attachment D). Discrete samples will not be submitted for bioaccessibility testing.

The study reference limits and evaluation table is provided in Worksheet #15. Worksheet #18 details the number of samples needed for each analytical group, matrix, and DU to be sampled.

Where, when, and how should the data be collected/generated?

Soil sample data will be collected from properties within the UCR Study Area where access agreements have been secured and residential use verified during a field reconnaissance phase. Sampling will be conducted during the 2016 field sampling season (April to October). Samples will be collected using the IC sampling methodology and discrete sampling methodology described in Attachment D, the FSP. The laboratory (ALS Laboratory in Kelso, WA) will process the samples (drying, sieving, subsampling) and conduct the TAL metals analysis (no mercury) and lead and arsenic IVBA analysis according to the laboratory analytical methods described in Attachment E.

Who will collect and generate the data?

All data for this study will be collected by TAI's Field Contractor Tetra Tech. The laboratory (ALS Laboratory in Kelso, WA) will process the samples (drying, sieving, subsampling) and conduct the TAL metals analysis (no mercury) as well as the lead and arsenic IVBA analysis.

How will the data be reported?

Records will include documents and electronic deliverables related to field sampling (field notebook, sample logs, COCs); laboratory documentation (e.g., laboratory records, data packages, project reports, electronic data deliverables [EDDs]); data validation; and data reports.

All definitive data will be reported by the laboratory in a Level 4 Contract Laboratory Program (CLP), or equivalent, data type package that will be a mixture of Stage 4 (S4VEM/S4VM) and Stage 2 validated or reviewed by third parties (refer to Worksheet #14). The IVBA data will be verified and validated according to SOPs in EPA's Standard Operating Procedure for an *In Vitro* Bioaccessibility Assay for Lead in Soil (USEPA 2012). Data will be reported in a data summary report after receipt of the validated data.

How will the data be archived?

Data will be provided electronically in an Excel file, and in Adobe AcrobatTM*.pdf format for inclusion in the project file. Data packages from the contract laboratory will be archived by TAI's Database Administrator. Data reports will be made available through integration into the project database web tool, which is an electronic data management system that is accessible via an external website (http://teck-ucr.exponent.com).

QAPP Worksheet #12-1: Measurement Performance Criteria Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance[1]	QC Sample Assesses Error for Sampling (S), Analytical (A), or Both (S and A)
01 (IC Sample Collection), 02 (Discrete Sample Collection)	MET-3050B.r14 MET-6020.r16 MET-ICP.r25	Accuracy/Bias	As per vendor's certificate of analysis	Laboratory Control Sample	A
		Accuracy/Bias	Percent R = 75-125	Matrix Spike	A
		Precision	Relative Percent Difference (RPD) ±20 percent	Matrix Spike/Matrix Spike Duplicate	A
		Precision	Relative Standard Deviation (RSD) ≤ 20 percent	Laboratory Replicates	A
		Precision	RSD ≤ 30 percent	Field Replicates[2]	S and A
		Accuracy/Bias (Contamination)	<Method Reporting Limit (MRL)	Field Equipment Blank	S
		Accuracy/Bias (Contamination)	<MRL	Method Blank	A
		Accuracy/Bias (Contamination)	<MRL	Sieve Blank	A
		Precision	RPD ±35 percent	Field Duplicates[3]	S and A
		Precision/Error	RPD ±50 percent	Laboratory Split Samples	A
		Accuracy/Bias	Percent Difference ±10 percent	Serial Dilution	A
		Accuracy/Bias	Percent Recovery = 75-125	Post Spike	A

[1] Laboratory spiking concentrations for arsenic and lead should be comparable to the project action limits of 20 mg/kg arsenic and 400 mg/kg lead in order for those recoveries to be meaningful and relevant to the DQOs.
[2] Applies to sampling procedure 01 only.
[3] Applies to sampling procedure 02 only.

QAPP Worksheet #12-2: Measurement Performance Criteria Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Soil
Analytical Group	Metals –IVBA[1] (no mercury)
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or Both (S and A)**
01 (IC sample collection)	MET-BIOACC.r1	Accuracy and Precision	Field and Laboratory Duplicates RPD within Laboratory Limits Matrix Spike Percent R 75-125 Standard Reference Material as per Manufacturer's Specifications	Field Duplicate Laboratory Duplicate Matrix Spike Standard Reference Material	S A A A

[1] IVBA duplicate sample analysis will be performed on 15 percent of the samples submitted for IVBA testing.

QAPP Worksheet #13: Existing Data Criteria and Limitations Table

☐ Worksheet Not Applicable (State Reason)

Existing Data	**Data Source (Originating Organization, Report Title, and Date)**	**Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)**	**How Data Will Be Used**
Risk assessment guidance	Bacom, A., G. Diamond, and B. Thayer. 2012. Memorandum to Marc Stifelman, U.S. Environmental Protection Agency, Region 10. Subject: Toxicity Values for Risk Screening of Vanadium. SRC, Inc.: North Syracuse, NY. April 26.	Not Applicable	To establish RBC for vanadium
Soil data	CH2M HILL. 2015. Draft Final UCR Residential Soil Study Field Sampling and Data Summary Report. October.	SRC, CH2M HILL, EPA, residential soil samples, 2014	Support rationale for the 2016 Residential Soil Study and specific modifications to 2014 sampling design
Project planning guidance	Crumbling, D. 2014. Mass of Analytical Sub-Sample for Metals & IVBA. W. Thayer, ed. Washington, DC: U.S. Environmental Protection Agency. Personal Communication. April 15.	Not Applicable	QAPP preparation
Risk assessment guidance	Diamond, G., and B. Thayer. 2011a. Memorandum to Marc Stifelman, U.S. Environmental Protection Agency, Region 10. Subject: Toxicity Values for Risk Screening of Antimony. SRC, Inc.: North Syracuse, NY. April 15.	Not Applicable	To establish RBC for antimony
Risk assessment guidance	Diamond, G., and B. Thayer. 2011b. Memorandum to Marc Stifelman, U.S. Environmental Protection Agency, Region 10. Subject: Toxicity Values for Risk Screening of Vanadium. SRC, Inc.: North Syracuse, NY. April 15.	Not Applicable	To establish RBC for vanadium

Existing Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)	How Data Will Be Used
Regulatory guidance	DOJ. 2006. Settlement Agreement for Implementation of Remedial Investigation and Feasibility Study at the Upper Columbia River Site. U.S. Department of Justice (DOJ): Washington, DC. June 2, 2006.	Not Applicable	Regulatory program authority
Soil criteria	Ecology (Washington State Department of Ecology). 2007. Model Toxics Control Act Regulation and Statute. Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC, as amended, October 12, 2007. https://fortress.wa.gov/ecy/publications/publications/9406.pdf	Not Applicable	Basis for arsenic project action limit[1]
Risk assessment guidance	USEPA. 1994. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. PB93-963510, OSWER 9285.7-15-1. February. Available online at: https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals.	Not Applicable	Risk assessment

Existing Data	**Data Source (Originating Organization, Report Title, and Date)**	**Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)**	**How Data Will Be Used**
Risk assessment guidance	USEPA. 2003. Superfund Lead-Contaminated Residential Sites Handbook. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. OSWER Directive 9285. 7-50. August. Available online at: https://www.epa.gov/superfund/lead-superfund-sites-guidance. Note: Data from this source references the two primary data sources below: - USEPA. 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002. - USEPA. 1996. Soil Screening Guidance: User's Guide. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response: Washington, DC. Publication 9355.4-23.	Not Applicable	Risk assessment
Analytical methods	USEPA. 2007. Estimation of Relative Bioavailability of Lead Soil and Soil-like Materials using *In Vivo* and *In Vitro* Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. May. Available online at: https://www.epa.gov/superfund/soil-bioavailability-superfund-sites-guidance.	Not Applicable	QAPP preparation, sample analysis

Existing Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)	How Data Will Be Used
Data validation labeling methods	USEPA. 2009a. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, DC. OSWER No. 9200.1-85. EPA 540-R-08-005. January.	Not Applicable	Reference for data validation labeling
HHRA Work Plan for UCR Study Area	USEPA. 2009b. Human Health Risk Assessment Work Plan for the Upper Columbia River Site Remedial Investigation and Feasibility Study. Prepared for U.S. Environmental Protection Agency, Region 10 by Syracuse Research Corporation. Final. March. Available online at: http://yosemite.epa.gov/r10/cleanup.nsf/sites/upperc.	Not Applicable	Provides background information that was used to support rationale for the 2016 Residential Soil Study
Data validation	USEPA. 2010. EPA Contract Laboratory Program. National Functional Guidelines for Inorganic Superfund Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation: Washington, DC. EPA/540/R-10/011. January. Available online at: http://www.epa.gov/superfund/programs/clp/download/ism/ism1nfg.pdf.	Not Applicable	Reference for verification and validation process for field and laboratory data
Incremental sampling methodology	USEPA. 2011. EPA's User Guide, Uniform Federal Policy Quality Assurance Project Plan Template for Soils Assessment of Dioxin Sites. U.S. Environmental Protection Agency. September. Available online at: https://www.epa.gov/superfund/site-evaluation-dioxin-superfund-sites.	Not Applicable	Reference for implementing the incremental composite sampling approach

Existing Data	**Data Source (Originating Organization, Report Title, and Date)**	**Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)**	**How Data Will Be Used**
Analytical methods	USEPA. 2012. Standard Operating Procedure for an *In Vitro* Bioaccessibility Assay for Lead in Soil. OSWER 9200.2-86. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. April. Available online at: http://www.epa.gov/superfund/bioavailability/pdfs/EPA_Pb_IVBA_SOP_040412_FINAL_SRC.pdf.	Not Applicable	Reference for verification and validation process for field and laboratory data
EPA directive to TAI for 2016 study	USEPA. 2015a. August 11, 2015 Letter from Laura C. Buelow, EPA Project Manager, to Kris McCaig, TAI Project Coordinator, detailing EPA's revised directive to TAI to conduct additional residential sampling as set forth in this letter.	Not Applicable	Support rationale for 2016 Residential Soil Study Area boundaries, timing, and roles
EPA directive to TAI for 2016 study	USEPA. 2015b. November 5, 2015 Letter from Laura C. Buelow, EPA Project Manager, to Kris McCaig, TAI Project Coordinator, detailing EPA's proposed changes to the residential soil sampling QAPP for 2016 based on EPA's 2014 residential soil sampling results.	Not Applicable	Support rationale for 2016 Residential Soil Study deviations from 2014 residential soil study
Incremental sampling methodology	Hathaway, J., G. Schaalje, R. Gilbert, B. Pulsipher, and B. Matzke. 2008. Determining the optimal number of increments in composite sampling. Environ. Ecol. Stat. 15:313-327.	Not Applicable	Methods
Incremental sampling methodology	HDOH. 2009. Multi-increment Sample Collection. Hawaii Department of Health (HDOH): Honolulu, HI. Available online at: www.hawaiidoh.org/tgm.aspx?p=0402a.aspx.	Not Applicable	Support the rationale for using incremental composite sampling approach

Existing Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)	How Data Will Be Used
Project planning guidance	IDQTF. 2005. Intergovernmental Data Quality Task Force Workbook for Uniform Federal Policy for Quality Assurance Project Plans. Part 2A: UFP-QAPP Workbook. Final. Version 1. March. Available online at: http://www2.epa.gov/sites/production/files/documents/part2ufp_wbk_0305.pdf.	Not Applicable	QAPP preparation
Project planning guidance	IDQTF. 2012. Intergovernmental Data Quality Task Force Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets. March. Available online at: http://www2.epa.gov/sites/production/files/documents/ufp_qapp_worksheets.pdf.	Not Applicable	QAPP preparation
Incremental sampling methodology	ITRC. 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. Interstate Technology and Regulatory Council: Washington, DC. 475 pp. Available online at: http://www.itrcweb.org/gd.asp.	Not Applicable	Methods
Risk assessment methods	Kissel, J., K. Richter, and R. Fenske. 1996. Factors affecting soil adherence to skin in hand-press trials. Bulletin of Environmental Contamination and Toxicology 56(5):722-728.	Not Applicable	Risk assessment
Risk assessment methods	Ruby, M. and Y. Lowney. 2012. Selective soil particle adherence to hands: Implications for understanding oral exposure to soil contaminants. Environ. Sci. Technol. 46(23):12759-12771.	Not Applicable	Risk assessment

Existing Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)	How Data Will Be Used
2014 residential soils QAPP for UCR Study Area	SRC Inc. 2014. Quality Assurance Project Plan, Upper Columbia River Residential Soil Study, Washington State. Prepared for EPA Region 10 and ERT. Prepared by SRC, Inc. for Lockheed Martin SERAS Program. August 13, 2014.	Not Applicable	Basis document for this QAPP Addendum No. 1, including incorporation, by reference, of all data sources identified in QAPP Worksheet #13 of the 2014 QAPP, if not otherwise referenced in this addendum
Map of residential properties within the UCR Study Area	Stevens County, WA property data obtained via contacting Stevens County Assessor's Office. http://www.co.stevens.wa.us/assessor/assessor.htm	Stevens County Database	Used to identify residential parcels within the study area for potential sampling
Project planning guidance	VSP Development Team. 2013. Visual Sampling Plan: A Tool for Design and Analysis of Environmental Sampling. Version 6.5. Pacific Northwest National Laboratory: Richland, WA. Available online at: http://vsp.pnnl.gov.	Not Applicable	QAPP preparation, estimating sample size
Soil data	Windward et al. 2015. Upper Columbia River, Final Soil Study Data Summary Report. Prepared by Windward Environmental LLC in association and consultation with Exponent, Parametrix, Inc., and Ramboll ENVIRON. October.	Exponent, TAI, soil samples, 2014	Support rationale for the 2016 Residential Soil Study and specific modifications to 2014 sampling design

[1] Project action limit for arsenic, 20 mg/kg, is also as specified in Appendix B to Colville Hazardous Substances Control Chapter (2007).

QAPP Worksheet #14: Summary of Project Tasks

☐ Worksheet Not Applicable (State Reason)

Sampling Tasks:

Two types of sampling tasks will be performed as part of the 2016 Residential Soil Study: IC sampling will be performed at every DU, and discrete core samples will be collected as "grab" samples at a randomly selected subset of DUs (Attachment D). Grab samples are individual samples collected from a single location and depth interval; these samples are not composited with other samples prior to analysis.

IC sampling entails the collection of multiple individual volumes of soil (termed "increments") from a target area (i.e., a DU) that are composited and subsampled according to a detailed SOP prior to laboratory analysis (ITRC 2012). At least one IC sample will be collected from each DU; each IC sample will consist of 30 increments. Increments will be located using systematic grid sampling with a random starting point. Triplicate IC samples (i.e., 3 x 30 increments) will be collected at a frequency of 20 percent (of DUs) and a minimum of 1 triplicate per property. The DU selected for triplicate sampling at a specific property will be selected randomly from DUs that have an area greater than 1,000 square feet (sq. ft.). Should triplicate sampling not be practical for technical reasons or because of property owner concerns, a field deviation will be documented. Sampling will be conducted using methods described in the EPA's User Guide, UFP-QAPP Template For Soils Assessment of Dioxin Sites (USEPA 2011), and the Interstate Technology and Regulatory Council (ITRC) Technical and Regulatory Guidance: Incremental Sampling Methodology (ITRC 2012).

Discrete samples will be collected at a frequency of 20 percent (of properties) and at one DU per randomly selected property where the IC sampling depth is 0 to 1 in. (Attachment D). Discrete samples will be collected from the 0 to 1 in. depth interval and the entire 1 to 6 in. depth interval at five locations within each selected DU. Selection of the subset of DUs was determined by the EPA Project Manager, in consultation with the TAI Project Coordinator (Attachment D).

Worksheet #18 details the specific number of each type of sample to be collected at each DU. Property-specific sampling maps are presented in Attachment C. Each property-specific map shows the boundaries for each DU to be sampled on that property as well as the locations of 0 to 1 in. and 1 to 6 in. discrete soil cores. Overview maps showing all of the properties to be sampled are provided at the beginning of Attachment C.

Analysis Tasks:

Both IC and discrete core samples will be submitted to the analytical chemistry laboratory for TAL metals analysis (no mercury). Worksheet #19 references the analytical method SOPs for TAL metals analysis (no mercury). Laboratory analytical methods are included as Attachment E to this QAPP.

Prior to analysis, IC samples will be dried and processed, and the entire sample will be sieved in the laboratory to a target particle size of <150 µm for soil samples and < 250 µm for beach samples. Details of the sample processing methodology are provided in the laboratory SOP (see Attachment E). Discrete core samples will also be dried and processed, and the entire sample sieved in the laboratory to a target particle size of <150 µm.

At 20 percent of DUs where non-dripline IC samples have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively, these samples will be submitted for in vitro bioaccessibility assay analysis (IVBA analysis; EPA Method 9200.2-81; USEPA 2012). If a DU selected for bioaccessibility testing has one or more replicate IC soil samples with concentrations that are greater than or equal to 100 mg/kg lead or 20 mg/kg arsenic, one of the replicate IC soil samples will be

randomly selected for testing.

Soil cores will not be submitted for IVBA analysis.

All remaining sieved soil will be archived after analytical samples are obtained for later use, if necessary. EPA must approve requests for archived sample disposal.

QC Tasks: Refer to Worksheet #20 for Field QC Samples and Worksheets #12 and #28 for Analytical QC Samples based on Subcontract Laboratory SOPs:

Some property owners have requested replicate soil samples from their properties. A field duplicate sample (a separate IC sample in addition to the 3 IC samples being collected per DU) will be provided, if requested.

Field duplicate samples will be collected from the 0 to 1 in. and 1 to 6 in. depth intervals at one of the five sample locations at each DU where discrete samples are collected. For discrete sample field duplicates, the acceptable RPD is ± 35 percent.

As done in past UCR RI/FS studies, laboratory split samples will be collected on 15 percent of the soil samples collected during this sampling event after sieving and sent to the Manchester Environmental Laboratory (MEL) for TAL metals analysis (no mercury) to measure interlaboratory precision/error. Details are found in the laboratory SOP (see Attachment E).

To help ensure data quality, QC samples will include laboratory replicate subsamples. At least 10 percent of the IC samples (ITRC 2012) will include the preparation and analysis of three laboratory replicate subsamples for the purpose of estimating and assessing variability due to subsample processing and analytical error (combined). The methodology for subsampling is provided in the laboratory SOP. These subsamples will be prepared for at least 1 IC sample per DU for at least 10 DUs (or for 10 percent of the DUs, whichever is greater). The laboratory replicate subsamples will be analyzed in different analytical runs; this will give the best evaluation of analytical error. For laboratory replicates, the acceptable relative standard deviation is 20 percent.

An experimental blank will be used to identify possible contamination from the laboratory and will be collected according to laboratory protocols. An experimental blank is similar to a rinsate blank and will be generated for equipment used in the laboratory's IC sieving process. Experimental blanks will be generated per batch of samples (i.e., 1 per 20). Equipment rinsate blanks are used to evaluate sampling device cleanliness and potential carryover of target contaminants from equipment contribution. The equipment rinsate samples will consist of ASTM Type II water (purchased and certified from a commercial vendor) poured over or through the sampling device and collected in a pre-preserved, laboratory-supplied sample container. One equipment rinsate blank will be collected for each type of sampling equipment used during the sampling event (at an interval of one per day) and will be analyzed for TAL metals (except mercury). A matrix spike/matrix spike duplicate will be performed in the laboratory to assess the accuracy of the analyses. The matrix spike/matrix spike duplicate will be performed according to the laboratory protocols and will occur at a frequency of at least once every 20 samples.

Existing Data:

All existing data (see Worksheet #13) will be compiled electronically for use in the 2016 Residential Soil Study for the UCR Study Area.

The primary source of existing data that will be used in the 2016 Residential Soil Study is the property map obtained from the Stevens County database.

Data Management Tasks:

Records will include documents and electronic deliverables related to field sampling (field notebook, sample logs, COCs); laboratory documentation (e.g., laboratory records, data packages, project reports, EDDs); data validation; and data reports. All data collected for this sampling event will be compiled into the project database. The Database Administrator (TAI contractor, Exponent) will be responsible for sample management in the field, and for importing the final analytical data back into the project database. Final validated data will be imported into the project file and published to the project database within 90 days of submission of the samples selected to undergo IVBA analysis. Any geographic information system materials created for the project will be delivered to EPA with the data summary report. ALS will automatically upload the EDDs to the project database file transfer protocol (ftp) site, which will automatically alert the data validator to begin the validation. The validator will then post the validation report and the validation summary sheet to the project database ftp site, which will alert the Database Administrator that validation is complete. Once all data packages have been validated, the Database Administrator will manage the process of compiling the data to be loaded in the project database and made available for review on the database web tool.

Minimum field records that will be maintained include the following:

- Field logbooks
- Photo documentation
- Field data forms
- Sample tracking and COC forms

Full laboratory data reports will be provided in electronic format to the Task QA Coordinator, who will oversee data verification and validation as well as archiving the final data and data quality reports in the project file. EDDs will be prepared in spreadsheet format and will be compatible with the project database. All activities and results related to sample analysis will be documented at the laboratory. Internal laboratory documentation procedures are described in the laboratory QA manual (see Attachment F).

The analytical chemistry laboratory will provide a data package for each sample delivery group or analysis batch that is comparable in content to a full CLP package. It 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
- Sample receipt, processing, and analysis dates
- Final analyte concentration including reporting limit, laboratory qualifiers, and reanalysis
- Percent recovery of each compound in the matrix spike sample
- Matrix spike recovery control limits
- RPD for all matrix spike/matrix spike duplicate and/or laboratory control sample/laboratory control sample duplicate results

Documentation and Records:

Documents and records that will be generated during this project include the Work Plan, QAPP Addendum, FSP, Field Documentation, Laboratory Logbooks, Sample Labels, COC Records, Custody Seals, Analytical Report, Data Review Records, Data Reduction Records, and Field Change Forms, if necessary. The summary report will include study area background, observations, a description of sampling activities, results, conclusions and/or recommendations, and any deviations or approved field changes.

Assessment/Audit Tasks:

The tasks associated with the QAPP will be assessed by the EPA Project Manager and the EPA oversignt personnel in the field.

The field team and laboratories will stay in close verbal contact with the TAI Project Coordinator and the TAI Analytical Chemistry Laboratory Coordinator during all phases of this task. This level of communication will serve to keep the EPA Project Manager apprised of activities and events, and any potential deviations. This will allow for informal but continuous task oversight.

Assessment activities will include readiness reviews prior to sampling and prior to release of the final data to the data users, and internal review while work is in progress.

The first readiness review will be conducted prior to field sampling. The field supervisor will verify that all field equipment is ready for transfer to the UCR Study Area, and that the field team and subcontractor(s), as required, have been scheduled and briefed (including review of the SHSP). Any deficiencies noted during this readiness review will be corrected prior to initiation of sampling activities. The second readiness review will be completed before final data are released for use. The Database Administrator will 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.

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 and complete and follows the QA procedures outlined in this QAPP addendum. The TAI Project Coordinator will be notified of any problems that may affect the final outcome of this task.

Data Review Tasks:

Field and laboratory data for this task will undergo a formal verification and validation. Validation will be a mixture of two stages (10 percent S4VEM / 90 percent S2BVE) and more detailed validation would be performed on samples validated by S2BVE if issues are identified in samples validated by S4VEM. Data verification and validation for metals will be completed according to methods described in EPA's functional guidelines for inorganic data review (USEPA 2010) and consistent with EPA guidance for labeling externally validated laboratory analytical data for Superfund (USEPA 2009a).

The IVBA data will be verified and validated according to SOPs in EPA's Standard Operating Procedure for an *In Vitro* Bioaccessibility Assay for Lead in Soil (USEPA 2012).

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 review and validation will be conducted as described on Worksheets #34 through #36.

QAPP Worksheet #15: Reference Limits and Evaluation Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low

Analyte	CAS Number	Project Action Limit[a] (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				Method Detection Limit	Quantitation Limit	Method Detection Limits (mg/kg)	Quantitation Limits (mg/kg)
Aluminum	7429-90-5	77,400	2	NS	NS	0.6	2
Antimony	7440-36-0	31.3[b]	0.05	NS	NS	0.02	0.05
Arsenic	7440-38-2	20[c]	0.5	NS	NS	0.2	0.5
Barium	7440-39-3	15,300	0.05	NS	NS	0.02	0.05
Beryllium	7440-41-7	156	0.02	NS	NS	0.005	0.02
Cadmium	7440-43-9	70.3	0.02	NS	NS	0.009	0.02
Calcium	7440-70-2	–	4	NS	NS	1	4
Chromium	7440-47-3	0.301[d]	0.2	NS	NS	0.07	0.2
Cobalt	7440-48-4	23.4	0.02	NS	NS	0.009	0.02
Copper	7440-50-8	3,130	0.1	NS	NS	0.04	0.1
Iron	7439-89-6	54,800	4	NS	NS	2	4
Lead	7439-92-1	400	0.05	NS	NS	0.02	0.05
Magnesium	7439-95-4	–	2	NS	NS	0.2	2
Manganese	7439-96-5	1,830	0.05	NS	NS	0.02	0.05

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low

Analyte	CAS Number	Project Action Limit[a] (mg/kg)	Project Quantitation Limit (mg/kg)	Analytical Method		Achievable Laboratory Limits	
				Method Detection Limit	Quantitation Limit	Method Detection Limits (mg/kg)	Quantitation Limits (mg/kg)
Nickel	7440-02-0	1,550	0.2	NS	NS	0.04	0.2
Potassium	7440-09-7	–	40	NS	NS	10	40
Selenium	7782-49-2	391	1	NS	NS	0.2	1
Silver	7440-22-4	391	0.02	NS	NS	0.005	0.02
Sodium	7440-23-5	–	40	NS	NS	5	40
Thallium	7440-28-0	0.782	0.02	NS	NS	0.002	0.02
Vanadium	7440-62-2	394	0.2	NS	NS	0.08	0.2
Zinc	7440-66-6	23,500	0.5	NS	NS	0.2	0.5

NS = not specified; see "Achievable Laboratory Limits" for the laboratory-specific Method Detection Limits and Quantitation Limits.

[a] Project action limits are residential soil screening levels that were calculated using EPA's Regional Screening Level Calculator (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search) with default values for exposure factors.

[b] Values are for antimony potassium tartrate based on Diamond and Thayer (2011a). Antimony potassium tartrate is the most common form of antimony found in the environment.

[c] Washington unrestricted land use value (Ecology 2007).

[d] Values are for chromium VI, and are based on a conservative estimate. Adjustments will be made to take into account ratio III:VI in soil for actual risk calculations.

QAPP Worksheet #16: Project Schedule Timeline Table

☐ Worksheet Not Applicable (State Reason)

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Mailing Access Agreements	TAI, Ramboll Environ	01/04/16	08/01/16	Access letters to property owners	08/01/16
Tracking Access Agreements	TAI, Ramboll Environ	01/11/16	04/01/16	Signed access agreements	04/01/16
Field Reconnaissance Planning	TAI, Ramboll Environ, Field Contractor Tetra Tech	01/11/16	April 25, 2016	Preliminary DU maps, resident interview forms, utility clearance	Before Mobilize to field
EPA Review and Approval of Field Reconnaissance Plan	EPA	03/21/16	04/01/16	Approval of Field Reconnaissance Plan	04/01/16
Field Reconnaissance	TAI, Field Contractor Tetra Tech	April 26, 2016	May 20, 2016	Property-specific maps of potential DUs; resident interviews completed; QAPP addendum finalized, including FSP	Approximately July 2016
EPA Review of Final QAPP Addendum	EPA	June 17, 2016	July 27, 2016	Approval of Final QAPP Addendum	Approximately August 2016
Field Sample Collection	TAI, Field Contractor Tetra Tech	Approximately August 2016	Approximately October 2016	Samples to analytical laboratory	Approximately August-October 2016
Laboratory Analysis	ALS	Approximately August 2016	Approximately December 2016	Laboratory results reports	See footnote.[1]

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Data Validation	ESI	Approximately September 2016	Approximately January 2017	Data validation reports	See footnote.[1]
Data Analysis and Reporting	TAI, Contractor Ramboll Environ	Approximately November 2016	Approximately March 2017	Draft DSR	See footnote.[2]
EPA Review Draft Data Summary Report (DSR)	EPA	Approximately April 2017	Approximately May 2017	EPA Comments on Draft DSR	Approximately May 2017
Revise Draft DSR	TAI, Contractor Ramboll Environ	Approximately May 2017	Approximately June 2017	Draft Final DSR	Approximately June 2017
EPA Review and Approval of Draft Final DSR	EPA	Approximately June 2017	Approximately July 2017	Final DSR	Approximately July 2017

[1] As indicated in the 2006 Settlement Agreement, validated analytical data will be delivered to EPA within 90 days of completion of sampling activities.

[2] As indicated in the 2006 Settlement Agreement, a data summary report will be delivered to EPA within 150 days of completion of sampling activities.

QAPP Worksheet #17: Sampling Design and Rationale

☐ Worksheet Not Applicable (State Reason)

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Consistent with the 2014 study, the objective of the 2016 study is to collect data to support refinement of exposure estimates for residents in the northernmost reaches of the UCR Study Area to support the HHRA. Specifically, surface soils will be collected from rural residential properties not previously sampled within the UCR Study Area from just south of China Bend, WA and extending to the U.S.–Canada border (Figure 1); surface soil concentrations for TAL metals (no mercury) will be determined; and the bioaccessibility of lead and arsenic in soil will be measured in some samples. The properties to be sampled were identified through voluntary participation.

The rationale for choosing the sampling approach for the 2016 Residential Soil Study is the same as the rationale provided for EPA's 2014 study of residential soil with the exception of specific changes to the timing, roles, boundaries, and a limited number of study design elements, which are detailed in the Introduction to this QAPP addendum.

Consistent with the 2014 study design, residential soil samples will be collected using an IC sampling design (see Figure 2). IC sampling entails the collection of multiple individual volumes of soil (termed "increments") from a target area (i.e., DU) that are composited and subsampled according to a detailed SOP prior to laboratory analysis. The IC sampling method is described in detail by the ITRC (2012). The UCR Study Area residential soil sampling design includes 1 to 3 IC samples per DU and 30 increments per IC sample. The rationale for the number of IC samples and the number of increments per sample is provided below. Increments will be located using systematic grid sampling with a random starting point. The mean of the IC samples collected from each DU will be used as the EPC for lead; the 95 percent upper confidence limit for the mean will be used as the EPC for all other metals (USEPA 1994). IC was selected as the sampling strategy because it provides a more cost-effective alternative to discrete sampling when the objective is to estimate the mean concentration for a DU (Hathaway et al. 2008). Composite sample data have lower variability than discrete sample data and a higher reproducibility (HDOH 2009).

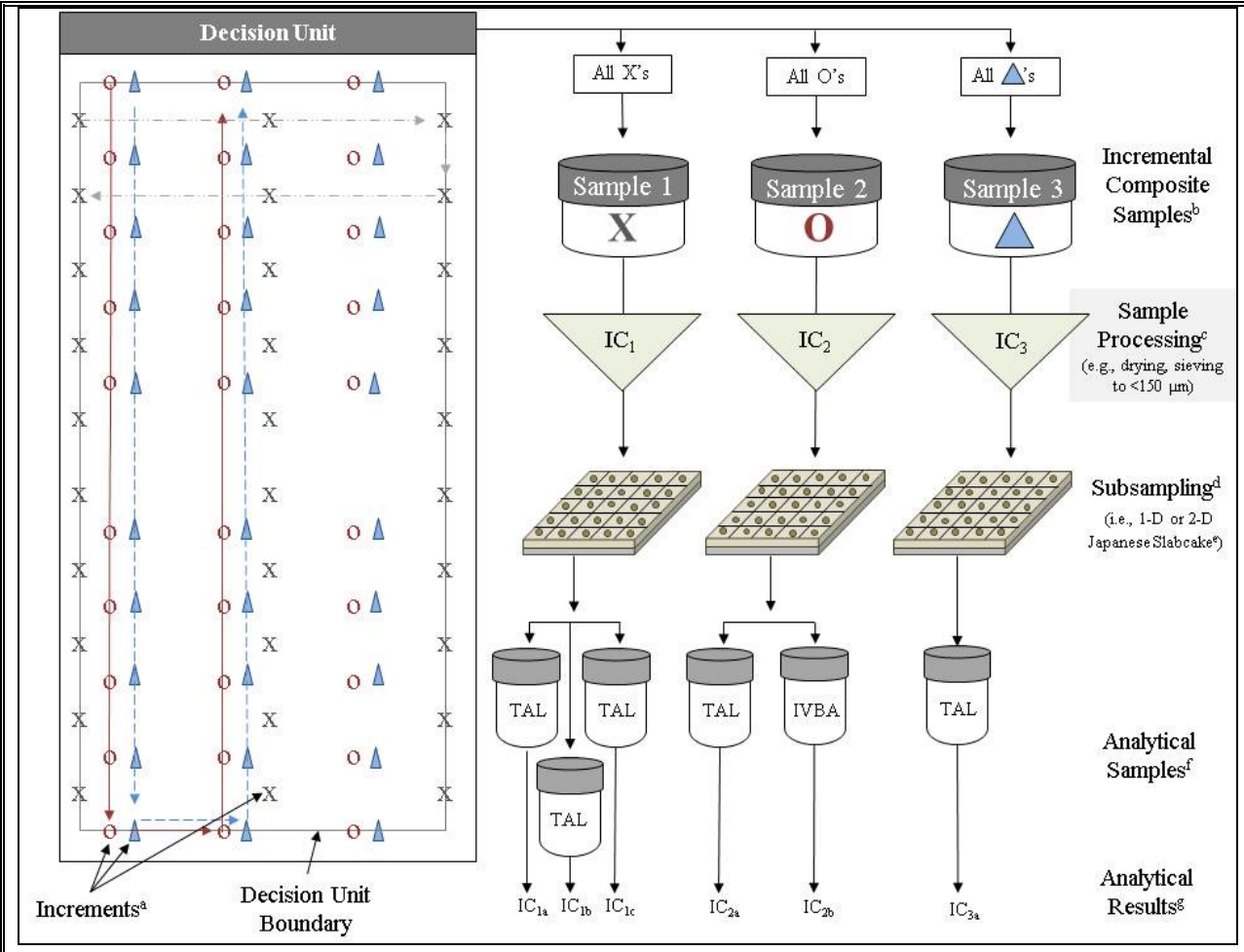


Figure 2. Overview of the 2016 Residential Soil Study IC sampling design applicable to collection of triplicate IC samples and a single replicate meeting IVBA analysis triggers

[a] Increments will be located by using systematic grid sampling with a random starting point.

[b] Thirty increments will be collected during the same field sampling event for each of the IC samples. Equal volumes from each increment will be combined to create one IC sample (as shown). Additional information is available in the FSP.

[c] Sample processing will take place in the laboratory, by pre-sieving the sample to 2 millimeter (mm) and then passing the entire IC sample through a 150 µm or 250 µm sieve (see text for additional information on laboratory procedures; latter applies to beach DUs only).

[d] Laboratory subsampling will consist of 30 increments; all remaining sieved soil will be archived after analytical samples are obtained. No additional subsampling will be done once the laboratory subsample (2 grams [g] of <150 or <250 µm soil) is placed in the jar. If laboratory replicate samples or split samples are required from a particular sample, additional jars will be required and 2 g of soil will be placed in each jar. Two g is the minimum mass required to control fundamental error (FE) at 5 percent for both <150 µm and <250 µm grain size fractions. Two g is also the minimum mass required to collect a representative subsample using incremental subsampling methods (Crumbling 2014).

[e] As described in ITRC (2012).

[f] Each of the IC samples will be analyzed for TAL metals (no mercury). At 20 percent of DUs where non-dripline IC samples have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively, these samples will be submitted for in vitro bioaccessibility assay analysis. If a DU selected for bioaccessibility testing has one or more replicate IC soil samples with concentrations that are greater than or equal to 100 mg/kg of lead or 20 mg/kg of arsenic, one of the replicate IC soil samples will be randomly selected for testing.

[g] At least 10 percent of the IC samples will include the preparation and analysis of three laboratory replicate subsamples for the purpose of estimating variance due to sample processing and analytical error (combined).

Figure adapted from ITRC (2012) and Hathaway et al. (2008).

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]:

Number of DUs per Property

A DU is defined as the smallest area about which a risk-based decision will be made. For this study, each of the 141 residential properties under investigation was divided into DUs based on property size and the presence of features that may influence exposure, such as children's play areas, beach areas, gardens, and discrete animal pens and riding areas. The number of DUs per property was determined following a visit to each property for which an access agreement has been received by TAI in spring 2016. Property-specific maps (see Attachment C) were generated that include DUs for areas near the homes that were most frequently used, children's play areas (when present; e.g., sandbox, swing set), gardens, and animal pens and riding areas. Boundaries for each DU were delineated based on land use and global positioning system (GPS) data collected during a visit to each property.

Several templates developed for the 2014 residential soil study were adapted for use in the current study and served as starting points for the property-specific sampling designs (see Attachment G). The templates depict various property sizes and features (e.g., gardens, play areas). The template best suited to the characteristics of a property was used as a starting point for the property-specific sampling design, and modified as necessary to accommodate the features and layout of the property.

Most of the properties have one DU ('house') that encompasses up to 1 acre immediately surrounding the residence. Distinct play areas, gardens, and animal pens/riding areas were delineated as separate DUs. Properties that included other frequently used areas were delineated and assigned to the "other-not specified" DU category. For example, a property that includes 5 acres of utilized land, which includes a child's play area and a vegetable garden, could have up to four DUs: one DU for up to 1 acre surrounding the residence (excluding gardens and play areas), one DU for the garden, one DU for the play area, and one DU for the remaining portion of the property that is regularly used ("other-not specified") (see Attachment G).

Driplines will not be sampled unless there is a concern of lead-based paint; for all other DU types, care has been taken to locate increments outside the dripline of the residence, and away from influences of any other painted surfaces. Areas located close to unpaved or compacted gravel roadways and railways were avoided to prevent sampling soil that is potentially contaminated by non-air sources (e.g., tire weights, fill soil from ballast); a 50-foot buffer in both directions from the center line of these features was implemented. Placement of sample locations within unpaved roads and driveways has also been avoided unless the resident identified the area as having high potential use. In such cases, the unpaved road or driveway area was established as a separate DU for sampling.

Number of IC Samples per DU, and Number of Increments per IC Sample

One to 3 IC samples will be collected per DU, and each IC sample will consist of 30 increments (ITRC 2012). With the exception of the frequency with which triplicate IC samples will be collected, the number of IC samples per DU and increments per IC sample is based wholly on the sampling design analysis that was conducted in preparation of the 2014 residential soil study and documented in Worksheet #17 of the 2014 study QAPP. The reduced frequency of triplicate IC sample collection is based on EPA's directive to TAI regarding changes proposed by EPA to the 2016 residential soil sampling QAPP based on the 2014 residential soil sampling results (USEPA 2015b).

Number of Discrete Samples per Property

Discrete samples will be collected from the 0 to 1 in. and 1 to 6 in. depth intervals at five locations within a DU in a randomly selected subset of DUs where the IC sampling depth is 0 to 1 in. Selection of the subset of DUs was determined by the EPA Project Manager, in consultation with the TAI Project Coordinator (Attachment D). As detailed in the Introduction to this QAPP addendum, this approach was modified from the 2014 study

approach based on consideration of factors that limited interpretation of the data regarding the vertical nature and extent of contamination.

Sample Locations Within a DU

A GPS receiver with differential correction was used to locate each DU. Where GPS could not be used to locate a DU, alternative approaches were employed as discussed in the field reconnaissance plan. Attachment D, Tables D1 and D2 provide a summary of the IC and discrete samples to be collected.

Increments for each IC sample will be located using a systematic grid with a random starting location (see Figure 2). The location of other features relevant to potential exposure will also be noted, such as play areas, gardens, and animal pens/riding areas. A trial run (no sample collection) will be performed to establish the distance between increment collection points to achieve the targeted 30 increments, while using the flags or GPS coordinates (determined using Visual Sampling Plan [VSP] software, version 6.5 [VSP Development Team 2013]) as guides. This sampling design will result in approximately equally spaced increments within the DU (i.e., uniform spatial distribution of increments). For example, a rectangular-shaped DU may be divided into five rows with six increments collected from each row. For more rectangular-shaped DUs, fewer rows might be used, with more increments per row collected. Row lengths and increments per row may be modified as needed to accommodate a variety of DU shapes, orientations, and obstructions encountered in the field.

Beach sample locations will be delineated in the field based on water elevation at the time of sampling and interviews with property owners regarding use of the beach.

Discrete core samples will be located in a randomly selected subset of DUs where the IC sample depth is 0 to 1 in. (Attachment D). The locations (coordinates) of the soil cores within each DU have been randomly determined using VSP. In the event one or more of the original soil locations cannot be sampled due to surface or subsurface obstructions, alternative soil core locations will be determined in the field by moving a pre-determined distance and direction from the original sample location as described in the FSP (see Attachment D).

Before sampling is initiated on well-maintained landscaped areas, property owners will be informed about the size, depth, and number of surface holes that will be punched, and given the option to proceed with sampling these areas. If the owner opts out of having the well-maintained lawn sampled, the location of that DU will be shifted outside of the well-maintained area.

Procedure for Locating and Collecting Multiple IC Samples

All IC samples from each DU will be collected during the same field event. For DUs with IC replicate samples, an identical number of increments will be collected for each IC sample collected, with each set of increments using a new systematic grid.

Increment locations will be determined from GPS coordinates (e.g., produced with VSP) or by measuring and flagging locations within the field. The sampling team will begin at one end of a row or column of grid cells, and collect increments within each grid cell by walking through the gridded area. Each increment location will be flagged. When the team reaches the end of the row or column, they will then proceed along the next row or column, walking back in the direction of the initial point of increment collection, once again collecting an increment of sample within each grid. The sampling team will continue in this serpentine pattern, until 30 increments have been collected for the IC sample, ending at the opposite corner or end of the field. At each increment collection point, a pin flag will be sunk and GPS coordinates may be captured. Sampling equipment will not be decontaminated between increments for one IC sample.

Increment locations for each IC sample will be unique and will not be taken from co-located or adjacent locations. If increment locations are determined with GPS coordinates exported from the VSP, this should not be a concern (the quasi-random number generator option in VSP is required). If the increment locations are determined by measuring and flagging in the field, the sampling team will meet these criteria by returning to the initial increment collection point (marked by a flag) and move to the right (or left, forward, backward) a pre-determined distance and begin increment collection for the second IC set of increments. Because flags will have been placed at each of the original increment locations, increments for the second and third IC samples

can be collected by moving the pre-determined distance and direction from each of the original flags.

Increment collection for the second and third IC samples will follow a serpentine pattern similar to the original sample but following a different path. For example, if the original sample is collected by following a path from north to south starting in the west and going east, a second IC sample would be collected walking a path from west to east starting in the north and moving south as shown in Figure 2 (but modified to collect 30 increments for each IC sample). The third IC sample could be collected from south to north, moving from east to west.

Method for Collecting Increment Soil Samples

Individual soil increments will be collected using a cylindrical or core-shaped sampler to ensure that each increment contains a proportionate amount of soil particles over the entire depth of interest, with an equal volume of soil particles from the top of the sample as the bottom. The entire 0 to 1 in. interval will be collected. The objective is to collect equal volumes of soil from each increment location. IC samples will be collected according to the IC soil sampling SOP (included with Attachment D). The diameter of the cylindrical or core-shaped sampler will be 2 to 4 cm but will remain constant within a DU. If a core sampler cannot be used (e.g., at a beach, depending on sediment substrate), it may be necessary to collect the sample with a stainless-steel spoon. If a spoon is used in place of the coring tool, then each increment should also be pre-measured (e.g., in a disposable wide mouth glass jar) in order to ensure that a consistent volume is collected.

Wearing a clean pair of nitrile gloves, a team member should clear large surface debris away by hand at the increment location. Surface debris includes all identifiable debris such as twigs, intact leaves, pine needles, woody debris, duff, vegetation (including grass and grass roots), and rocks.

Sample Depth

The exposure pathway of concern is incidental ingestion of surface soils resulting from contact with soil. The sampling depth will be the soil depth interval that people are most likely to come into contact with and will vary by DU. "With respect to risk assessment, the top inch of soil best represents current exposure to contaminants (USEPA 1989, 1996) and is the source of data used in the IEUBK model to represent exposure from soil" (USEPA 2003).

The sampling depth depends on the land use and varies by DU. For samples collected in yards or in areas with thick vegetation, the sample depth will be measured from below the thatch or root zone. Any excess material will be placed back in the ground at the sample location. Surface soil will be collected from the entire 0 to 1 in. depth interval (top 2 cm) below organic litter or sod (USEPA 2003) in house, agriculture, dripline (not sampled unless there is a concern of lead-based paint), and "other-not specified" DUs. The sampling depth for gardens (both vegetable and ornamental) will be the tilled depth because it is reasonable to expect that people routinely come into contact with soil throughout the tilled depth (typically 0 to 12 in.). Sampling depth for play areas will generally be 0 to 1 in. Based on observations made during the site visit, areas where soil disturbance is deeper than 1 in. will be sampled at a depth of 0 to 3 in. (e.g., animal activity areas). Beaches will generally be sampled at a depth of 0 to 6 in. unless there were cultural resources concerns; those beaches will be sampled at a depth of 0 to 1 in. (see Attachment H for the study Cultural Resources Coordination Plan).

Discrete core samples will be collected at depths of 0 to 1 in. and 1 to 6 in.

Mass of Soil Required

House, Garden, Play Area, Other-Not Specified, Agriculture, Animal Activity Area, Dripline DUs

For this QAPP addendum, the total mass of soil required for each non-beach IC sample is the same as specified in EPA's 2014 residential soil study QAPP, Worksheet #17. As described in the 2014 study QAPP, for the purposes of estimating the required mass of the IC sample, it was assumed the <150 µm particle size fraction could make up as little as 5 percent of the soil by mass in locations where loamy sand and gravelly loamy sand are found. Therefore, the minimum mass of the IC sample was estimated by dividing the mass of <150 µm soil required for laboratory analyses by 0.05. The mass of <150 µm soil required for laboratory analysis, QC samples, and contingency for re-analysis is as follows: bioaccessibility (10 g) and TAL metals analysis (no

mercury; 10 g). The mass required for TAL metals analysis (no mercury; 10 g) exceeds the minimum mass required to control FE at 5 percent for both <150 µm and <250 µm grain size fractions (latter applies to beach DUs only). The mass required for TAL metals analysis (no mercury) also exceeds the minimum mass required to collect a representative subsample using incremental subsampling methods (approximately 2 g) (Crumbling 2014). A minimum of 2 g <150 µm soil will be used for TAL metals analysis (no mercury), and a minimum or 1 g <150 µm soil will be used for the IVBA analysis.

IC samples that will provide three replicate subsamples for TAL metals analysis (no mercury; Figure 2) will require a sample mass of 40 g; this will require a total soil mass for the IC sample of 40/0.05, or 800 g. Individual soil increments (that make up an IC sample) must weigh at least 27 g (800 g/30 increments).

IC samples that will provide three replicate subsamples for TAL metals analysis (no mercury) and a laboratory split sample (15 percent sent to MEL for analysis) will require a sample mass of 50 g; this will require a total soil mass for the IC sample of 50/0.05, or 1,000 g. Individual soil increments (that make up an IC sample) must weigh at least 34 g.

For the discrete samples collected at 0 to 1 in. and 1 to 6 in. depth intervals, 10 g of soil is needed for TAL metals analysis (no mercury) for each depth interval; a total soil mass of 200 g (10/0.05) is needed for each of the two core sample depth intervals. Soil cores will not be submitted for IVBA analysis.

The mass of the <150 µm soil remaining after analysis will be archived; at a minimum, each IC sample must provide a mass of <150 µm soil for archiving that is sufficient to repeat all analyses performed for that IC sample. All archived samples will be retained until written approval from EPA is provided to destroy the archived samples.

Beach DUs

For this QAPP addendum, the total mass of soil required for each beach IC sample is the same as specified in EPA's 2014 residential soil study QAPP, Worksheet #17. As described in the 2014 study QAPP, for the purposes of estimating the required mass of the beach IC samples, it was assumed the <250 µm particle size fraction could make up as little as 5 percent of beach sand. Therefore, the minimum mass of the IC sample was estimated by dividing the mass of <250 µm soil required for laboratory analyses by 0.05. The mass of <250 µm soil required for laboratory analysis, QC samples, and contingency for re-analysis is as follows: bioaccessibility (10 g) and TAL (no mercury) metals (10 g). A minimum of 2 g <250 µm soil will be used for TAL (no mercury) extraction, and a minimum or 1 g <250 µm soil will be used for the IVBA analysis.

IC samples that will provide three replicate subsamples for TAL metals analysis (no mercury; Figure 2) will require a sample mass of 40 g; this will require a total soil mass for the IC sample of 40/0.05, or 800 g. Individual soil increments (that make up an IC sample) must weigh at least 27 g (800 g/30 increments).

IC samples that will provide three replicate subsamples for TAL metals analysis (no mercury) and a laboratory split sample (15 percent sent to MEL for analysis) will require a sample mass of 50 g; this will require a total soil mass for the IC sample of 50/0.05, or 1,000 g. Individual soil increments (that make up an IC sample) must weigh at least 34 g.

Discrete samples will not be collected at the beach DUs.

The mass of the <250 µm soil remaining after analysis will be archived; at a minimum, each IC sample must provide a mass of <250 µm soil for archiving that is sufficient to repeat all analyses performed for that IC sample. All archived samples will be retained until written approval from EPA is provided to destroy the archived samples.

Sample Processing and Analysis

For this investigation, mixing the increments and sieving will not be conducted in the field; the entire IC sample will be sent to the laboratory for processing (drying, sieving, subsampling). Physical disaggregation of samples will be conducted by breaking aggregates apart by hand but not through pounding with a mortar and pestle. This process is also expected to break down the dried vegetation such that the attached soil particles will be knocked loose. Grinding will not be conducted without prior approval from EPA. Samples will be dried and passed through a No. 10 sieve (2.0 mm) in the laboratory to remove large debris (e.g., sticks, stones) present in the sample. The resulting material will be weighed and sieved through a No. 100 sieve to isolate the target particle size of <150 µm. This particle size fraction is intended to represent the fraction expected to adhere to skin via dermal contact (Ruby and Lowney 2012). Beach samples will be sieved through a No. 60 sieve to isolate the target particle size of <250 µm. This particle size fraction represents dermal adherence under wet conditions (Kissel et al. 1996). The entire IC sample will be sieved to the target particle size.

No additional subsampling will be done once the laboratory subsample (2 g of <150 µm soil) is placed in the jar. If laboratory replicate samples or split samples are required from a particular sample, additional jars will be required and 2 g of soil will be placed in each jar. Two g is the minimum mass required to control FE at 5 percent for both <150 µm and <250 µm grain size fractions (latter applies to beach DUs only). Two g is also the minimum mass required to collect a representative subsample using incremental subsampling methods (Crumbling 2014).

Each IC sample will be analyzed for TAL (no mercury) metals. At 20 percent of DUs where non-dripline IC samples have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively, these samples will be submitted for in vitro bioaccessibility assay analysis.

Subsamples for IVBA analysis will be collected at the time subsamples for TAL metals analysis (no mercury) and laboratory replicate analysis are collected; they will be archived until laboratory analytical results are available. All archived samples will be retained until written approval from EPA is provided to destroy the archived samples. A maximum of one IC sample per selected DU will be submitted for bioaccessibility testing. If a DU selected for bioaccessibility testing has one or more replicate IC soil samples with concentrations that are greater than or equal to 100 mg/kg lead or 20 mg/kg arsenic, one of the replicate IC soil samples will be randomly selected for testing. IVBA analysis will not be done on the dripline samples. All remaining sieved soil (<2 mm and <150 µm fractions for soil and <2 mm and <250 µm fractions for beach) will be archived after analytical samples are obtained and retained for later use, if necessary. All archived samples will be retained until written approval from EPA is provided to destroy the archived samples.

The discrete samples will be dried and passed through a No. 10 sieve (2.0 mm) in the laboratory to remove large debris (e.g., sticks, stones) present in the sample. The resulting material will be weighed and sieved through a No. 100 sieve to isolate the target particle size of <150 µm; this fraction will be submitted for TAL metals analysis (no mercury).

Quality Assurance and Quality Control (QA/QC) Samples

Some property owners have requested replicate soil samples from their properties. A field duplicate sample (a separate IC sample in addition to the IC sample(s) being collected per DU) will be provided, if requested.

Field duplicate samples will be collected from the 0 to 1 in. and 1 to 6 in. depth intervals at one of the five sample locations at each DU where discrete samples are collected.

As done in past UCR RI/FS studies, laboratory split samples will be collected on 15 percent of the soil samples collected during this sampling event after sieving and sent to MEL for TAL metals analysis to measure interlaboratory precision and error. Samples will be selected for split sample analysis using procedures outlined in the Split Sample QAPP (to be provided by EPA R10). QC samples will include laboratory replicate subsamples. At least 10 percent of the IC samples will include the preparation and analysis of three laboratory replicate subsamples for the purpose of estimating and assessing variability due to subsample processing and analytical error (combined). The methodology for subsampling is provided in the laboratory SOP. These subsamples will be prepared for at least one IC sample per DU for at least 10 DUs (or for 10 percent of the DUs, whichever is greater). The laboratory replicate subsamples will be analyzed in different analytical runs; this will give the best evaluation of analytical error.

Field equipment rinsate blanks will be collected during field sampling efforts to identify possible contamination from field sampling equipment. One equipment rinsate blank will be collected for each type of sampling equipment used during the sampling event (at an interval of one per day). An experimental blank will be used to identify possible contamination from the laboratory and will be collected according to laboratory protocols. Experimental blanks will be collected once per batch of 20 samples. A matrix spike/matrix spike duplicate will be performed in the laboratory to assess the accuracy of the analyses. The matrix spike/matrix spike duplicate will be performed according to the laboratory protocols and will occur at a frequency of at least once every 20 samples.

QAPP Worksheet #18: Sampling Locations and Methods[1] and SOP Requirements Table

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
075	075-H1	House	0.11	0-1	3		
075	075-A1	Agriculture Area	3.66	0-1	1		
075	075-O1	Other	1.15	0-1	1		
075	075-B1	Beach	0.21	0-6	1		
076	076-H1	House	0.28	0-1	1		
076	076-H2	House	0.50	0-1	3		
076	076-D1	Lead-Based Paint Concern	0.01	0-1	1		
076	076-G1	Garden	0.05	0-12	1		
076	076-G2	Garden	0.11	0-12	1		
076	076-N1	Animal/Livestock	0.12	0-3	1		
077	077-H1	House	1.18	0-1	3		
077	077-H2	House	0.44	0-1	1		
077	077-D1	Lead-Based Paint Concern	0.02	0-1	1		
077	077-G1	Garden	0.81	0-12	1		
077	077-N1	Animal/Livestock	0.39	0-3	1		
077	077-A1	Agriculture Area	0.27	0-1	1		
077	077-A2	Agriculture Area	0.13	0-1	1		
078	078-H1	House	0.36	0-1	3	0-1, 1-6	5, 5
078	078-G1	Garden	0.04	0-12	1		
078	078-O1	Other	<0.01	0-1	1		
078	078-N1	Animal/Livestock	0.05	0-3	1		
079	079-H1	House	0.36	0-1	1		
079	079-H2	House	0.06	0-1	3		
080	080-H1	House	0.03	0-1	1		
080	080-O1	Other	0.12	0-1	3		
081	081-O1	Other	0.01	0-1	1		
081	081-A1	Agriculture Area	0.03	0-1	1		
081	081-H1	House	0.23	0-1	3		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
081	081-D1	Lead-Based Paint Concern	0.02	0-1	1		
082	082-H1	House	0.36	0-1	1		
082	082-G1	Garden	0.02	0-12	1		
082	082-G2	Garden	0.05	0-12	1		
082	082-O1	Other	0.10	0-1	3	0-1, 1-6	5, 5
082	082-N1	Animal/Livestock	0.57	0-3	1		
082	082-N2	Animal/Livestock	0.02	0-3	1		
083	083-H1	House	0.08	0-1	3		
083	083-G1	Garden	0.05	0-12	1		
083	083-G2	Garden	0.03	0-12	1		
084	084-H1	House	0.53	0-1	3		
084	084-D1	Lead-Based Paint Concern	0.01	0-1	1		
085	085-H1	House	0.33	0-1	3		
085	085-H2	House	0.02	0-1	1		
085	085-D1	Lead-Based Paint Concern	0.02	0-1	1		
085	085-O1	Other	0.10	0-1	1		
086	086-H1	House	0.38	0-1	1		
086	086-H2	House	0.62	0-1	1		
086	086-G1	Garden	0.06	0-12	3		
087	087-H1	House Under Construction	0.41	0-1	3		
088	088-H1	House	0.29	0-1	1		
088	088-D1	Lead-Based Paint Concern	0.02	0-1	1		
088	088-H2	House	0.19	0-1	3		
088	088-O1	Other	0.22	0-1	1		
089	089-H1	House	0.60	0-1	1		
089	089-A1	Agriculture Area	0.15	0-12	1		
089	089-O1	Other	0.22	0-1	3		
090	090-H1	House	0.14	0-1	3		
090	090-O1	Other	0.07	0-1	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
091	091-H1	House	0.25	0-1	3		
091	091-G1	Garden	<0.01	0-10	1		
092	092-O1	Other	0.28	0-1	3		
092	092-O2	Other	0.20	0-1	1		
093	093-H1	House Under Construction	0.22	0-1	3		
094	094-H1	House	0.37	0-1	3		
094	094-P1	Play Area	0.22	0-1	1		
095	095-H1	House	0.42	0-1	1		
095	095-O1	Other	0.51	0-1	3		
095	095-O2	Other	0.20	0-1	1		
095	095-A1	Agriculture Area	2.75	0-1	1		
096	096-H1	House	0.41	0-1	1		
096	096-O1	Other	0.54	0-1	3		
097	097-H1	House	0.26	0-1	1		
097	097-H2	House	0.19	0-1	3		
098	098-H1	House	0.20	0-1	1		
098	098-G1	Garden	0.16	0-12	3		
098	098-O1	Other	0.08	0-1	1		
099	099-H1	House	0.04	0-1	3		
099	099-G1	Garden	<0.01	0-12	1		
099	099-G2	Garden	<0.01	0-12	1		
099	099-O1	Other	0.04	0-1	1		
099	099-A1	Agriculture Area	0.07	0-1	1		
100	100-H1	House	0.12	0-1	1		
100	100-N1	Animal/Livestock	0.14	0-3	1		
100	100-N2	Animal/Livestock	<0.01	0-3	1		
100	100-O1	Other	0.10	0-1	3		
100	100-G1	Garden	0.01	0-12	1		
101	101-H1	House	0.38	0-1	3		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
101	101-G1	Garden	<0.01	0-12	1		
101	101-O1	Other	0.08	0-1	1	0-1, 1-6	5, 5
102	102-H1	House	0.03	0-1	3	0-1, 1-6	5, 5
102	102-G1	Garden	<0.01	0-6	1		
103	103-H1	House	0.28	0-1	1		
103	103-O1	Other	0.42	0-1	3		
104	104-H1	House	0.05	0-1	1		
104	104-H2	House	0.29	0-1	1		
104	104-N1	Animal/Livestock	0.52	0-3	3		
105	105-H1	House	0.18	0-1	1		
105	105-P1	Play Area	0.26	0-1	3		
106	106-H1	House	0.04	0-1	1		
106	106-G1	Garden	0.30	0-12	1		
106	106-G2	Garden	0.18	0-12	1		
106	106-O1	Other	0.05	0-1	3		
107	107-H1	House	0.24	0-1	3		
108	108-O1	Other	1.59	0-1	1		
108	108-O2	Proposed Future House Location	0.50	0-1	3		
109	109-H1	House	0.06	0-1	3		
110	110-H1	House	0.93	0-1	3		
110	110-O1	Other	4.25	0-1	1		
110	110-O2	Other	0.39	0-1	1		
110	110-G1	Garden	<0.01	0-12	1		
110	110-G2	Garden	0.01	0-12	1		
110	110-A1	Agriculture Area	0.14	0-1	1	0-1, 1-6	5, 5
111	111-H1	House Under Construction	0.04	0-1	3	0-1, 1-6	5, 5
112	112-H1	House	0.48	0-1	1		
112	112-O1	Other	0.35	0-1	3		
112	112-G1	Garden	0.01	0-12	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
113	113-G1	Garden	<0.01	0-12	1		
113	113-G2	Garden	0.01	0-12	1		
113	113-G3	Garden	0.22	0-12	1		
113	113-O1	Other	0.17	0-1	3		
114	114-H1	House	0.33	0-1	1		
114	114-G1	Garden	0.01	0-12	1		
114	114-O1	Other	0.35	0-1	3		
115	115-O1	Other	0.31	0-1	3		
116	116-O1	Other	0.24	0-1	3		
117	117-O1	Other	0.25	0-1	3		
118	118-H1	House	0.51	0-1	1	0-1, 1-6	5, 5
118	118-N1	Animal/Livestock	0.16	0-3	1		
118	118-N2	Animal/Livestock	0.02	0-3	1		
118	118-G1	Garden	0.31	0-12	1		
118	118-G2	Garden	0.55	0-12	3		
119	119-P1	Play Area	1.00	0-1	3	0-1, 1-6	5, 5
120	120-H1	House	0.24	0-1	1		
120	120-D1	Lead-Based Paint Concern	0.02	0-1	1		
120	120-G1	Garden	0.36	0-12	3		
120	120-A1	Agriculture Area	0.26	0-1	1		
120	120-O1	Other	0.65	0-1	1		
121	121-H1	House	1.06	0-1	3		
121	121-G1	Garden	0.10	0-12	1		
121	121-N1	Animal/Livestock	1.46	0-3	1		
121	121-N2	Animal/Livestock	0.52	0-3	1		
122	122-H1	House	0.17	0-1	1		
122	122-P1	Play Area	0.76	0-1	1		
122	122-O1	Other	0.15	0-1	3		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
122	122-H2	House	1.08	0-1	1		
122	122-G1	Garden	0.10	0-12	1		
122	122-G2	Garden	0.08	0-12	1		
122	122-O2	Other	0.09	0-1	1		
123	123-H1	House	0.10	0-1	1		
123	123-O1	Other	0.02	0-1	1		
123	123-G1	Garden	0.17	0-12	1		
123	123-G2	Garden	0.20	0-12	3		
123	123-O2	Other	0.26	0-1	1		
124	124-H1	House	0.07	0-1	1		
124	124-G1	Garden	0.02	0-12	1		
124	124-G2	Garden	0.03	0-12	3		
124	124-O1	Other	0.27	0-1	1	0-1, 1-6	5, 5
124	124-N1	Animal/Livestock	0.03	0-3	1		
124	124-B1	Beach	0.12	0-6	1		
124	124-N2	Animal/Livestock	0.06	0-3	1		
125	125-O1	Other	0.04	0-1	3		
126	126-H1	House	0.18	0-1	1		
126	126-A1	Agriculture Area	0.57	0-1	1		
126	126-O1	Other	1.79	0-1	1		
126	126-O2	Other	0.08	0-1	1		
126	126-O3	Other	0.62	0-1	1		
126	126-P1	Play Area	0.36	0-1	3		
126	126-G1	Garden	0.35	0-12	1		
126	126-G2	Garden	0.02	0-12	1		
127	127-H1	House	0.51	0-1	1		
127	127-H2	House	0.70	0-1	1		
127	127-G1	Garden	0.48	0-12	1		
127	127-G2	Garden	0.05	0-12	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
127	127-A1	Agriculture Area	5.54	0-12	1		
127	127-N1	Animal/Livestock	0.36	0-3	3		
127	127-O1	Other	0.40	0-1	1		
128	128-H1	House	0.10	0-1	1		
128	128-H2	House Under Construction	0.02	0-1	1		
128	128-G1	Garden	0.03	0-12	1		
128	128-G2	Garden	0.21	0-12	3		
128	128-G3	Garden	0.39	0-12	1		
128	128-N1	Animal/Livestock	0.07	0-3	1		
128	128-O1	Other	0.46	0-1	1		
129	129-H1	House	0.25	0-1	1		
129	129-H2	House	0.18	0-1	3	0-1, 1-6	5, 5
130	130-H1	House	0.10	0-1	1		
130	130-G1	Garden	0.33	0-12	3		
130	130-H2	House	0.83	0-1	1		
131	131-H1	House	0.20	0-1	1		
131	131-B1	Beach	0.11	0-6	3		
132	132-H1	House	0.05	0-1	3		
132	132-G1	Garden	0.01	0-12	1		
132	132-G2	Garden	0.02	0-12	1		
132	132-O1	Other	0.13	0-1	1		
133	133-H1	House	0.06	0-1	1	0-1, 1-6	5, 5
133	133-G1	Garden	0.04	0-12	3		
134	134-O1	Proposed Future House Location	1.11	0-1	3		
135	135-H1	House	0.62	0-1	1		
135	135-G1	Garden	0.15	0-12	3		
135	135-O1	Other	0.11	0-1	1		
136	136-H1	House	0.37	0-1	3		
136	136-G1	Garden	0.09	0-12	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
136	136-A1	Agriculture Area	0.61	0-1	1		
136	136-O1	Other	1.72	0-1	1	0-1, 1-6	5, 5
137	137-O1	Other	0.80	0-1	3		
138	138-H1	House	1.21	0-1	1		
138	138-G1	Garden	0.19	0-8	1		
138	138-G2	Garden	1.36	0-12	1		
138	138-O1	Other	0.61	0-1	1		
138	138-O2	Other	0.70	0-1	3		
139	139-H1	House	0.74	0-1	3		
139	139-G1	Garden	0.01	0-12	1		
139	139-G2	Garden	0.02	0-12	1		
139	139-N1	Animal/Livestock	0.47	0-3	1		
140	140-H1	House	0.09	0-1	3		
140	140-G1	Garden	0.01	0-12	1		
140	140-O1	Other	0.02	0-1	1		
140	140-O2	Other	0.05	0-1	1		
141	141-H1	House	0.19	0-1	3		
141	141-H2	House	0.03	0-1	1		
141	141-H3	House	0.24	0-1	1		
141	141-N1	Animal/Livestock	0.16	0-3	1		
141	141-N2	Animal/Livestock	0.91	0-3	1		
141	141-N3	Animal/Livestock	0.08	0-3	1		
141	141-N4	Animal/Livestock	0.98	0-3	1		
141	141-O1	Other	0.27	0-1	1		
141	141-O2	Other	0.53	0-1	1		
141	141-A1	Agriculture Area	0.21	0-1	1		
142	142-H1	House Under Construction	0.16	0-1	3		
142	142-O1	Other	0.27	0-1	1		
143	143-H1	House	0.66	0-1	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
143	143-G1	Garden	0.26	0-12	3		
143	143-G2	Garden	0.02	0-12	1		
143	143-A1	Agriculture Area	0.08	0-1	1		
144	144-H1	House	1.19	0-1	1		
144	144-G1	Garden	0.61	0-12	3		
145	145-H1	House	0.73	0-1	1		
145	145-A1	Agriculture Area	0.14	0-1	3	0-1, 1-6	5, 5
146	146-H1	House	0.25	0-1	3		
147	147-H1	House	0.91	0-1	1	0-1, 1-6	5, 5
147	147-G1	Garden	0.06	0-12	3		
147	147-G2	Garden	0.20	0-12	1		
148	148-H1	House	0.46	0-1	1		
148	148-O1	Other	0.25	0-1	1		
148	148-O2	Other	0.02	0-1	1		
148	148-O3	Other	0.10	0-1	3		
149	149-H1	House	0.30	0-1	1		
149	149-D1	Lead-Based Paint Concern	0.02	0-1	1		
149	149-A1	Agriculture Area	0.29	0-1	3		
149	149-G1	Garden	0.11	0-12	1		
149	149-G2	Garden	0.02	0-12	1		
149	149-N1	Animal/Livestock	0.08	0-3	1		
150	150-H1	House	0.06	0-1	3	0-1, 1-6	5, 5
150	150-G1	Garden	0.16	0-12	1		
151	151-H1	House	0.28	0-1	3	0-1, 1-6	5, 5
152	152-H1	House	0.20	0-1	1		
152	152-G1	Garden	0.04	0-12	1		
152	152-O1	Other	0.05	0-1	3		
153	153-H1	House	0.68	0-1	1		
153	153-P1	Play Area	0.18	0-1	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
153	153-G1	Garden	0.15	0-12	1		
153	153-G2	Garden	0.01	0-12	1		
153	153-O1	Other	0.38	0-1	3		
153	153-O2	Other	0.24	0-1	1		
153	153-O3	Other	0.74	0-1	1		
153	153-O4	Other	0.04	0-1	1		
153	153-O5	Other	0.06	0-1	1		
153	153-O6	Other	0.11	0-1	1		
153	153-O7	Other	0.78	0-1	1		
154	154-H1	House	0.17	0-1	3		
154	154-G1	Garden	0.01	0-12	1		
155	155-H1	House	0.07	0-1	1		
155	155-H2	House	0.05	0-1	1	0-1, 1-6	5, 5
155	155-G1	Garden	0.20	0-12	1		
155	155-G2	Garden	0.01	0-12	1		
155	155-O1	Other	0.06	0-1	1		
155	155-O2	Other	0.70	0-1	3		
156	156-H1	House	0.08	0-1	1		
156	156-O1	Other	0.23	0-1	3		
157	157-H1	House	0.22	0-1	1		
157	157-H2	House	0.26	0-1	1		
157	157-G1	Garden	0.07	0-12	1		
157	157-O1	Other	0.46	0-1	3		
157	157-B1	Beach	0.11	0-6	1		
157	157-B2	Beach	0.03	0-6	1		
158	158-H1	House	0.29	0-1	3		
158	158-O1	Other	0.17	0-1	1	0-1, 1-6	5, 5
159	159-H1	House	0.36	0-1	3		
159	159-H2	House Under Construction	0.15	0-1	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
159	159-O1	Other	0.91	0-1	1		
159	159-O2	Other	0.77	0-1	1		
159	159-G1	Garden	0.16	0-12	1		
160	160-H1	House	0.57	0-1	1		
160	160-G1	Garden	0.01	0-12	3		
160	160-O1	Other	0.35	0-1	1		
161	161-H1	House	0.36	0-1	1		
161	161-D1	Lead-Based Paint Concern	0.01	0-1	1		
161	161-N1	Animal/Livestock	0.32	0-3	3		
162	162-H1	House	0.42	0-1	3		
163	163-H1	House	0.13	0-1	1		
163	163-G1	Garden	0.07	0-12	3		
163	163-O1	Other	0.28	0-1	1		
164	164-H1	House	0.09	0-1	3		
165	165-H1	House	0.15	0-1	3		
165	165-O1	Other	0.48	0-1	1		
166	166-O1	Proposed Future House Location	1.28	0-1	3		
167	167-O1	Proposed Future House Location	0.58	0-1	1		
167	167-O2	Proposed Future House Location	0.70	0-1	1		
167	167-O3	Proposed Future House Location	0.70	0-1	3		
167	167-O4	Proposed Future House Location	0.70	0-1	1		
167	167-O5	Proposed Future House Location	0.70	0-1	1		
168	168-H1	House	0.07	0-1	3		
168	168-D1	Lead-Based Paint Concern	0.02	0-1	1		
168	168-G1	Garden	0.06	0-12	1		
168	168-G2	Garden	0.01	0-12	1		
168	168-N1	Animal/Livestock	0.20	0-3	1		
169	169-H1	House	1.14	0-1	1	0-1, 1-6	5, 5
169	169-G1	Garden	<0.01	0-12	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
169	169-G2	Garden	0.61	0-12	1		
169	169-G3	Garden	0.56	0-12	1		
169	169-G4	Garden	0.04	0-12	3		
170	170-H1	House	0.07	0-1	3		
170	170-G1	Garden	0.12	0-12	1		
170	170-G2	Garden	0.38	0-12	1		
171	171-H1	House	0.16	0-1	1		
171	171-G1	Garden	0.07	0-12	1		
171	171-B1	Beach	1.18	0-6	3		
172	172-O1	Other	0.07	0-1	3		
173	173-H1	House	0.36	0-1	3		
173	173-G1	Garden	0.01	0-12	1		
173	173-G2	Garden	0.03	0-12	1		
173	173-G3	Garden	0.04	0-12	1		
173	173-G4	Garden	0.02	0-12	1		
173	173-G5	Garden	<0.01	0-12	1		
173	173-G6	Garden	<0.01	0-12	1		
173	173-P1	Play Area	0.46	0-1	1		
174	174-H1	House	0.16	0-1	3		
174	174-A1	Agriculture Area	0.16	0-1	1	0-1, 1-6	5, 5
174	174-G1	Garden	0.07	0-12	1		
175	175-H1	House	0.31	0-1	1		
175	175-G1	Garden	0.01	0-12	1		
175	175-G2	Garden	0.10	0-12	3		
176	176-H1	House	0.71	0-1	1		
176	176-H2	House	0.16	0-1	1		
176	176-P1	Play Area	0.21	0-1	1		
176	176-A1	Agriculture Area	0.40	0-1	3		
177	177-H1	House	0.19	0-1	3		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
177	177-G1	Garden	0.01	0-12	1		
178	178-H1	House	0.05	0-1	3	0-1, 1-6	5, 5
179	179-H1	House	0.04	0-1	3		
180	180-H1	House	0.11	0-1	1		
180	180-O1	Other	0.08	0-1	3		
181	181-H1	House	0.05	0-1	1		
181	181-H2	House	0.02	0-1	1		
181	181-G1	Garden	0.01	0-12	1		
181	181-G2	Garden	0.03	0-12	3		
181	181-A1	Agriculture Area	0.12	0-1	1		
181	181-N1	Animal/Livestock	0.09	0-3	1		
181	181-N2	Animal/Livestock	0.20	0-3	1		
181	181-O1	Other	0.09	0-1	1		
182	182-H1	House	0.46	0-1	1		
182	182-H2	House	0.20	0-1	1		
182	182-O1	Other	0.12	0-1	1		
182	182-O2	Other	0.20	0-1	1	0-1, 1-6	5, 5
182	182-O3	Other	1.10	0-1	3		
182	182-G1	Garden	0.01	0-12	1		
182	182-G2	Garden	0.35	0-12	1		
183	183-O1	Proposed Future House Location	0.03	0-1	3		
184	184-H1	House	0.59	0-1	3		
185	185-H1	House	0.05	0-1	1		
185	185-G1	Garden	<0.01	0-12	1		
185	185-A1	Agriculture Area	0.07	0-1	3		
186	186-O1	Other	1.48	0-1	3		
187	187-H1	House	0.14	0-1	3	0-1, 1-6	5, 5
188	188-H1	House	0.02	0-1	1		
188	188-A1	Agriculture Area	1.42	0-1	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
188	188-G1	Garden	0.28	0-12	1		
188	188-G2	Garden	0.09	0-12	1		
188	188-G3	Garden	0.25	0-12	1		
188	188-P1	Play Area	0.67	0-1	3		
189	189-H1	House	0.13	0-1	3		
189	189-H2	House	0.06	0-1	1		
189	189-O1	Other	0.03	0-1	1		
189	189-G1	Garden	0.01	0-12	1		
190	190-H1	House	1.12	0-1	3		
190	190-O1	Other	0.41	0-1	1		
190	190-G1	Garden	0.03	0-12	1		
190	190-N1	Animal/Livestock	0.19	0-3	1		
190	190-N2	Animal/Livestock	0.37	0-3	1		
190	190-N3	Animal/Livestock	0.31	0-3	1		
191	191-H1	House	0.22	0-1	3	0-1, 1-6	5, 5
192	192-H1	House	0.48	0-1	3		
192	192-G1	Garden	0.01	0-12	1		
192	192-A1	Agriculture Area	0.10	0-1	1		
193	193-H1	House	1.26	0-1	1		
193	193-G1	Garden	0.11	0-12	3		
194	194-H1	House	0.26	0-1	3		
194	194-N1	Animal/Livestock	0.15	0-3	1		
195	195-O1	Proposed Future House Location	0.06	0-1	3		
195	195-G1	Garden	0.01	0-12	1		
195	195-G2	Garden	0.01	0-12	1		
196	196-O1	Other	0.45	0-1	3		
196	196-A1	Agriculture Area	2.73	0-1	1		
196	196-A2	Agriculture Area	1.66	0-1	1		
196	196-G1	Garden	0.03	0-12	1		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
197	197-H1	House	0.17	0-1	3		
198	198-H1	House	0.45	0-1	1		
198	198-G1	Garden	0.05	0-12	3		
199	199-G1	Garden	0.02	0-12	1		
199	199-O1	Other	0.12	0-1	3		
200	200-H1	House	0.32	0-1	3		
200	200-G1	Garden	0.01	0-12	1		
200	200-O1	Other	0.02	0-1	1		
201	201-O1	Other	0.18	0-1	3		
202	202-H1	House	0.21	0-1	3		
202	202-N1	Animal/Livestock	<0.01	0-3	1		
202	202-O1	Other	0.29	0-1	1	0-1, 1-6	5, 5
203	203-H1	House	0.27	0-1	1		
203	203-O1	Other	0.81	0-1	3	0-1, 1-6	5, 5
203	203-O2	Other	0.22	0-1	1		
204	204-H1	House	0.93	0-1	3		
204	204-G1	Garden	0.28	0-12	1		
204	204-A1	Agriculture Area	0.08	0-1	1		
205	205-O1	Proposed Future House Location	1.42	0-1	3		
206	206-H1	House	0.10	0-1	3		
206	206-H2	House	0.13	0-1	1		
206	206-G1	Garden	0.09	0-12	1		
206	206-A1	Agriculture Area	0.18	0-1	1		
206	206-O1	Other	0.14	0-1	1		
207	207-O1	Other	0.65	0-1	3	0-1, 1-6	5, 5
801	801-O1	Other	0.15	0-1	3		
801	801-O2	Other	0.08	0-1	1		
801	801-O3	Other	1.53	0-1	1		
802	802-O1	Other	0.35	0-1	3		

Residential Property	DU	Rationale for Sampling	DU Size (acres)	Incremental Composite Sample[2]		Deep (Discrete) Core Samples[3]	
				Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[4]
803	803-O1	Other	0.53	0-1	3		
803	803-O2	Other	0.24	0-1	1		
803	803-O3	Other	0.28	0-1	1		
804	804-O1	Other	0.43	0-1	3		
804	804-O2	Other	1.27	0-1	1		
805	805-O1	Other	0.20	0-1	1		
805	805-O2	Other	0.39	0-1	3		
806	806-O1	Other	0.85	0-1	1		
806	806-O2	Other	0.37	0-1	1		
806	806-O3	Other	0.03	0-1	1	0-1, 1-6	5, 5
806	806-O4	Other	0.32	0-1	3		
806	806-O5	Other	0.12	0-1	1		
807	807-O1	Other	0.06	0-1	3		
808	808-O1	Other	0.52	0-1	3		
808	808-O2	Other	0.17	0-1	1	0-1, 1-6	5, 5

[1] Matrix is soil. Analytical group is target analyte list metals.
[2] Refer to Standard Operating Procedures (SOP) #4.
[3] Refer to SOP #5.
[4] Number of samples 5, 5 refers to 0-1 and 1-6 respectively.

QAPP Worksheet #19: Analytical SOP Requirements Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Analytical Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	TAL Metals (no mercury)	Low	MET-3050B.r14 MET-6020.r16 MET-ICP.r25 IC Sample Preparation and Subsampling ICP-AES 6010C Prep method 3050B	2 g [2]	1 to 2 g wide-mouth clear polyethylene jar	None	6 months
Soil	TAL Metals (no mercury)	Low	MET-3050B.r14 MET-6020.r16 MET-ICP.r25 IC Sample Preparation and Subsampling ICP-AES 6010C Prep method 3050B	8 g [3]	4 to 2 g wide-mouth clear polyethylene jar	None	6 months
Soil	IVBA	Low	MET-3050B.r14 MET-6020.r16 MET-BIOACC.r1	5 g	N/A – generated in laboratory	None	5 months
Water (Field Equipment Blank)	TAL Metals (no mercury)	Low	MET-DIG.r16 MET-6020.r16 MET-ICP.r25	250 milliliter (mL)	Nitric acid preserved 250 mL polyethylene bottle	None	6 months

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (see Worksheet #23).
[2]Regular sample
[3]Sample designated for laboratory QC

QAPP Worksheet #20: Field Quality Control Sample Summary Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Analytical Group	Concen-tration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Replicate Pairs	No. of Inorganic Matrix Spikes	No. of Field Blanks	No. of Equip. Blanks	No. of Proficiency Testing Samples	Total No. of Samples to Lab[2]
Soil – IC samples	TAL Metals	Low	MET-3050B.r14 MET-6020.r16 MET-ICP.r25	448primary	282replicates	5 percent (37samples, collected at lab after processing)	N/A	1 per day per type of sampling equipment used	N/A	767(730 primary and replicate samples, plus 37 inorganic matrix spike samples)
Soil – Discrete Samples 0 to 1 in. and 1 to 6 in.	TAL Metals	Low	MET-3050B.r14 MET-6020.r16 MET-ICP.r25	290primary (includes both depths)	1 field duplicate per depth interval at one location per DU where discrete samples collected	5 percent (18samples, collected at lab after processing)	N/A	N/A	N/A	366(348 primary and duplicate samples, plus 18 inorganic matrix spike samples)
Water – Rinsate Blanks	TAL Metals	Low	MET-DIG.r15 MET-6020.r16 MET-ICP.r25					1 per day per type of sampling equipment used		144

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (see Worksheet #23).
[2]Number of rinsate blanks will vary depending on the number of types of equipment used on each day.

QAPP Worksheet #21: Project Sampling SOP References Table

☐ Worksheet Not Applicable (State Reason)

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
01	SOP 1 – Underground Utility Location	Ramboll Environ			See Attachment D, FSP for more information
02	SOP 2 – Positioning at Soil Sample Collection Areas	Ramboll Environ	Trimble	☒	See Attachment D, FSP for more information
03	SOP 3 – Field Determination of Incremental Sample Locations	Ramboll Environ	Trimble		See Attachment D, FSP for more information
04	SOP 4 – Incremental Composite Sample Collection	Ramboll Environ	Multi-increment sampling tool (MIST)	☒	See Attachment D, FSP for more information
05	SOP 5 – Discrete Soil Sample Collection	Ramboll Environ	Hand tools	☒	See Attachment D, FSP for more information
06	SOP 6 – Sample Storage, Packaging, and Shipping	Ramboll Environ			
07	SOP 7 – Sample Custody	Ramboll Environ			
08	SOP 8 – Decontamination of Soil Sampling Equipment	Ramboll Environ			

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GPS	None	Keep batteries charged	Field performance	Visual inspection	At time of use	Receiving GPS satellite	Send to manufacturer for repair and calibration	Joss Moore	03

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (see Worksheet #21)

QAPP Worksheet #23: Analytical SOP References Table

☐ Worksheet Not Applicable (State Reason)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
MET-3050B.r14	MET-3050B.r14; Metals Digestion	Definitive	TAL Metals (Soil)	ICP/MS; ICP/AES	ALS/Kelso	☐
MET-6020.r16	MET-6020.r16; Determination of Metals and Trace Element by Inductively Coupled Plasma Mass Spectrometry (ICP/MS)					
MET-ICP.r25	MET-ICP.r25; Determination of Metals and Trace Element by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP/AES)					

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
MET-DIG.r15 MET-6020.r16 MET-ICP.r25	MET-DIG.r15; Metals Digestion MET-6020.r16; Determination of Metals and Trace Element by ICP/MS MET-ICP.r25; Determination of Metals and Trace Element by ICP/AES	Definitive	TAL Metals (Water)	ICP/MS; ICP/AES	ALS/Kelso	☐
GEN-SUBS.r6	GEN-SUBS.r6; Sub-sampling and Compositing of Samples	Definitive	TAL Metals	Sieve, Balance	ALS/Kelso	☐
MET-BIOACC.r1	MET-BIOACC.r1; Bioaccessibility of Metals in Soils and Waste	Definitive	IVBA	Modified toxicity characteristic leaching procedure extractor	ALS/Kelso	

QAPP Worksheet #24: Analytical Instrument Calibration Table

☐ Worksheet Not Applicable (State Reason)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
ICP-AES EPA Method 6010C	Establish instrument detection limits (IDLs)	Every 3 months	In accordance with manufacturer's recommendation or laboratory SOP	Notify the manufacturer if problem occurs	Certified instrument technician	MET-ICP.r25
	Calibrate using low level initial calibration verification at MRL	Daily prior to sample analysis	±30 percent of the true value	Identify and correct problem, then recalibrate if necessary	Laboratory Project Manager, analyst, or certified instrument technician	
	Establish linear dynamic range	Once every 6 months or when the system is repaired	Calculated value should be within ± 10 percent of the true value	Correct problem, then repeat the calibration process	Laboratory Project Manager, analyst, or certified instrument technician	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
	Run interference check solution	At the beginning of analytical run	ICS-A: Absolute value of concentration for all non-spiked analytes < level of detection (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20 percent of true value	Correct problem, then repeat the calibration process, or use internal standards to eliminate the problem	Laboratory Project Manager, analyst or certified instrument technician	
	Run second source calibration verification (ICV)	Once after standard calibration	±10 percent of its true value	Correct problem, then repeat the calibration process	Laboratory Project Manager, analyst or certified instrument technician	
	Run Continuing Calibration Verification Standard (CCV)	Once every 10 samples	±10 percent of its true value	Terminate analysis; recalibrate and reanalyze the samples	Laboratory Project Manager, analyst or certified instrument technician	
	Run Continuing Calibration Blank (CCB)	Once every 10 samples	Less than the established lower limit of quantitation for any desired target analyte	Terminate analysis; recalibrate and reanalyze the samples	Laboratory Project Manager, analyst or certified instrument technician	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
ICP/MS EPA Method 6020A	IDLs	Every 3 months	In accordance with manufacturer's recommendation or laboratory SOP	Notify the manufacturer if problem occurs	Laboratory Project Manager, analyst or certified instrument technician	MET-6020.r16
	Tuning	Prior to initial calibration	Mass calibration <0.1 atomic mass unit (amu) from true value; Resolution <0.9 amu at 5 percent peak height; for stability, RSD <5 percent for at least five replicate analyses	Correct problem, then repeat tuning	Laboratory Project Manager, analyst or certified instrument technician	
	Initial calibration using either single or multi-point standard calibration	Daily prior to analysis of sample	Within 10 percent of the expected value	Correct problem, then repeat initial calibration	Laboratory Project Manager, analyst or certified instrument technician	
	Linear dynamic range or high level check standard	Once every 6 months or when the system is repaired	Calculated value should be within ±10 percent of the true values	Correct problem, then repeat the calibration process	Laboratory Project Manager, analyst or certified instrument technician	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
	Interference check solution	After calibration and before field samples; reanalyzed every 12 hours	Interference check solution-A: Absolute value of concentration for all non-spiked analytes <2 × method detection limit (unless they are a verified trace impurity from one of the spiked analytes). Interference check solution-AB: Within ±20 percent of its true value	Correct problem, then repeat the calibration process or use internal standards to eliminate the problem	Laboratory Project Manager, analyst or certified instrument technician	
	Second-source ICV	Once after standard calibration	Within ±10 percent of its true value	Correct problem, then repeat the calibration process	Laboratory Project Manager, analyst or certified instrument technician	
	Run lower limit of quantitation limit	Once after ICV	Within ±20 percent of its true value	Qualify the data as estimated values	Laboratory Project Manager, analyst or certified instrument technician	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
	Internal standards	Every analysis	Internal standard intensity within 30 to 125 percent of intensity of the internal standard in the initial calibration	Terminate the analysis, correct the problem, recalibrate and reanalyze the samples	Laboratory Project Manager, analyst or certified instrument technician	
	CCV	Following initial calibration, after every 10 samples and the end of the sequence	±10 percent of its true value	Terminate analysis; recalibrate and reanalyze the samples	Laboratory Project Manager, analyst or certified instrument technician	
	CCB	After initial calibration, after CCV calibration, after every 10 samples and the end of the sequence	<MRL	Terminate analysis; recalibrate and reanalyze the samples	Laboratory Project Manager, analyst or certified instrument technician	

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

☐ Worksheet Not Applicable (State Reason)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
ICP/MS	Clean the instrument. Change gas, gas purifier, and tubing. Dispose of wastes.	Check instrument connections, gas flow, pressure, ion mass, and detector sensitivity.	Visually inspect for wear or damage; check indicators from computer controls	Daily or when needed	Intensity of spectrum is within manufacturer's recommendation and mass calibration difference is < 0.1 amu from the true value	Call for maintenance service	Analyst or certified instrument technician	Quality Assurance Manual Appendix E Analytical SOP MET-6020 (see Attachment F)
ICP/AES	Check argon dewar. Replace peristaltic pump tubing. Empty waste container. Clean nebulizer, spray chamber, and torch. Replace water filter. Replace vacuum air filters.	N/A	Visually inspect	Daily Daily Weekly Every 2 weeks Quarterly Monthly	In accordance with manufacturer's recommendation or laboratory SOP	Perform activity	Analyst or certified instrument technician	Quality Assurance Manual Appendix E Analytical SOP MET-ICP (see Attachment F)

[1]Specify the appropriate reference letter or number from Analytical SOP References table (see Worksheet #23)

QAPP Worksheet #26: Sample Handling System

☐ Worksheet Not Applicable (State Reason)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Tetra Tech
Sample Packaging (Personnel/Organization): Tetra Tech
Coordination of Shipment (Personnel/Organization): Tetra Tech
Type of Shipment/Carrier: FedEx or courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Les Kennedy/ALS
Sample Custody and Storage (Personnel/Organization): Les Kennedy/ALS
Sample Preparation (Personnel/Organization): Lance Jording/ALS
Sample Determinative Analysis (Personnel/Organization): Jeff Coronado/ALS
SAMPLE ARCHIVING
Field Sample Storage (no. of days from sample collection): Les Kennedy/ALS
Sample Extract/Digestate Storage (no. of days from extraction/digestion): Lance Jording/ALS
Biological Sample Storage (no. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Les Kennedy/ALS
Number of Days from Analysis: All samples will be archived until TAI provides the laboratory with a copy of the written notification from EPA that the samples are no longer needed.

QAPP Worksheet #27: Sample Custody Requirements

☐ Worksheet Not Applicable (State Reason)

Field Sample Custody Procedures (sample collection, packaging, shipment, delivery to laboratory): Field sample collection and custody procedures are detailed in the FSP (Attachment D).
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): See Worksheet #26 and FSP (Attachment D)

Sample Identification Procedures:

Each IC and discrete sample will be assigned a unique sample identification number that includes the study name, medium, sample location (i.e., property number), DU type, sample type, and sample type number. For discrete samples, a discrete sample location number will also be assigned. The unique sample number will be entered in the field notebook, field tracking sheets, COC forms, and other records documenting sampling activities.

The following sample numbering convention will be used for IC samples:

Study Prefix – Study Location – DU Type – Sample Type – IC Sample Number

Explanation:

Study Prefix:	16R = 2016 Residential Soil Study
Study Location:	Property number (unique numbers assigned to individual properties)
DU Type:	H for house, A for agriculture, P for play area, G for garden, D for dripline, N for animal activity area, B for beach, and O for other (if more than one DU of same type at a given property, letter code followed by number)
Sample Type:	IC = incremental composite
IC Sample Number:	01 = primary sample
	02 = primary field replicate
	03 = secondary field replicate

The following sample numbering convention will be used for discrete samples:

Study Prefix – Study Location – DU Type – Sample Type – Discrete Sample Number

Explanation:

Study Prefix:	16R = 2016 Residential Soil Study
Study Location:	Property number (unique numbers assigned to individual properties)
DU Type:	H for house, A for agriculture, P for play area, G for garden, D for dripline, N for animal activity area, B for beach, and O for other (if more than one DU of same type at a given property, letter code followed by number)

Sample Type:	D1A through D1E = discrete samples collected from 0 to 1 in. below ground surface (bgs) at locations A, B, C, D, and E D6A through D6E = discrete samples collected from 1 to 6 in. bgs at locations A, B, C, D, and E
Discrete Sample Number:	01 = primary sample 02 = field duplicate sample

For example:

- 16R-137-H-IC-01 is a primary IC soil sample collected at property 137, house DU.
- 16R-137-H-D1A-01 is a primary discrete surface soil sample collected from the 0 to 1 in. depth interval at location A of property 137, house DU.
- 16R-137-G1-IC-03 is a primary field replicate IC soil sample collected at property 137, first garden DU where more than one garden DU was established.
- 16R-137-H-D6B-02 is a field duplicate discrete subsurface soil sample collected from the 1 to 6 in. depth interval at location B of property 137, house DU.

COC Procedures:

COC procedures are detailed in the FSP (Attachment D).

QAPP Worksheet #28: Quality Control Samples Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low
Sampling SOP	01, 02
Analytical Method/SOP Reference	MET-DIG; MET-6020; MET-ICP
Sampler's Name	Tetra Tech Field Personnel
Field Sampling Organization	Tetra Tech
Analytical Organization	ALS, Kelso
No. of Sample Locations	719 IC, 336 Discrete

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Matrix Spike/Duplicate Matrix Spike	One per matrix per analytical method for each batch of at most 20 samples per site.	Percent R = 75-125 RPD ±20 percent	Examine the project-specific DQOs. Notify Laboratory QA Manager and Project Chemist of additional measures to be taken.	Analyst Project Chemist	Accuracy/ Precision	For matrix evaluation, use laboratory control sample acceptance criteria.

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low
Sampling SOP	01, 02
Analytical Method/SOP Reference	MET-DIG; MET-6020; MET-ICP
Sampler's Name	Tetra Tech Field Personnel
Field Sampling Organization	Tetra Tech
Analytical Organization	ALS, Kelso
No. of Sample Locations	719 IC, 336 Discrete

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
IC Field Replicates	DUs will be sampled in triplicate with frequency of 20 percent of the total number of DUs and a minimum of one triplicate per property.	NS	Examine IC sampling records	Analyst Project Chemist	Precision	RSD $\leq$30
Laboratory Control Sample	Each group of 20 or less.	As per vendor's certificate of analysis	Correct problem, then re-digest, and reanalyze the laboratory control sample and all samples in the associated batch.	Analyst Project Chemist	Accuracy	As per vendor's certificate of analysis
Method Blank	Each time samples are extracted.	No analytes detected >1/2 MRL	Correct problem, then re-digest, and reanalyze the Method Blank and all samples in the associated batch.	Analyst Project Chemist	Accuracy/ Bias (Contamination)	No analytes detected >1/2 MRL

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low
Sampling SOP	01, 02
Analytical Method/SOP Reference	MET-DIG; MET-6020; MET-ICP
Sampler's Name	Tetra Tech Field Personnel
Field Sampling Organization	Tetra Tech
Analytical Organization	ALS, Kelso
No. of Sample Locations	719 IC, 336 Discrete

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Replicates	10 percent of all IC samples	NS	Report data; document in final deliverable	TAI Contractor Task Leader (TL)	Precision	<20 percent RSD
Discrete Sample Field Duplicate	1 per each depth interval at one location per DU where discrete samples collected	NS	Identify the exceedance in the validation report and/or data quality assessment	TAI Contractor TL	Precision	RPD ±35 percent
Laboratory Split Samples	15 percent of all samples	NS	Identify the exceedance in the validation report and/or data quality assessment	EPA R10 MEL	Precision/ Error	RPD ±50 percent
Field Equipment Blank	1 per day of sampling	NS	Document in final deliverable	TAI Contractor TL	Accuracy/ Bias (Contamination)	<MRL

Matrix	Soil
Analytical Group	TAL Metals (no mercury)
Concentration Level	Low
Sampling SOP	01, 02
Analytical Method/SOP Reference	MET-DIG; MET-6020; MET-ICP
Sampler's Name	Tetra Tech Field Personnel
Field Sampling Organization	Tetra Tech
Analytical Organization	ALS, Kelso
No. of Sample Locations	719 IC, 336 Discrete

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Sieve Blank	1 per 20 samples	NS	Qualify data	Analyst	Accuracy/ Bias (Contamination)	< MRL
Serial Dilution	1 per 20 samples	Percent Dilution ±10	Run method of standard additions or qualify data	Analyst	Accuracy/ Bias	Percent Dilution ±10
Post Spike	1 per 20 samples	Percent Recovery = 85-115	Run serial dilution	Analyst	Accuracy/ Bias	Percent Recovery = 85-115

QAPP Worksheet #29: Project Documents and Records Table

☐ Worksheet Not Applicable (State Reason)

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
• IC sample collection forms • Discrete sample collection forms • Field logbooks • Chains of custody • Sample labels • Custody seals • Sample tracking log • Field deviation form • Copies of signed access agreements • Property information (electronic database), sample location coordinates, and maps	N/A	• Instrument run logs • Sample digestion logs • Preventative maintenance logs • Instrument printouts • Internal COC records • Temperature logs • Standard receipt logs • Standard preparation logs • Data reduction/data review records • Analytical results • IC sample processing and subsampling records (laboratory)	• Data assessment forms	• Analytical reports • Validation reports • Field Data Summary Report

QAPP Worksheet #30: Analytical Services Table

☐ Worksheet Not Applicable (State Reason)

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person, and telephone number)	Backup Laboratory/Organization (name and address, contact person, and telephone number)
Soil	TAL Metals	Low	See Worksheet #18	MET-DIG; MET-6020; MET-ICP; Method 6010C Prep method 3050B	28 days	Jeff Coronado ALS Environmental 1317 South 13th Avenue Kelso, WA 98626 360-501-3330	Kurt Clarkson ALS Environmental 1317 South 13th Avenue Kelso, WA 98626 360-501-3356

QAPP Worksheet #31: Planned Project Assessments Table

☐ Worksheet Not Applicable (State Reason)

Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Person(s) Responsible for Performing Assessment (title and organizational affiliation)**	**Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)**	**Person(s) Responsible for Identifying and Implementing Corrective Actions (title and organizational affiliation)**	**Person(s) Responsible for Monitoring Effectiveness of Corrective Actions (title and organizational affiliation)**
Readiness Review	Before mobilizing to the field	Internal	Tetra Tech	Health and Safety (H&S) Manager, Quality Manager, Project Delivery Manager, Environmental Compliance Manager	Field Program Project Manager Field Program Supervisor	TAI Project Coordinator Field Program Supervisor	TAI Project Coordinator Field Program Supervisor
Field Safety Audit	Once during sampling	Internal	Tetra Tech	H&S Manager	Field Program Project Manager Field Program Supervisor	TAI Project Coordinator Field Program Supervisor	Project Coordinator Field Team Manager
Data Quality Review	Following sample analysis and validation	External	EPA	EPA RQAM	Analytical Chemistry Laboratory Project Manager Data Validator	EPA RQAM TAI Task QA Coordinator TAI Analytical Chemistry Laboratory Coordinator	EPA RQAM

QAPP Worksheet #32: Assessment Findings and Corrective Action Responses

☐ Worksheet Not Applicable (State Reason)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Peer Review	Directly onto the deliverable	Tetra Tech	Task dependent	Comments made directly onto the deliverable	TAI Project Coordinator	Prior to deliverable due date
Readiness Review	Readiness Review Checklist	Tetra Tech	Immediately	Comments made directly on checklist	TAI Project Coordinator	Prior to onset of field work
Field Observations/ Deviations from QAPP	Logbook and Field Change Form	Tetra Tech EPA Project Manager TAI Project Coordinator	Immediately	Field Change Form	TAI Project Coordinator EPA Project Manager	Within 24 hours of change
H&S	Audit Report	Tetra Tech	Immediately	Comments made directly on Audit Report	TAI Project Coordinator	Within 24 hours
Laboratory Performance Audits	Audit Report	Laboratory	Within 30 days	Corrective Action Plan	Regulatory Agency	Within 30 days

QAPP Worksheet #33: QA Management Reports Table

☐ Worksheet Not Applicable (State Reason)

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Monthly Progress Report	Monthly	Third Friday of the month following performance period	TAI Project Coordinator	EPA Project Manager

QAPP Worksheet #34: Verification (Step I) Process Table

☐ Worksheet Not Applicable (State Reason)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
COC Record	Reviewed by field sampling personnel in field and data validation group prior to final analytical report preparation	Internal	TAI Contractor TL TAI Contractor QA/QC Group
Laboratory Data Package	Reviewed for measurement performance criteria	Internal/External	TAI Contractor, ALS Laboratory Personnel
Analytical Report	Reviewed for completeness	Internal	Peer Review Team
Analytical Report	An S4 level data validation review will be performed prior to data release	Internal	TAI Contractor QA/QC Group
Field Sampling Report	Reviewed for completeness	External	TAI Contractor, Peer Review Team
Summary Report	Reviewed for completeness	Internal	Peer Review Team
Completeness Check	Review of planning documents, analytical data package, sampling documents, and external reports, as applicable, using the UFP-QAPP Checklist	Internal	TAI Contractor TL TAI Contractor QA/QC Group

QAPP Worksheet #35: Validation (Steps IIa and IIb) Process Table

☐ Worksheet Not Applicable (State Reason)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	SOPs	Ensure that the sampling methods and procedures outlined in QAPP were followed, any deviations were noted, and field change orders were approved and followed.	TAI Contractor TL and TAI and EPA Project Managers
IIb	SOPs	Determine potential impacts from noted deviations and approved field changes regarding PQOs.	TAI Contractor QA/QC Group
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	TAI Contractor TL, TAI Contractor QA/QC Group
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	TAI Contractor and ALS Laboratory Personnel
IIb	Laboratory data package	Determine potential impacts from noted and approved deviations regarding PQOs. Examples include practical quantitation limit and QC sample limits (precision/accuracy).	TAI Contractor QA/QC Group

QAPP Worksheet #36: Validation (Steps IIa and IIb) Summary Table

☐ Worksheet Not Applicable (State Reason)

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/IIb	Soil	TAL Metals	Low	EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, January 2010	Chemistry QA Personnel, Environmental Standards, Inc.
IIa/IIb	Soil	IVBA	Low	EPA Standard Operating Procedure for an *In Vitro* Bioaccessibility Assay for Lead in Soil, April 2012 https://www.epa.gov/superfund/soil-bioavailability-superfund-sites-guidance	Chemistry QA Personnel, Environmental Standards, Inc.

QAPP Worksheet #37: Usability Assessment

☐ Worksheet Not Applicable (State Reason)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
Describe the evaluative procedures used to assess overall measurement error associated with the project:
Identify the personnel responsible for performing the usability assessment:
Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they can identify trends, relationships (correlations), and anomalies:

The following items will be assessed and conclusions drawn based on the results:

Holding Time: All sample data will be checked to verify that both sample preparation and analysis were performed within the required method holding time.

Calibration: Data associated with instrument calibration and verification of calibration will be reviewed to confirm that all data were generated using properly calibrated instrumentation.

Accuracy/Bias Contamination: Results for all field blanks, laboratory method blanks, and instrument calibration blanks will be checked against the performance criteria specified in Worksheet #28; results for analytes that exceed criteria will be identified and the impact on field sample data will be assessed. Data will be summarized by type of blank.

Accuracy/Bias Overall: Reported values of laboratory control samples, performance samples, and matrix spikes will be evaluated against the spiked or certified concentration, and the percent recovery will be calculated and compared to the criteria specified in Worksheet #28. The percent recovery information will be used to assess the bias associated with the analysis. Recovery for matrix spikes in conjunction with the recovery reported for performance samples and laboratory control samples will provide information on the impact of the sample matrix on specific analyses. Average recoveries will be calculated and reported by analyte for each type of QC sample.

Precision: Results of the RPD will be calculated for each analyte in the laboratory. These RPDs will be checked against the measurement performance criteria presented on Worksheet #28; RPDs exceeding the stated criteria will be identified.

Sensitivity: Reporting limits will be checked against the criteria presented on Worksheet #15 and quantitation limits presented on Worksheet #15.

Representativeness: A review of field records will be used to confirm that sample collection and handling was performed in a manner that conformed to the designated SOP. Similarly, laboratory preparation procedures will be reviewed during validation to ensure that a representative sample was selected for analysis. Any deviations or modifications to field or laboratory procedures that might affect the representativeness of the sample will be discussed in the project final report.

Comparability: The sampling and analytical procedures that will be used in this program have been selected to ensure that the resulting data will be comparable to data from similar programs conducted previously or which will be conducted in the future. Any modifications or deviations from stated procedures that might affect data comparability will be addressed in the project final report.

Completeness: Completeness for the analytical program will be calculated as the number of data points that are accepted as usable based on the validation process divided by the total number of data points for each analysis.

ATTACHMENT A

RESIDENTIAL SOIL STUDY
DATA QUALITY OBJECTIVES

CONTENTS

ACRONYMS AND ABBREVIATIONS ..... A-ii
UNITS OF MEASURE ..... A-iii
1 2016 RESIDENTIAL SOIL STUDY DATA QUALITY OBJECTIVES A-1-1
1.1 STATE THE PROBLEM A-1-1
1.2 IDENTIFY THE GOAL OF THE STUDY A-1-1
1.3 IDENTIFY INFORMATION INPUTS A-1-2
1.4 DEFINE THE BOUNDARIES (IN SPACE AND TIME) OF THE STUDY A-1-3
1.5 DEVELOP THE ANALYTIC APPROACH A-1-4
1.6 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA A-1-6
1.7 DEVELOP THE DETAILED PLAN FOR OBTAINING DATA A-1-6
2 REFERENCES A-2-1

ACRONYMS AND ABBREVIATIONS

CCT	Confederated Tribes of the Colville Reservation
DQO	data quality objective
DU	decision unit
EPA	U.S. Environmental Protection Agency
IC	incremental composite
IEUBK	Integrated Exposure Uptake Biokinetic
RI/FS	Remedial investigation and feasibility study
TAI	Teck American, Incorporated
UCR	Upper Columbia River

UNITS OF MEASURE

mg/kg	milligram(s) per kilogram
µm	micron

1 2016 RESIDENTIAL SOIL STUDY DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected. In brief, the DQO process typically follows a seven-step procedure, as follows:

1.1 STATE THE PROBLEM

Historic emissions from the Trail smelting facility in Trail, British Columbia have included metal-enriched particulates and aerosols. These airborne particles were deposited at varying distances from the smelter and became incorporated into the soil horizon. Various studies and soil sampling activities have been conducted in the Columbia River valley corridor south of the U.S. – Canada border (see Worksheet #10 of SRC Inc. 2014, the approved QAPP for the 2014 residential soil study). In 2014, the U.S. Environmental Protection Agency (EPA) conducted an investigation of residential soil in the northern portion of the Upper Columbia River (UCR) study area (CH2MHill 2015) and Teck American Incorporated (TAI) conducted an investigation of upland soils in and around the same area studied by EPA (Windward et al. 2015). Both studies were conducted as part of the remedial investigation and feasibility study (RI/FS) for the UCR Site, for which the areal extent of contamination has not been fully delineated. Based on the results of these investigations, EPA determined that additional information is needed regarding the concentrations of lead and arsenic in residential soils from properties not previously sampled within the 2014 residential soil study area and in an expanded area extending south from the southern boundary of that study area to approximately the intersection of Williams Lake Road and Highway 25 on the east side of the river (hereafter, the "UCR Study Area").

Exposure point concentrations for Washington state residents living within the UCR Study Area, including gardeners and Tribal members, need to be refined. TAI is planning a focused rural residential investigation of the UCR Study Area to provide data to assess potential risks to existing residents from exposure to metals in soils.

1.2 IDENTIFY THE GOAL OF THE STUDY

Sample surface soil in locations where there is a high potential for exposure by residents, especially young children. Young children and gardeners are likely to be exposed to possible metal exposure via direct soil ingestion.

Principal Human Health Risk Study Question:

Do lead and arsenic concentrations (and possibly other target analyte list metals[1]) in the fine-grained fraction of sediment and soils[2] from rural residential parcels pose an unacceptable risk to human health, particularly to children who live within the UCR Study Area (see Figure 1)?

1.3 IDENTIFY INFORMATION INPUTS

- SRC Inc. 2014. Quality Assurance Project Plan, Upper Columbia River Residential Soil Study, Washington State. Prepared for EPA Region 10 and ERT. Prepared by SRC, Inc. for Lockheed Martin SERAS Program. August 13, 2014.
- Windward et al. 2015. Upper Columbia River, Final Soil Study Data Summary Report. October.
- CH2M Hill 2015. FINAL UCR Residential Soil Study Field Sampling and Data Summary Report. October.
- Land use data from Stevens County Assessor's Office and the Confederated Tribes of the Colville Indian Reservation (CCT)
- Assistance from CCT, local government, community groups, school district, property owners, and residents to identify residential land use and obtain access to target properties
- EPA 2015a. August 11, 2015 Letter from Laura C. Buelow, EPA Project Coordinator, to Kris McCaig, TAI Project Coordinator detailing EPA's revised directive to TAI to conduct additional residential sampling as set forth in this letter.
- EPA 2015b. November 5, 2015 Letter from Laura C. Buelow, EPA Project Coordinator, to Kris McCaig, TAI Project Coordinator detailing EPA's proposed changes to the residential soil sampling QAPP for 2016 based on EPA's 2014 residential soil sampling results.

1 Target analyte list metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

2 For soils, the particle size in question is <150 μm; for beach sand, the particle size in question is <250 μm.

Project action limits for lead and arsenic are the same as those specified in the 2014 residential soil study QAPP (see Worksheet #15):

- 400 milligrams per kilogram (mg/kg) lead and
- 20 mg/kg arsenic.

Data to be collected will incorporate the following objectives and considerations:

- Inferred exposure areas based on communications with residents, accessibility of soil, gardens, play areas, agricultural land, or other visual information at each property.
- The target particle size for soil is <150 μm representative of dermal adherence as a proxy for inadvertent soil ingestion (Ruby and Lowney 2012); the target particle size for beach sediment is <250 μm, representative of dermal adherence of wet sediment (Kissel et al. 1996).
- Estimates of bioavailability based on in vitro bioaccessibility for lead and arsenic (EPA 2007)

1.4 DEFINE THE BOUNDARIES (IN SPACE AND TIME) OF THE STUDY

As directed by EPA, the focus of the 2016 Residential Soil Study is on residential properties located within the UCR Study Area (see Figure 1). TAI will sample all residential properties within the 2014 sampling area that were not previously sampled, assuming landowner consent is provided. TAI will also sample residential properties within the expanded sampling zone (see Figure 1) subject to landowner consent and the following conditions:

- The 2016 sampling zone will not include the area depicted in the map as "Northport Exclusion Area."
- Sampling in the area of Marble, Washington (delineated by the blue line), will be at a representative number of properties, rather than all properties. The specific technical details regarding the number representative properties to be sampled will be determined by the EPA Project Coordinator, in consultation with the TAI Project Coordinator.

If EPA determines that additional residential sampling is needed for the 2016 sampling program beyond the geographic boundary of sampling zone depicted in the attached map, EPA will conduct an additional study or analysis, such as isotopic analysis, with the goal of analyzing potential sources of contamination at the Site. EPA will consider soil sampling data and other information, including the additional study or analysis and any other data it might gather, in determining whether to expand the residential soil sampling within the

proposed expansion area. Any such additional study or analysis will be developed within the context of the RI/FS.

The design of decision units (DUs) to be sampled within each residential property will consider the potential to segregate portions of the property for evaluation and potential remediation, and may depend upon size, access, known presence of imported fill, historical activities such as tilling, topography, and other features.

The target particle size is <150 micron (μm) representative of dermal adherence as a proxy for inadvertent soil ingestion (Ruby and Lowney 2012). The <250 μm particle size fraction will be used for beach areas.

The sampling depth will be based on the soil depth interval that people are most likely to come into contact with and will vary by DU. The 0 to 1 inch depth interval for soil is the primary focus of this study because the top inch of soil best represents current exposure (EPA 1989; 1996) and will provide data that is recommended for use with the Integrated Exposure Uptake Biokinetic (IEUBK) model (EPA 2003). The sampling depth for gardens will be the tilled depth (generally 0 to 12 inches); the sampling depth for beaches will be 0 to 6 inches. Soil located within the drip lines of structures will not be sampled unless there is concern of lead-based paint. In a subset of DUs with an incremental composite (IC) sample depth of 0 to 1 inch below ground surface, discrete soil samples will be collected from depths of 0 to 1 and 1 to 6 inches below ground surface and where area use by residents is expected to be high based on interviews and the site visit to allow for comparison to data collected in the 2014 study and to reduce uncertainty regarding interpretation of the 2014 discrete sample results for evaluation of the vertical nature and extent of contamination. Selection of the subset of DUs will be determined by the EPA Project Manager, in consultation with the TAI Project Coordinator pending evaluation of received access agreements.

Samples will be collected during a limited seasonal period when climatic conditions would likely exclude the presence of snow on the ground or frozen ground (typically April through October).

1.5 DEVELOP THE ANALYTIC APPROACH

The rationale for choosing the sampling approach for the 2016 Residential Soil Study is the same as the rationale provided for EPA's 2014 study of residential soil with the exception of specific changes to the timing, roles, boundaries, and a limited number of study design elements specified in EPA's directive to TAI (EPA 2015a; 2015b) and based on discussion between EPA and TAI.

With the exception of discrete soil samples, soil samples will be collected from DUs following an IC sampling design. Potential exposure areas that are observed at each residential property will inform the identification and design of property-specific DUs. One or more DUs may be identified for a given residential property depending on the size, features, and usage patterns associated with the property.

Each IC sample will consist of 30 increments. The increments will be collected using a systematic grid to provide uniform spatial coverage over the DU (ITRC 2012). Soil located within the drip lines of structures will not be sampled unless there is concern of lead-based paint. At locations where there is concern of lead-based paint, drip line soil may represent a combination of aerial deposition and lead-based paint contribution and will be sampled.

Data quality objectives for the 2014 study specified collection of discrete soil samples from the 1 to 6 inch depth interval at each property to provide additional information on the vertical nature and extent of contamination at selected DUs. Evaluation of the 2014 discrete soil sample results suggests a high degree of variability among core samples within the same DU and weak correspondence with IC sample results at the same DU. Because the IC sample depth at most of the DUs designated for discrete sample collection was 0 to 1 inch, the lack of discrete data for the 0 to 1 inch depth interval contributed to uncertainty regarding correspondence of the IC and discrete sample results, further limiting the interpretive value of the 1 to 6 inch discrete sample data with regard to the vertical nature and extent of contamination. Given these factors, the 2016 Residential Soil Study will collect discrete samples from the 0 to 1 inch and 1 to 6 inch depth intervals in a representative subset of DUs where the IC sampling depth is 0 to 1 inch. Selection of the representative subset of DUs will be determined by the EPA Project Coordinator, in consultation with the TAI Project Coordinator. Collection of these samples will allow for comparison to data collected in the 2014 study and are expected to reduce uncertainty regarding interpretation of the 2014 discrete sample results for evaluation of the vertical nature and extent of contamination.

Areas near paved and compacted gravel roadways and railways will be avoided to prevent sampling soil that may be contaminated by non-air sources; a 50-foot buffer in either direction from the center line of these features will be established. Sample placement on unpaved roads and driveways will also be avoided. TAL metals (no mercury) and lead and arsenic bioaccessibility[3] will be measured. TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead,

3 Bioaccessibility testing will only be run for increment composite samples that have a lead or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively.

magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

1.6 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

The goal of this step is to define performance or acceptance criteria to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels. For this study, performance and acceptance criteria will apply to generating appropriate and acceptable data for use during risk assessment activities and providing sufficient data to reduce uncertainty and the probability for false positive or false negative decision errors. The same performance and acceptance criteria applied by EPA during the 2014 study of residential soil will be applied to this study.

1.7 DEVELOP THE DETAILED PLAN FOR OBTAINING DATA

This final step is the development of a resource-effective design for collecting the proposed samples in a manner that will achieve the specified performance criteria. The plan for obtaining data is summarized in the study Field Sampling Plan for the 2016 Residential Soil Study. Additionally, because field sampling methods associated with this study involve soil collection, penetration, and disturbance, TAI and its technical team will work with potentially affected parties to assess the effects of the planned work and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. A cultural resources coordination plan has been prepared to provide relevant background information about site-related cultural resources, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and tribal parties with interests in the cultural resources of the site.

2 REFERENCES

CH2M Hill 2015. FINAL UCR Residential Soil Study Field Sampling and Data Summary Report. October.

EPA 2003. Superfund Lead-Contaminated Residential Sites Handbook. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. OSWER Directive 9285. 7-50. August. Available online at: http://www.epa.gov/superfund/lead/products/handbook.pdf.

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EPA 2007. Estimation of Relative Bioavailability of Lead Soil and Soil-like Materials using In Vivo and In Vitro Methods. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC. May. Available online at: http://www.epa.gov/superfund/health/contaminants/bioavailability/lead_tsd_main.pdf.

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EPA 2015b. November 5, 2015 Letter from Laura C. Buelow, EPA Project Coordinator, to Kris McCaig, TAI Project Coordinator detailing EPA's proposed changes to the residential soil sampling QAPP for 2016 based on EPA's 2014 residential soil sampling results.

ITRC 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. Interstate Technology and Regulatory Council: Washington, DC. 475 pp. Available online at: http://www.itrcweb.org/gd.asp.

Kissel J, Richter K and Fenske R 1996. "Factors affecting soil adherence to skin in hand-press trials." Bulletin of Environmental Contamination and Toxicology 56(5): 722-728.Ruby M and Lowney Y 2012. Selective soil particle adherence to hands: Implications for understanding oral exposure to soil contaminants. Environ. Sci. Technol. 46(23): 12759–12771.

Ruby M and Lowney Y 2012. Selective soil particle adherence to hands: Implications for understanding oral exposure to soil contaminants. Environ. Sci. Technol. 46(23): 12759–12771.

SRC Inc. 2014. Quality Assurance Project Plan, Upper Columbia River Residential Soil Study, Washington State. Prepared for EPA Region 10 and ERT. Prepared by SRC, Inc. for Lockheed Martin SERAS Program. August 13, 2014.

Stevens County, WA property data obtained via contacting Stevens County Assessor's Office. http://www.co.stevens.wa.us/assessor/assessor.htm

Windward et al. 2015. Upper Columbia River, Final Soil Study Data Summary Report. Prepared by Windward Environmental LLC in association and consultation with Exponent, Parametrix, Inc., and Ramboll ENVIRON. October.

ATTACHMENT B

RESIDENTIAL SOIL STUDY
HUMAN HEALTH RISK-BASED CONCENTRATIONS

Table B-1. Human Health Risk-Based Concentrations

Analyte	CASRN	Residential Soil Screening Levels[a] Carcinogenic SSL TR=1.0E-6 (mg/kg)	Residential Soil Screening Levels[a] Noncarcinogenic SSL HI=1 (mg/kg)	RBC (mg/kg)
Aluminum	7429-90-5	–	77,400	77,400
Antimony	11071-15-1	–	31.3	31.3[b]
Arsenic (inorganic)	7440-38-2	0.67	21.6	9.67[c]
Barium	7440-39-3	–	15,300	15,300
Beryllium	7440-41-7	1,380	156	156
Cadmium	7440-43-9	1,840	70.3	70.3
Calcium	7440-70-2	–	–	–
Chromium (VI)	18540-29-9	0.301	234	0.301[d]
Cobalt	7440-48-4	368	23.4	23.4
Copper	7440-50-8	–	3,130	3,130
Iron	7439-89-6	–	54,800	54,800
Lead	7439-92-1	–	400	400
Magnesium	7439-95-4	–	–	–
Manganese	7439-96-5	–	1,830	1,830
Nickel (soluble salts)	7440-02-0	12,700	1,550	1,550
Potassium	7440-09-7	–	–	–
Selenium	7782-49-2	–	391	391
Silver	7440-22-4	–	391	391
Sodium	7440-23-5	–	–	–
Thallium	7440-28-0	–	0.782	0.782
Vanadium	7440-62-2	–	394	394
Zinc	7440-66-6	–	23,500	23,500

Notes:

– = EPA's Regional Screening Level Calculator does not provide a value for this analyte.

CASRN = Chemical Abstracts Services Registry Number

HI = hazard index

RBC = risk-based concentration

SSL = soil screening level

TR = target risk

[a] Except as noted, residential soil screening levels calculated using EPA's Regional Screening Level Calculator (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search) and default values for residential exposure factors.

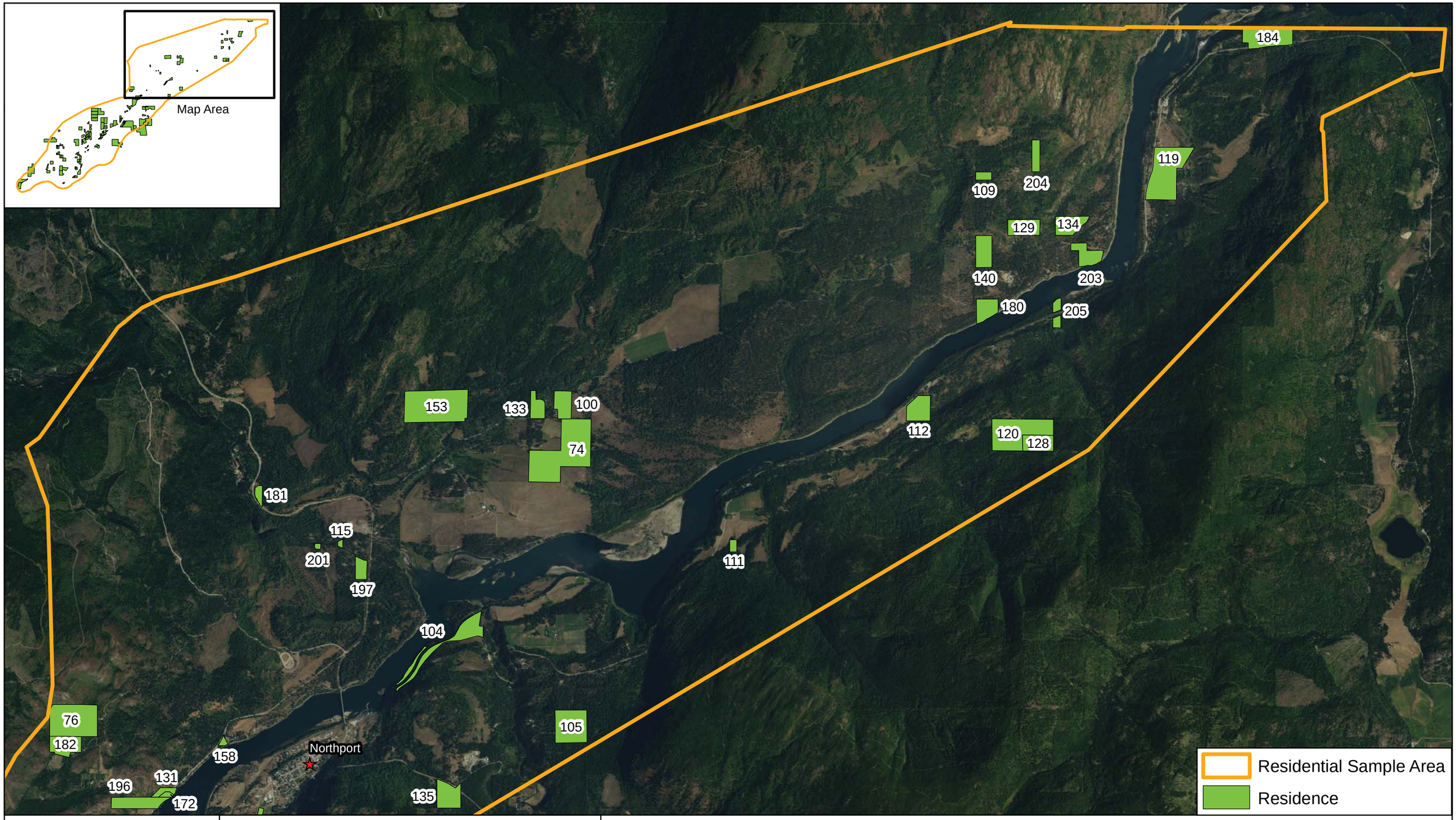
[b] Values are for antimony potassium tartrate based on Diamond and Thayer (2011a). Antimony potassium tartrate is the most common form of antimony found in the environment.

[c] Values were adjusted using the following equation: final Regional Screening Level = 0.67 (1E-6) + 9 (natural background). The project action limit is based on the Washington cleanup level (20 mg/kg).

[d] Values are for chromium VI and are based on a conservative estimate. Adjustments will be made to take into account ratio III:VI in soil for actual risk calculations.

ATTACHMENT C

PROPERTY-SPECIFIC MAPS



Teck

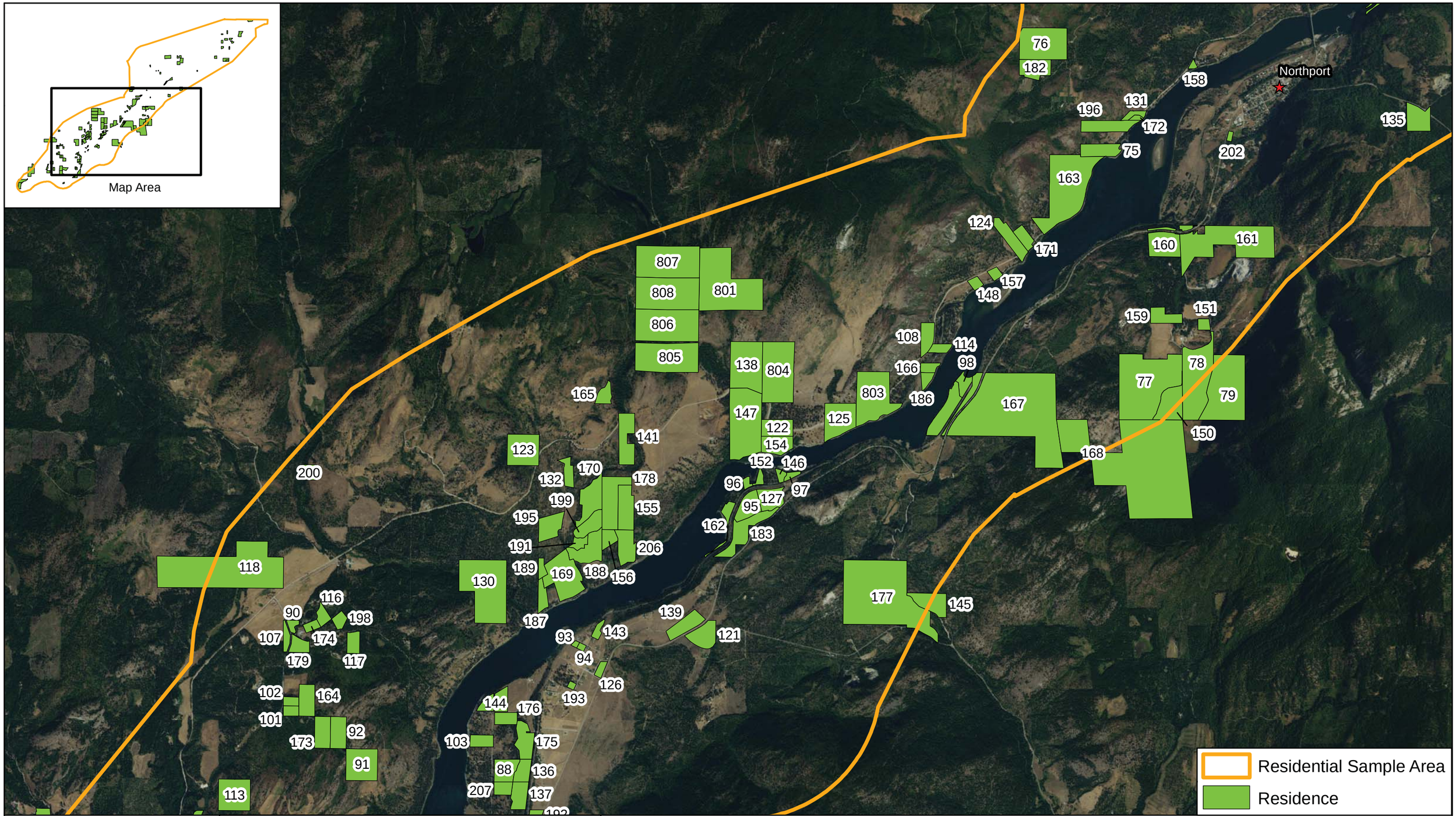
Kilometers
0 1 2

Miles
0 1 2

N

Overview Map 1 2016 Residential Soil Study
Residence Locations

Upper Columbia River, Washington


Map Area
Northport
76
182
158
131
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75
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114
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143
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126
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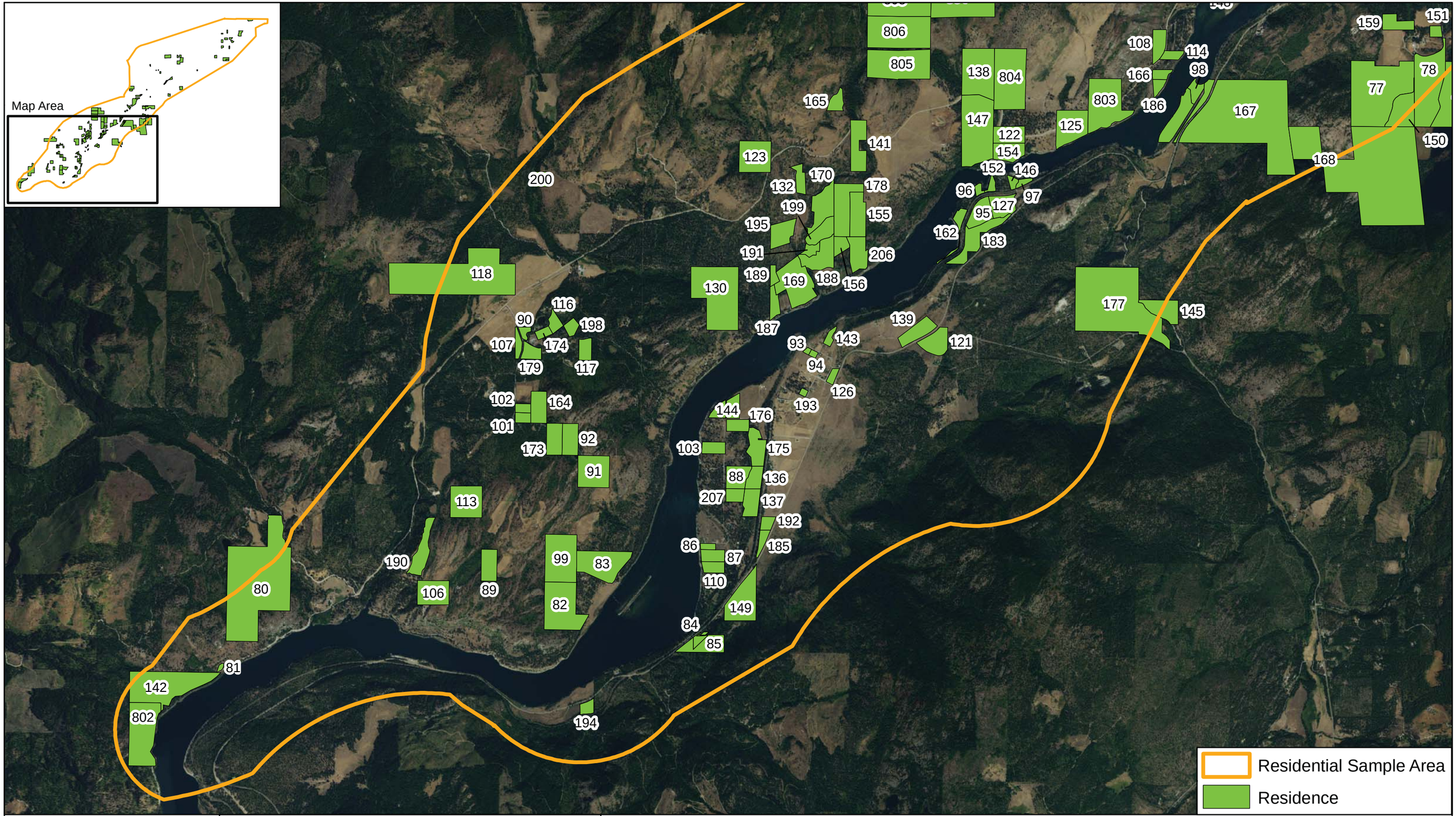
164
101
92
173
91
144
176
193
103
175
88
136
207
137
113
177
145
Residential Sample Area
Residence
Teck
Kilometers
0
1
2
Miles
0
1
2
N
Overview Map 2 2016 Residential Soil Study
Residence Locations
Upper Columbia River, Washington



Teck

Kilometers
0 1 2

Miles
0 1 2

N

Overview Map 3 2016 Residential Soil Study
Residence Locations

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-1. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 075**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-2. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 076 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-3. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 076**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 50 100

Feet
0 300 600

N

Map C-4. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 077 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

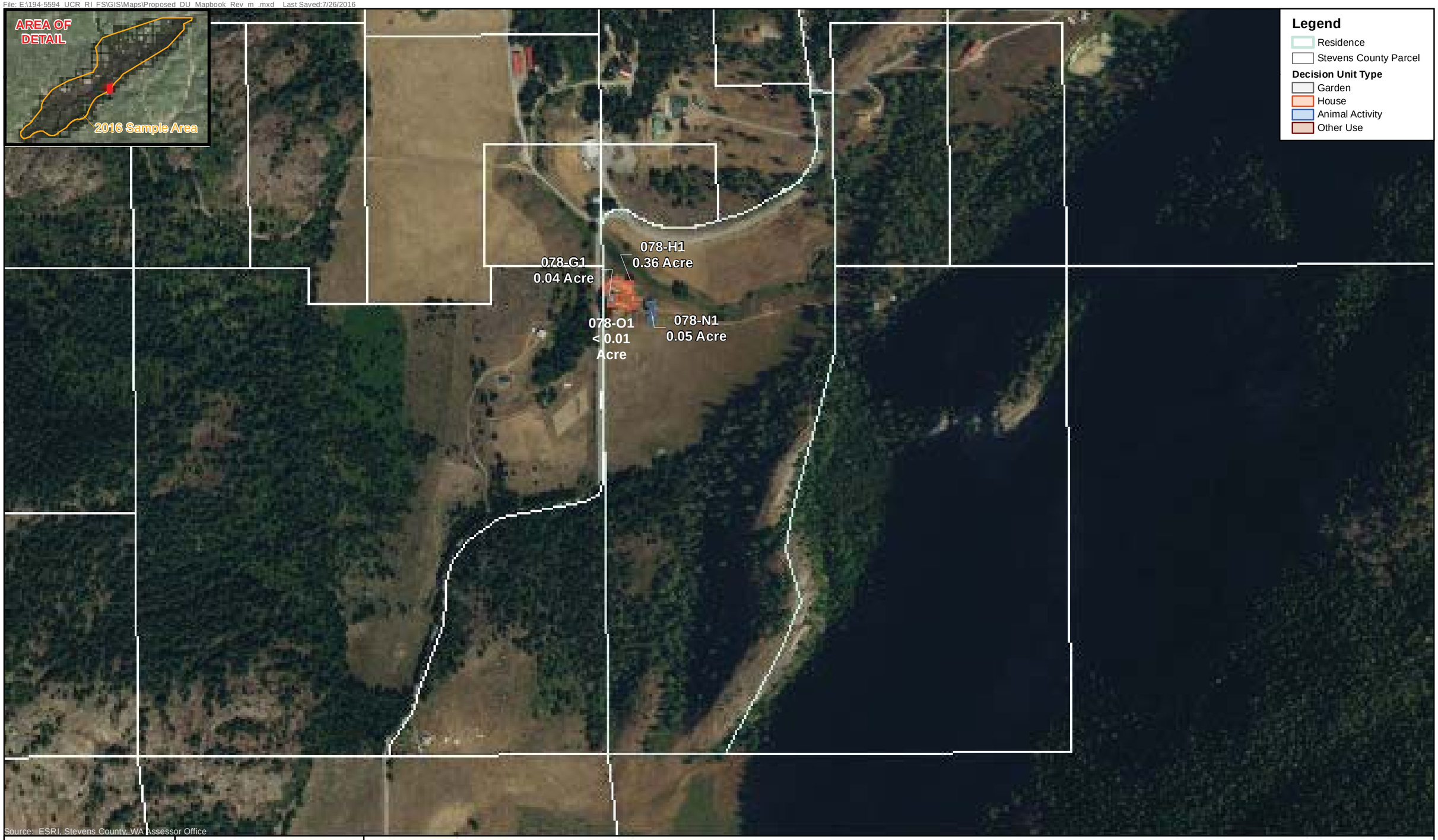
Feet
0 50 100

N

Map C-5. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 077**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 70 140

Feet
0 410 820

N

Map C-6. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 078 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 4.5 9

Feet
0 25 50

N

Map C-7. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 078**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 50 100

Feet
0 300 600

N

Map C-8. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 079 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 6 12

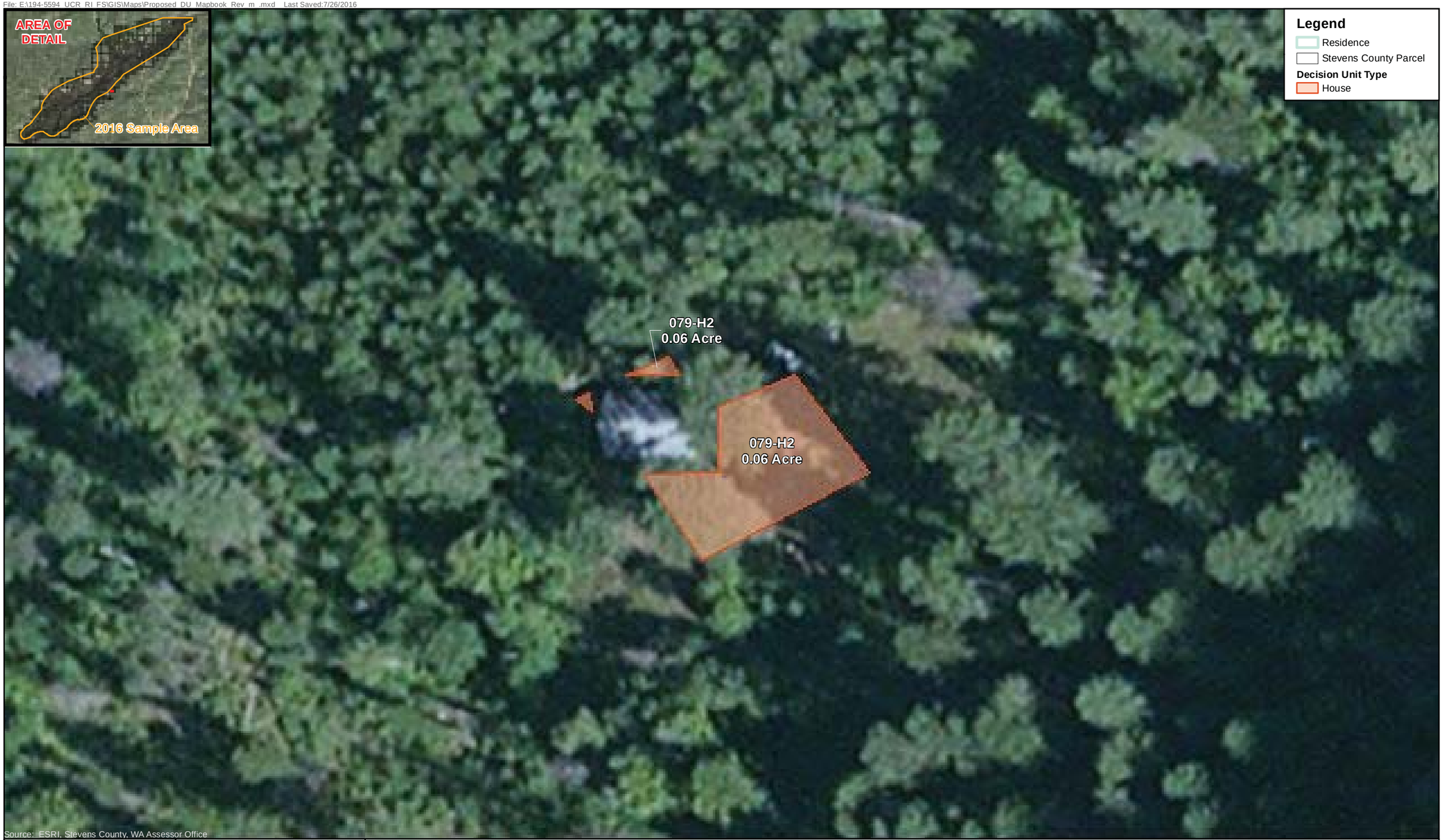
Feet
0 30 60

N

Map C-9. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 079 North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 4.5 9

Feet
0 25 50

N

Map C-10. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 079 South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 100 200

Feet
0 580 1,160

N

Map C-11. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 080 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-12. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 080 North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-13. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 080 South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-14. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 081**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 210 420

N

Map C-15. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 082 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-16. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 082**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 160 320

N

Map C-17. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 083 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 9 18

Feet
0 50 100

N

Map C-18. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 083**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-19. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 084**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 125 250

N

Map C-20. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 085**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-21. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 086**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-22. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 087**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

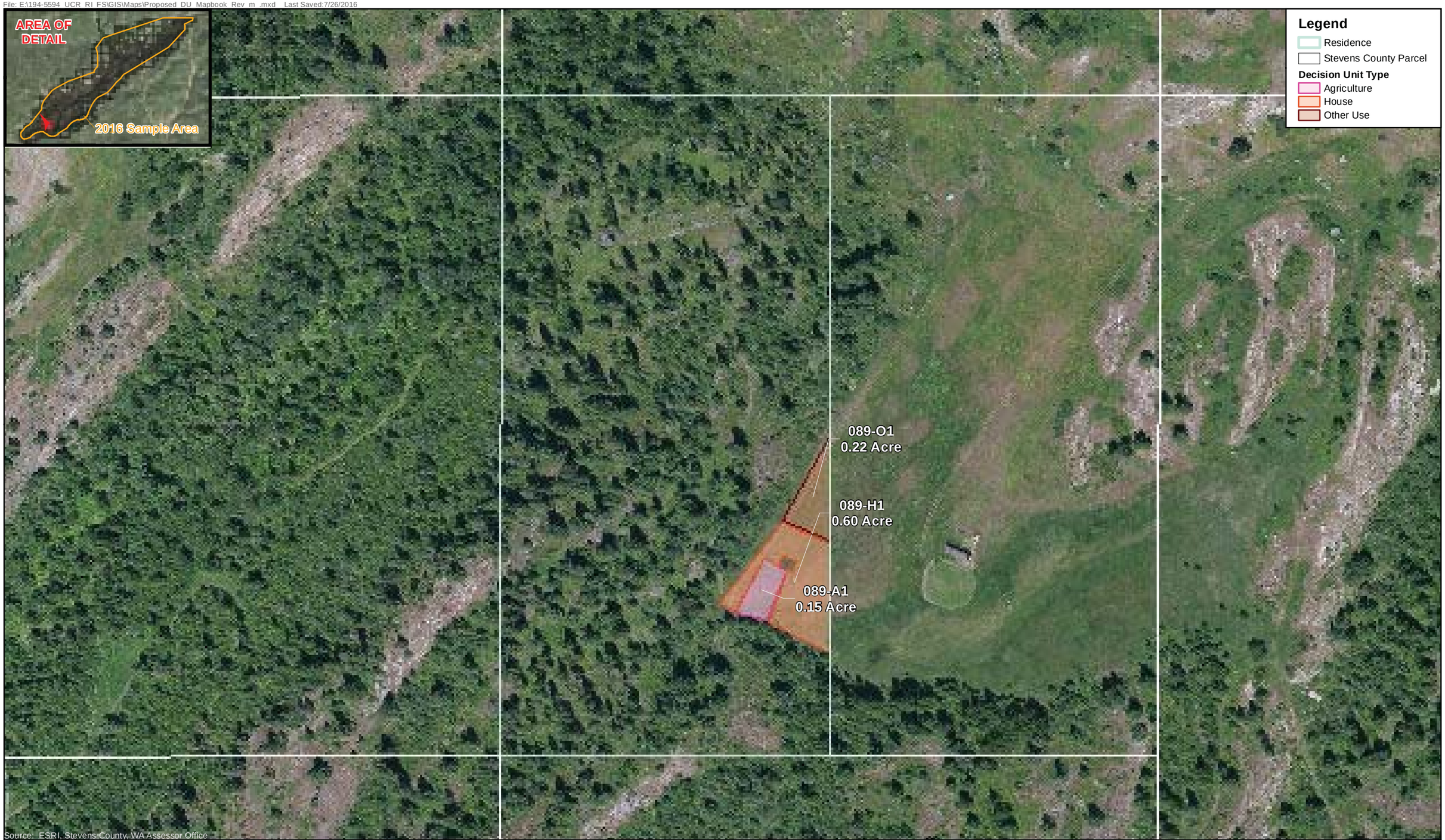
Feet
0 90 180

N

Map C-23. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 088**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-24. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 089**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-25. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 090**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-26. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 091 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-27. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 091**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 140 280

N

Map C-28. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 092**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

Feet
0 30 60

N

Map C-29. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 093**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-30. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 094**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-31. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 095**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-32. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 096**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-33. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 097**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-34. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 098**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

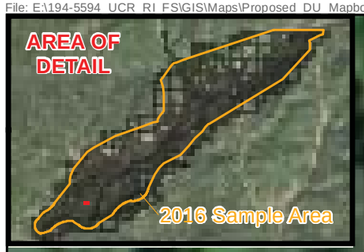
Feet
0 210 420

N

Map C-35. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 099 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Legend

- Residence
- Stevens County Parcel

Decision Unit Type

- Garden
- House
- Other Use

099-G2
< 0.01 Acre

099-G1
< 0.01 Acre

099-H1
0.04 Acre

099-O1
0.04 Acre

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 3.5 7

Feet
0 20 40

N

Map C-36. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 099 - Central**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-37. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 099 - North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 125 250

N

Map C-38. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 100 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-39. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 100**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 9 18

Feet
0 50 100

N

Map C-40. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 101**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-41. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 102**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

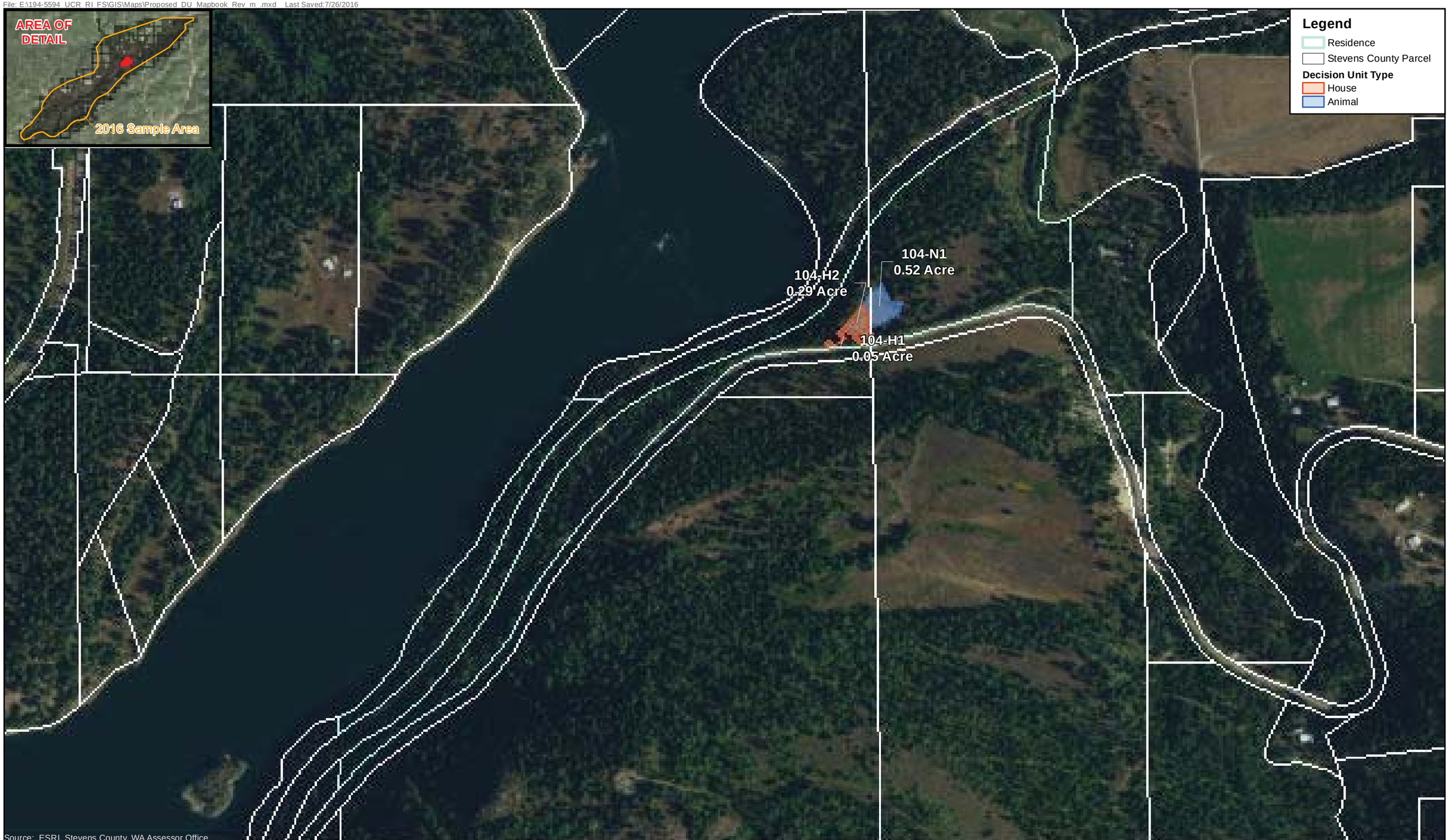
Feet
0 60 120

N

Map C-42. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 103**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 60 120

Feet
0 360 720

N

Map C-43. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 104 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

Feet
0 30 60

N

Map C-44. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 104**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 20 40

Feet
0 140 280

N

Map C-45. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 105**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-46. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 106**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 125 250

N

Map C-47. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 107**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 20 40

Feet
0 130 260

N

Map C-48. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 108**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-49. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 109**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-50. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 110**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-51. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 111**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-52. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 112**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-53. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 113 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-54. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 113**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-55. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 114**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

Feet
0 30 60

N

Map C-56. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 115**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-57. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 116**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-58. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 117**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 50 100

Feet
0 330 660

N

Map C-59. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 118 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-60. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 118**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 240 480

N

Map C-61. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 119 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-62. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 119**
Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 180 360

N

Map C-63. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 120 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-64. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 120**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-65. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 121**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-66. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 122**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 130 260

N

Map C-67. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 123 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-68. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 123**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 200 400

N

Map C-69. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 124 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-70. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 124 - North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 4.5 9

Feet
0 25 50

N

Map C-71. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 124 - South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 180 360

N

Map C-72. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 125 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-73. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 125**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-74. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 126**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-75. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 127**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-76. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 128**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-77. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 129**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 50 100

Feet
0 290 580

N

Map C-78. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 130 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-79. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 130 - South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-80. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 130 - North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: E... Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-81. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 131**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-82. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 132**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-83. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 133**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

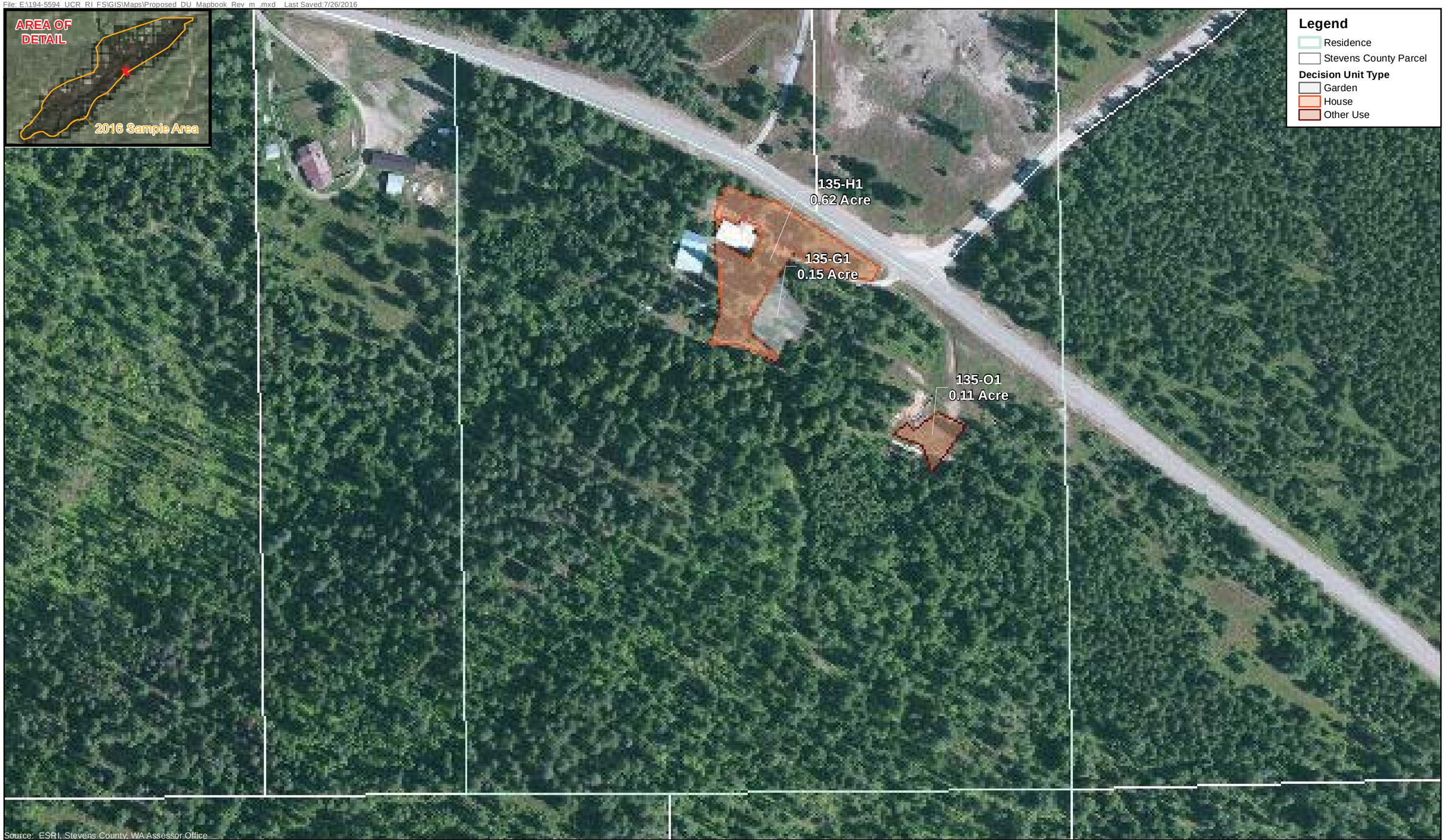
Feet
0 80 160

N

Map C-84. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 134**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-85. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 135**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-86. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 136**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-87. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 137**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 240 480

N

Map C-88. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 138 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-89. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 138**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-90. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 139 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-91. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 139**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-92. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 140 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 9 18

Feet
0 50 100

N

Map C-93. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 140**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 230 460

N

Map C-94. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 141 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-95. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 141**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 240 480

N

Map C-96. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 142 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 3.5 7

Feet
0 20 40

N

Map C-97. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 142**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-98. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 143**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-99. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 144**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-100. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 145**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-101. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 146**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 50 100

Feet
0 325 650

N

Map C-102. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 147 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-103. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 147**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-104. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 148**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 260 520

N

Map C-105. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 149 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-106. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 149**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 225 450

N

Map C-107. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 150 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

Feet
0 30 60

N

Map C-108. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 150**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-109. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 151**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-110. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 152**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 180 360

N

Map C-111. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 153 (Overview)**
Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-112. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 153**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-113. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 154**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 200 400

N

Map C-114. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 155 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-115. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 155 - Detail**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

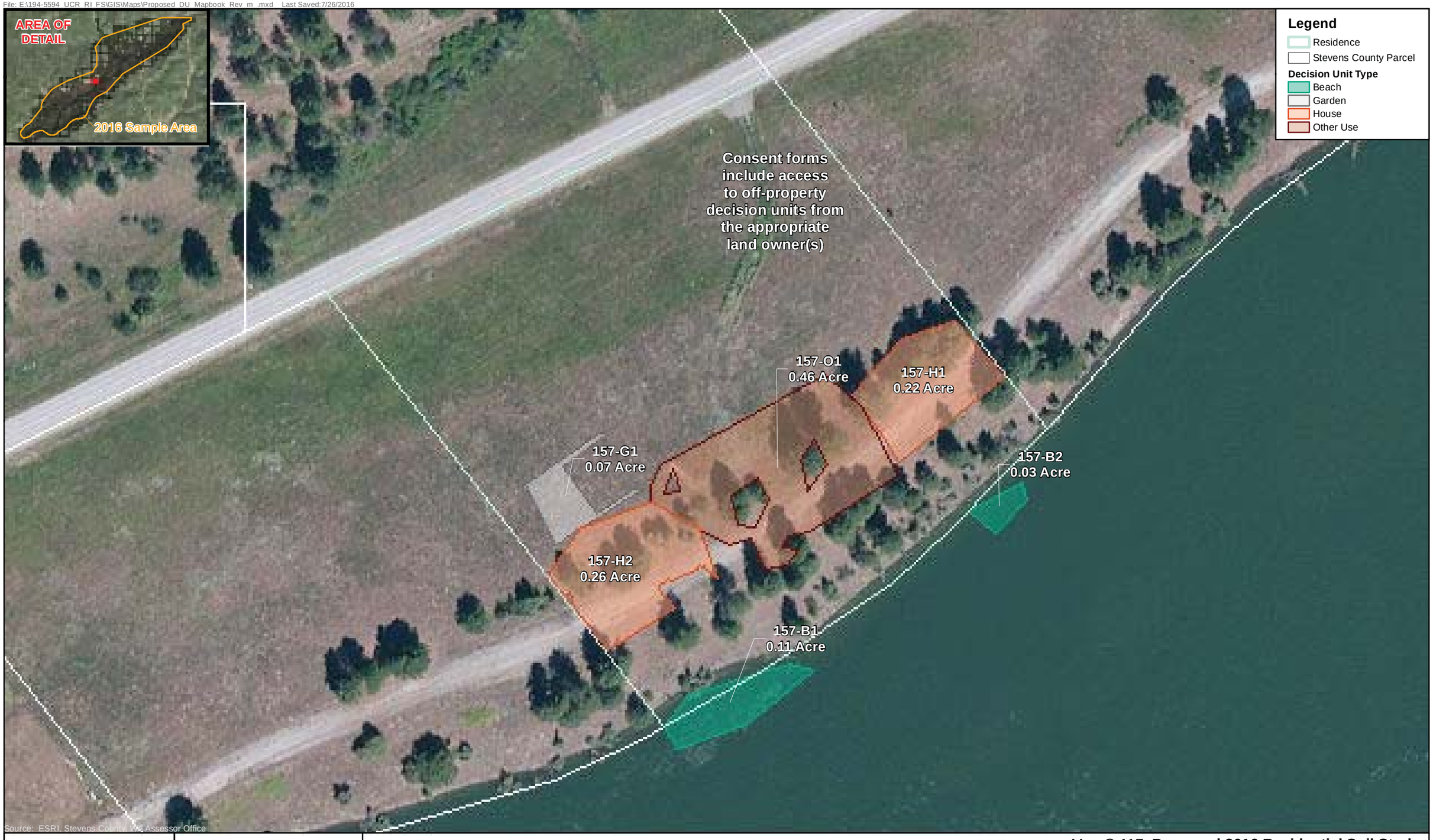
Feet
0 80 160

N

Map C-116. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 156**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-117. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 157**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-118. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 158**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-119. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 159**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-120. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 160**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 270 540

N

Map C-121. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 161 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-122. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 161**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 250 500

N

Map C-123. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 162 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-124. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 162**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 60 120

Feet
0 370 740

N

Map C-125. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 163 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-126. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 163**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-127. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 164**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-128. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 165**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-129. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 166**

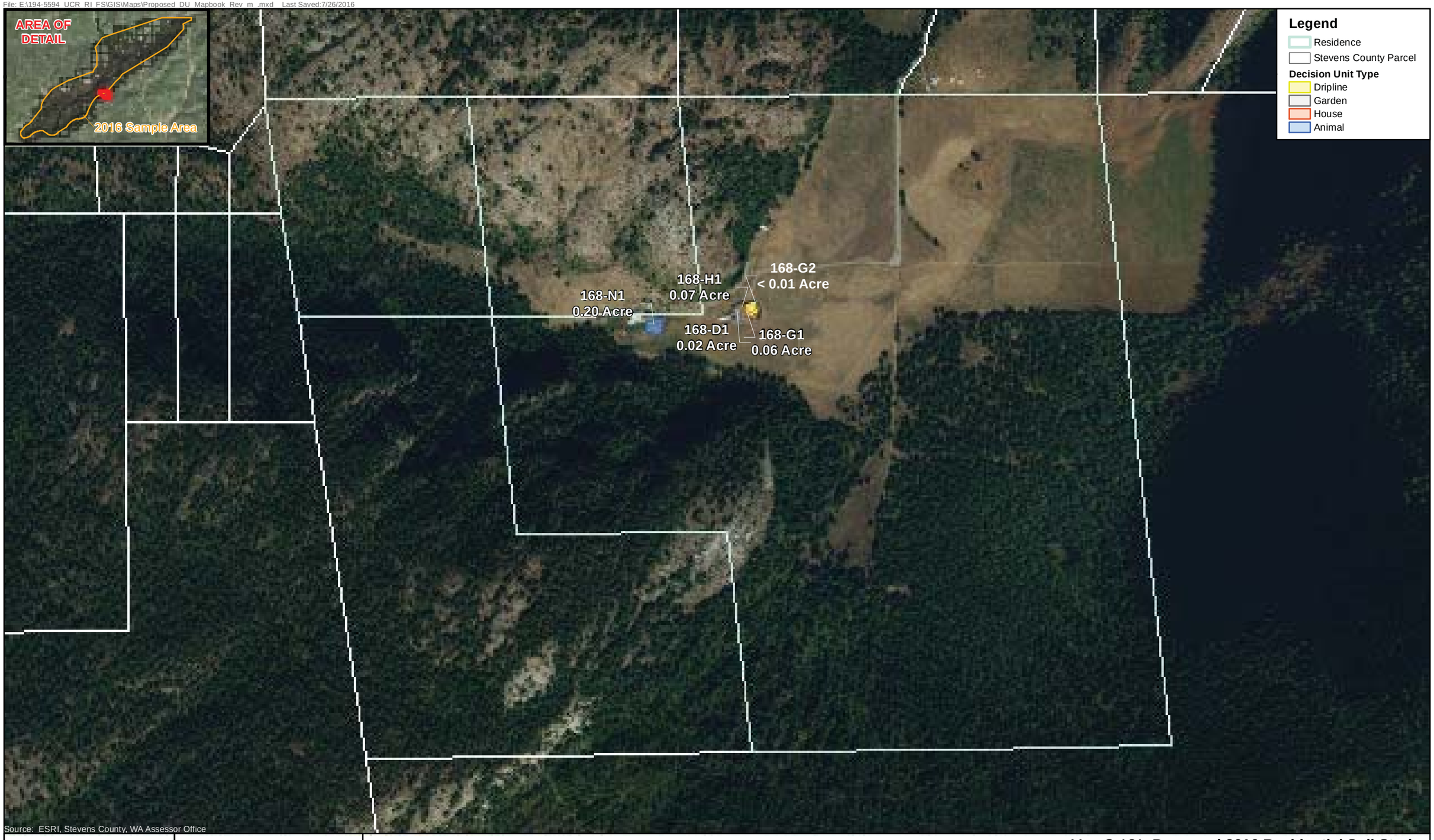
Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Map C-130. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 167**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 75 150

Feet
0 450 900

N

Map C-131. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 168 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-132. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 168**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 240 480

N

Map C-133. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 169 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-134. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 169**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 260 520

N

Map C-135. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 170 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

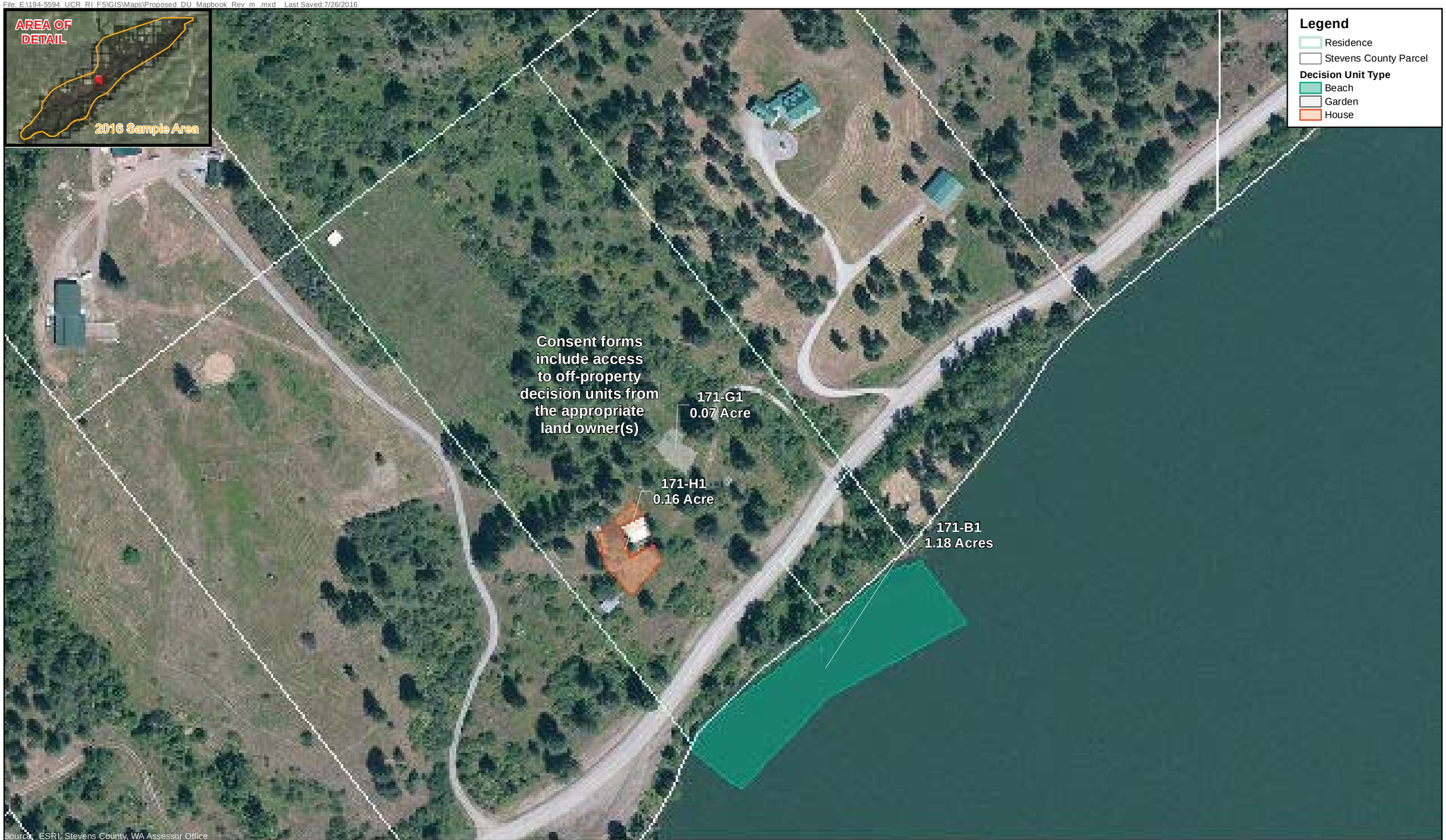
Feet
0 30 60

N

Map C-136. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 170**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-137. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 171**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

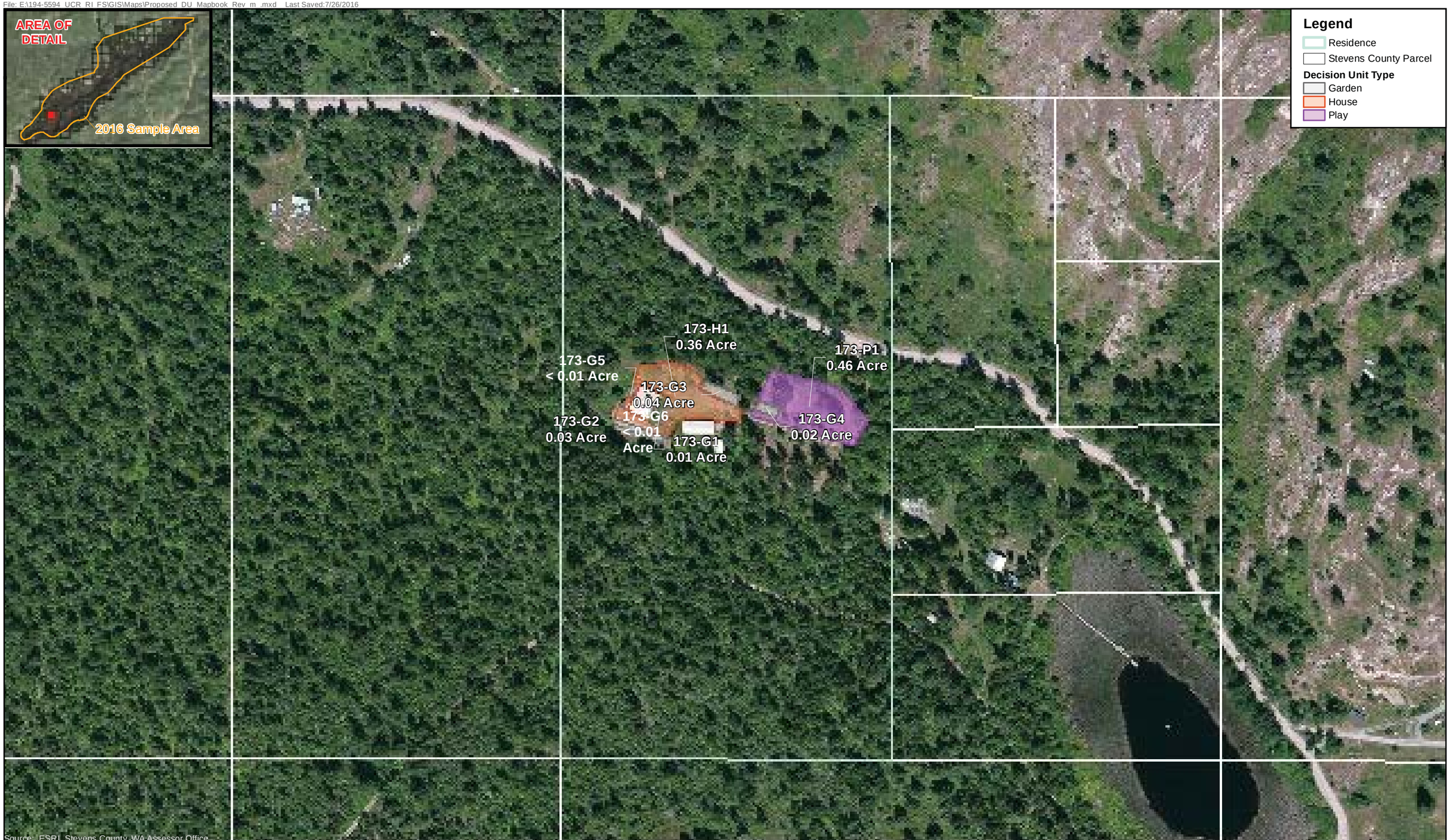
Feet
0 30 60

N

Map C-138. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 172**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-139. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 173 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-140. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 173**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

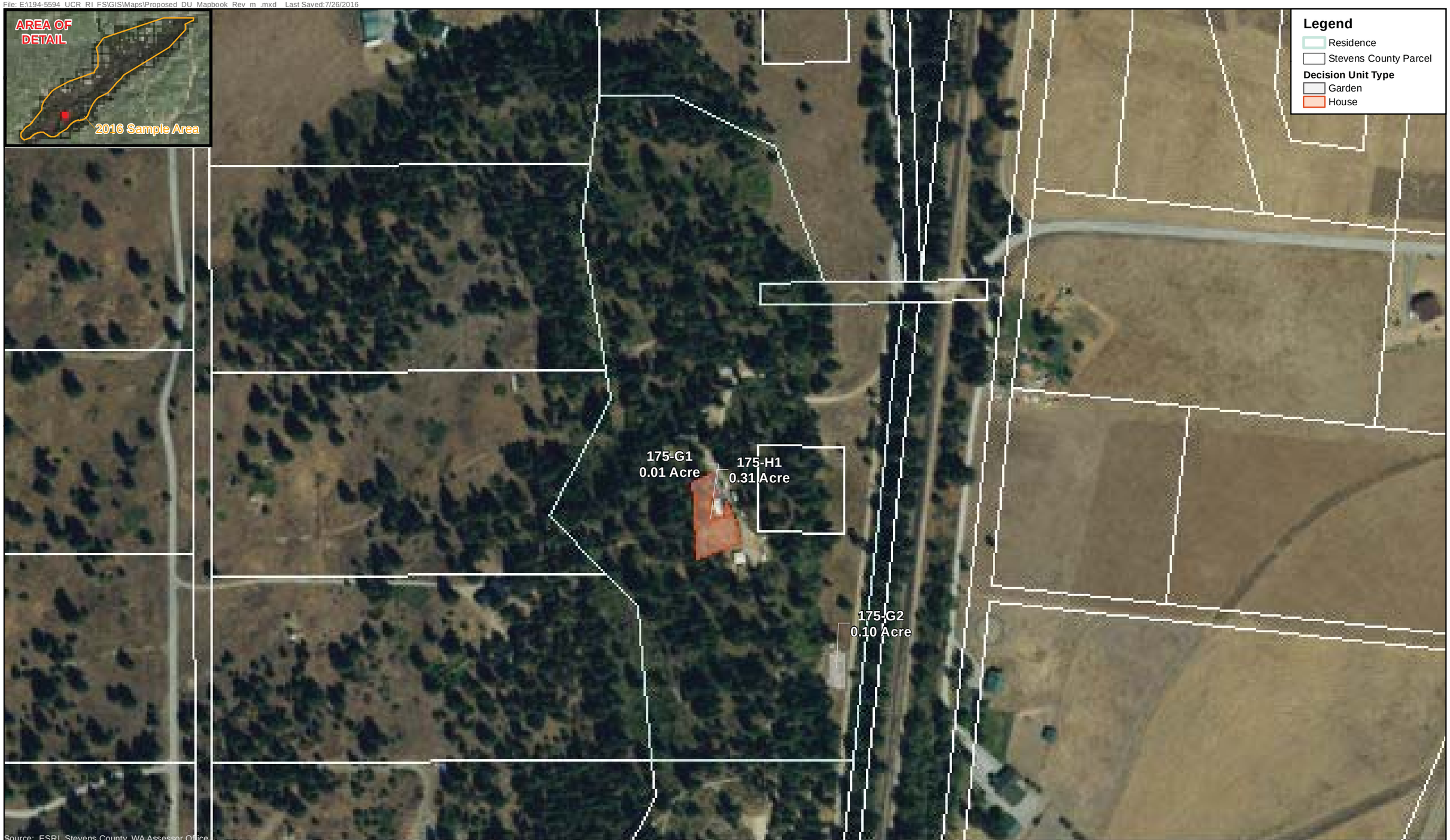
Feet
0 50 100

N

Map C-141. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 174**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 175 350

N

Map C-142. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 175 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-143. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 175**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-144. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 176**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 60 120

Feet
0 375 750

N

Map C-145. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 177 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

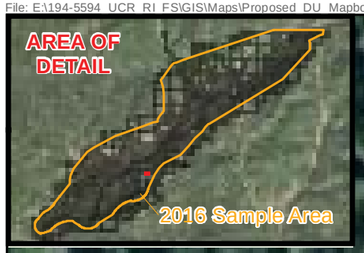
Feet
0 30 60

N

Map C-146. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 177 - South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Legend

Residence

Stevens County Parcel

Decision Unit Type

Garden

177-G1
< 0.01 Acre

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6 12

Feet
0 30 60

N

Map C-147. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 177 - North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 240 480

N

Map C-148. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 178 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-149. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 178**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-150. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 179**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 100 200

N

Map C-151. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 180**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-152. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 181**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 80 160

N

Map C-153. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 182**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 230 460

N

Map C-154. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 183 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10
Feet
0 30 60
N

Map C-155. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 183**
Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 120 240

N

Map C-156. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 184**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-157. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 185 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-158. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 185**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-159. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 186**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

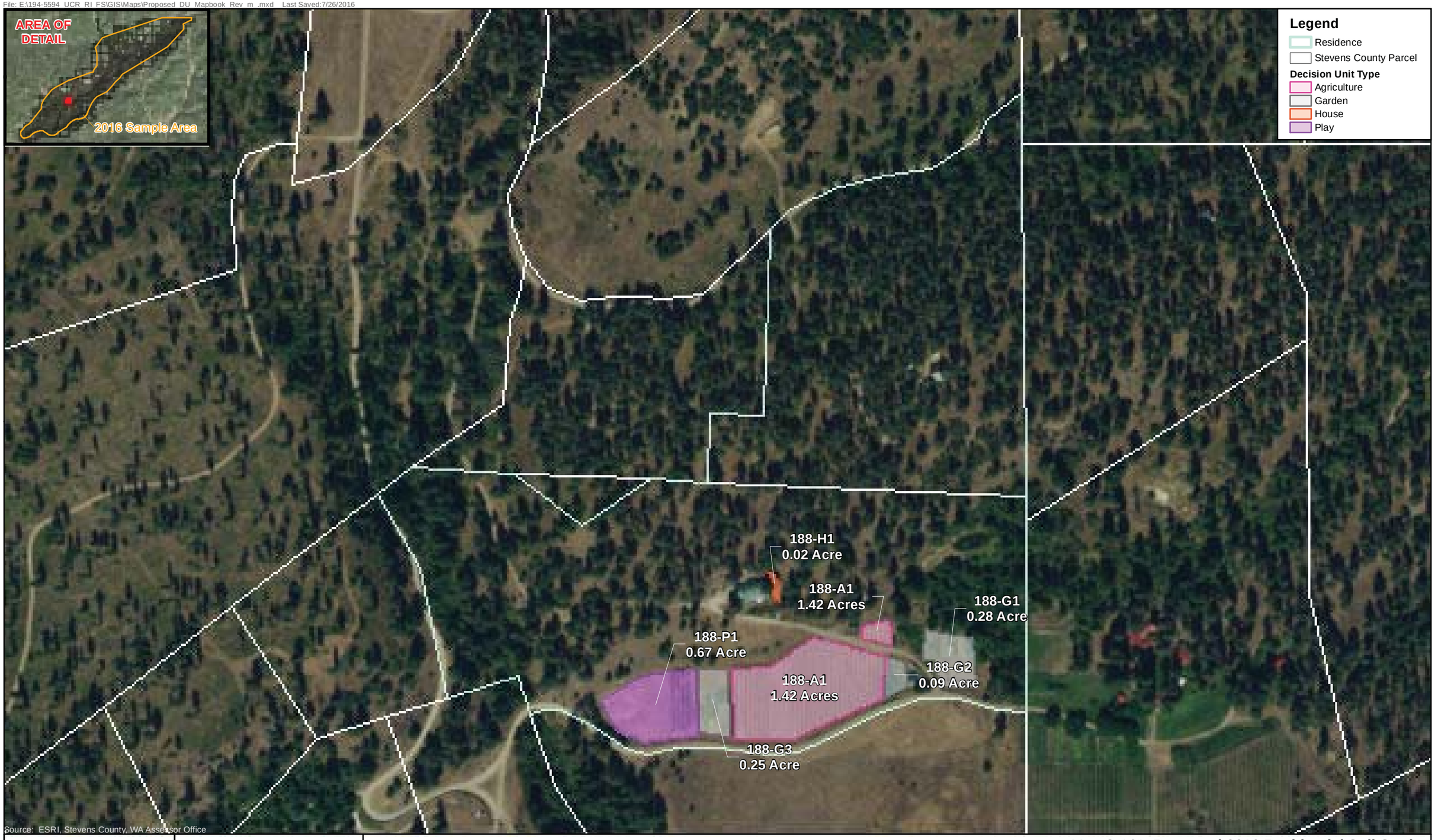
Feet
0 140 280

N

Map C-160. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 187**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 160 320

N

Map C-161. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 188 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-162. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 188**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-163. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 189**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 260 520

N

Map C-164. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 190 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-165. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 190**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-166. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 191**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 50 100

N

Map C-167. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 192**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-168. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 193**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-169. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 194**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 140 280

N

Map C-170. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 195 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-171. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 195**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

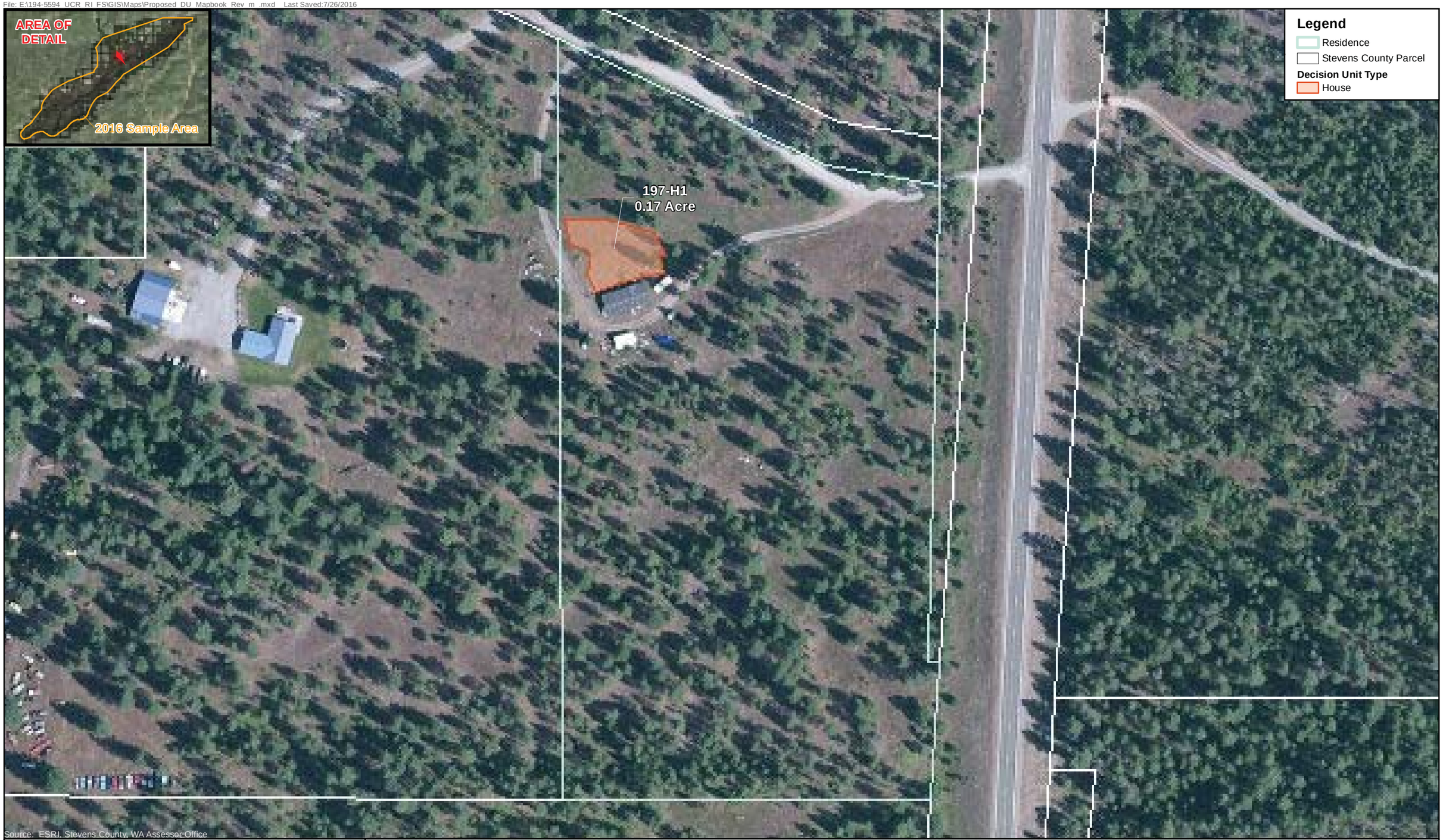
Feet
0 130 260

N

Map C-172. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 196**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016



Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-173. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 197**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-174. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 198**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 110 220

N

Map C-175. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 199**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-176. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 200**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-177. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 201**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-178. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 202**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 90 180

N

Map C-179. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 203**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 125 250

N

Map C-180. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 204**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 20 40

Feet
0 130 260

N

Map C-181. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 205**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 160 320

N

Map C-182. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 206**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-183. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 207**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 280 560

N

Map C-184. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 801 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-185. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 801 - North**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 7.5 15

Feet
0 40 80

N

Map C-186. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 801 - South**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 280 560

N

Map C-187. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 802 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 3.5 7

Feet
0 20 40

N

Map C-188. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 802**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 40 80

Feet
0 250 500

N

Map C-189. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 803 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 75 150

N

Map C-190. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 803**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 40 80

Feet
0 280 560

N

Map C-191. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 804 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

TETRA TECH

Meters
0 10 20

Feet
0 70 140

N

Map C-192. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 804**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 25 50

Feet
0 160 320

N

Map C-193. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 805 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 10 20

Feet
0 60 120

N

Map C-194. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 805**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 175 350

N

Map C-195. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 806 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 8 16

Feet
0 40 80

N

Map C-196. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 806 - East**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 6.5 13

Feet
0 30 60

N

Map C-197. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 806 - West**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 175 350

N

Map C-198. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 807 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 5 10

Feet
0 30 60

N

Map C-199. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 807**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 30 60

Feet
0 175 350

N

Map C-200. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 808 (Overview)**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 9 18

Feet
0 50 100

N

Map C-201. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 808 - East**

Upper Columbia River, Washington

File: E:\194-5594_UCR_RI_FS\GIS\Maps\Proposed_DU_Mapbook_Rev_m_.mxd Last Saved:7/26/2016

Source: ESRI, Stevens County, WA Assessor Office

TETRA TECH

Meters
0 9 18

Feet
0 50 100

N

Map C-202. **Proposed 2016 Residential Soil Study Decision Unit Locations for Residence 808 - West**

Upper Columbia River, Washington

ATTACHMENT D

FIELD SAMPLING PLAN FOR THE UPPER COLUMBIA RIVER RESIDENTIAL SOIL STUDY

CONTENTS

LIST OF FIGURES ..... **D-iv**
LIST OF TABLES ..... **D-iv**
ACRONYMS AND ABBREVIATIONS ..... **D-v**
UNITS OF MEASURE ..... **D-vi**
1 INTRODUCTION **D-1-1**
1.1 PURPOSE AND OBJECTIVES D-1-2
1.2 DOCUMENT ORGANIZATION D-1-2
2 FIELD INVESTIGATION APPROACH **D-2-1**
2.1 GENERAL OVERVIEW D-2-1
2.2 RATIONALE FOR SAMPLING DESIGNS D-2-1
2.3 RATIONALE FOR ANALYTE LIST D-2-2
2.4 SUMMARY OF SAMPLING ACTIVITIES D-2-2
2.5 PROJECT ORGANIZATION D-2-18
2.6 PROJECT COMMUNICATIONS D-2-18
3 FIELD PROCEDURES **D-3-1**
3.1 TASKS TO BE PERFORMED D-3-1
3.2 FIELD EQUIPMENT AND SUPPLIES D-3-1
3.3 IC SOIL SAMPLE COLLECTION D-3-2
3.4 DISCRETE SAMPLE COLLECTION D-3-4
3.5 QA/QC SAMPLE COLLECTION D-3-4
3.5.1 Replicates of IC Samples D-3-5
3.5.2 Discrete Sample Field Duplicates D-3-5
3.5.3 Equipment Rinsate Blank D-3-5
3.5.4 MS/MSD Samples D-3-5
3.6 INDIVIDUAL SAMPLE IDENTIFICATION NUMBERS D-3-5
3.6.1 Soil Samples D-3-6
3.6.2 Equipment Rinsate Blank Samples D-3-8
3.7 SAMPLE MANAGEMENT D-3-8
3.8 EQUPMENT DECONTAMINATION D-3-9
3.9 MANAGEMENT OF INVESTIGATION-DERIVED WASTE D-3-10
3.10 FIELD DOCUMENTATION D-3-10
3.10.1 Field Forms D-3-10
3.10.2 Field Logbook D-3-10
3.10.3 Chain-of-Custody Procedures D-3-11
3.11 DIGITAL PICTURES D-3-13
4 REFERENCE **D-4-1**

Attachment D1. Discrete Decision Unit Selection Approach Memorandum, Field Forms, Sample Receipt, and the Washington State Real Estate Disclosure Requirements
Attachment D2. Standard Operating Procedures
Attachment D3. Health and Safety Plan

LIST OF FIGURES

Figure D1. UCR Soil Study Area
Figure D2. Study Organizational Chart

LIST OF TABLES

Table D1. Summary of Residential Soil Sampling Program
Table D2. Residential Soil Sampling Program by Property Owner
Table D3. Field Sample Volumes, Containers, Preservatives, and Hold Times

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CD	compact disc
DU	decision unit
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
GPS	global positioning system
Hg	mercury
HHRA	human health risk assessment
ID	identification
SHSP	site health and safety plan
IC	Incremental composite
IDW	investigation derived waste
ITRC	Interstate Technology and Regulatory Council
IVBA	in vitro bioaccessibility assay
MS/MSD	matrix spike/matrix spike duplicate
MIST	Multi-Incremental Sampling Tool
PPE	personal protective equipment
QAPP	quality assurance project plan
QA/QC	quality assurance and quality control
QC	quality control
RI/FS	remedial investigation and feasibility study
SOP	standard operating procedure
TAI	Teck American Incorporated
TAL	target analyte list
UCR	Upper Columbia River
VSP	visual sampling plan

UNITS OF MEASURE

cm	centimeter(s)
ft	foot/feet
g	gram(s)
gal	gallon(s)
g/cm^3	gram(s) per cubic centimeter
in.	inch(es)
lb	pound(s)
m	meter(s)
mg/kg	milligram(s) per kilogram
mL	milliliter(s)
mm	millimeter(s)
μm	micrometer(s)
oz	ounce(s)

1 INTRODUCTION

The objective of the 2016 Upper Columbia River (UCR) Residential Soil Study is to generate analytical data for soil samples that will be used to refine exposure estimates for residents living within the study area, including gardeners and tribal members, to support the human health risk assessment (HHRA). This study expands the geographic boundaries of a residential soil study conducted by the U.S. Environmental Protection Agency (EPA) in 2014 and includes properties within the 2014 boundary that were not previously sampled. The current study area extends from the U.S.-Canada border to just south of China Bend, Washington (UCR Study Area, Figure D1). Teck American Incorporated (TAI) sent letters to property owners within the UCR Study Area requesting access for field reconnaissance and sampling activities. Participation of property owners in the study is voluntary.

Soil sampling will be focused on residential property locations where there is a high potential for exposure by residents, especially young children, based on activities determined from interviews and site visits. Young children and gardeners are most likely to be exposed to metals in soil via ingestion of fine soil particles that adhere to skin. Soil samples collected during the Residential Soil Study will be analyzed for target analyte list (TAL) metals (except mercury).[1] Some samples will also be submitted for in vitro bioaccessibility assay (IVBA) analysis of lead and arsenic in soil.[2]

The field efforts for this study consist of a field reconnaissance phase and a field sampling phase. The reconnaissance phase occurred in the spring of 2016 and consisted of visiting each property where landowners agreed to participate in the study in order to observe property features and to interview the landowner or resident to determine the locations for sampling decision units (DUs). The sampling phase will occur in the summer of 2016 and consist of collecting incremental composite (IC) soil samples at the DUs established for each property. Discrete core soil samples will also be collected at some DUs.

[1] TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. Project action limits are listed in the Residential Soil Study Quality Assurance Project Plan (QAPP) Addendum No. 1, Worksheet #15, and are based on risk-based concentrations for residential soil summarized in Attachment D to the QAPP addendum.

[2] Bioaccessibility testing will be performed at a frequency of 20 percent of DUs where one or more IC samples have a lead and/or arsenic concentration greater than or equal to 100 or 20 mg/kg, respectively.

The Residential Soil Study represents one of the tasks that will be completed as part of the UCR remedial investigation and feasibility study (RI/FS). The RI/FS is being conducted under a Settlement Agreement between TAI and EPA.

1.1 PURPOSE AND OBJECTIVES

The purpose of this field sampling plan (FSP) is to document the approach and field procedures to execute field sampling activities. Analytical data for samples collected during the sampling effort will be primarily used to assess residential exposure to metals in surface soil. Some of the data will also be used for comparison with discrete core sample results collected during EPA's 2014 study of residential soils (CH2M HILL 2015) to provide information on the vertical nature and extent of metals in soil at sampled locations.

The rationale and decision logic for selecting the number, size, and sample depth for DUs at the properties are described in the Residential Soil Study Quality Assurance Project Plan, Upper Columbia River, Washington State, Addendum No. 1 (QAPP Addendum). Property-specific details, including the locations and sizes of the sampling DUs, were determined during the field reconnaissance phase.

1.2 DOCUMENT ORGANIZATION

This FSP has been developed as a support document for the QAPP Addendum. This FSP constitutes Attachment D of the QAPP Addendum.

In addition to this introduction, the FSP includes the following sections and attachments:

- Section 2 presents the approach for the field investigation.
- Section 3 details the sampling tasks and data collection procedures.
- Section 4 provides references used in the development of this FSP.
- Attachment D1 presents a summary of the approach used to select specific DUs for collection of discrete soil samples, project-specific field forms for field sampling, sample receipt, and the Washington State real estate disclosure requirements to be provided to property owners.
- Attachment D2 contains the standard operating procedures (SOPs) for sample collection and field documentation.
- Attachment D3 contains the General Site Health and Safety Plan (SHSP) for the project.

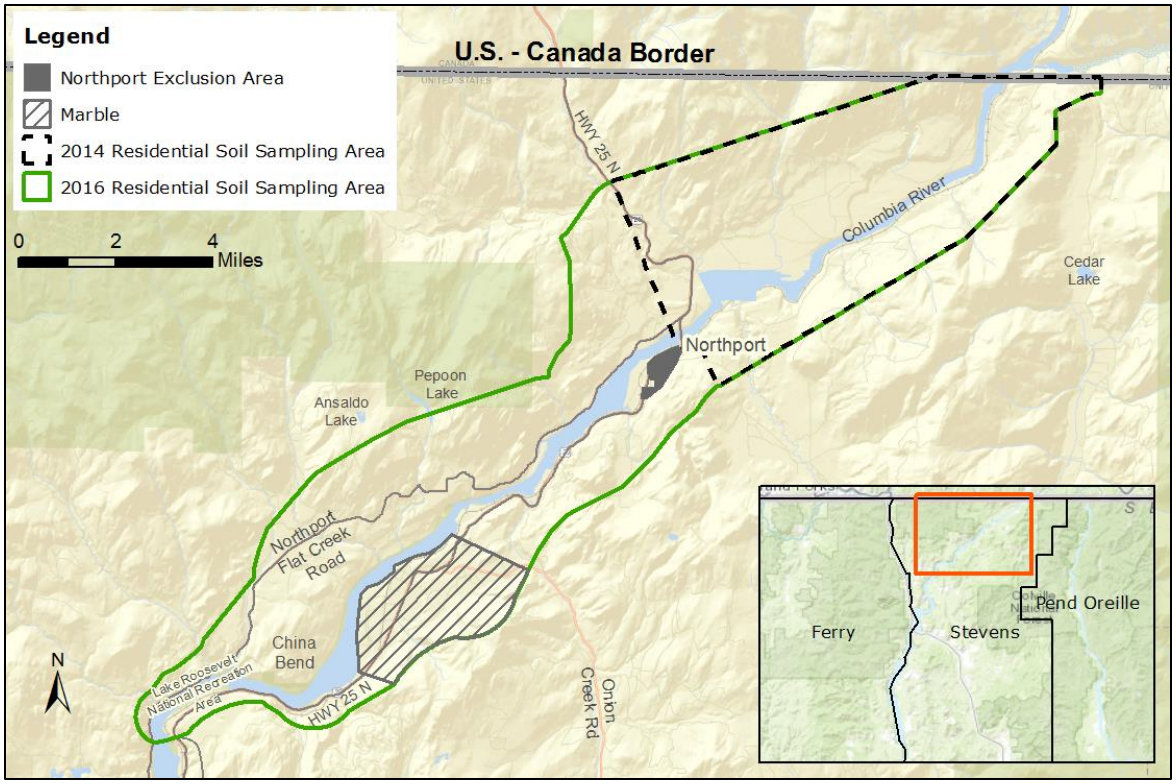


Figure D1. UCR Soil Study Area

2 FIELD INVESTIGATION APPROACH

This section provides information about the design of the Residential Soil Study.

2.1 GENERAL OVERVIEW

The objective of the Residential Soil Study is to collect data to support refinement of exposure estimates for residents in the UCR Study Area to support the HHRA. Specifically, soils will be collected from rural residential properties not previously sampled within the UCR Study Area (see Figure D1). Using IC sampling methods, soil samples will be collected from locations where there is a high potential for exposure by residents, especially young children, based on activities determined from interviews and site visits. Young children and gardeners are most likely to be exposed to metals as a result of ingestion of fine soil particles that adhere to skin. Additionally, in a subset of DUs with an IC sample depth of 0 to 1 in. below ground surface (bgs), discrete core samples will be collected from depths of 0 to 1 in. and 1 to 6 in. bgs (Attachment D1). The discrete core samples will be collected to provide data for comparison to EPA's 2014 discrete core dataset, which were collected to support evaluation of the vertical nature and extent of contamination in residential soils within the study area. Soil samples collected during the Residential Soil Study will be analyzed for TAL metals (except mercury). Some IC samples will also be submitted for IVBA analysis of lead and arsenic in soil.

2.2 RATIONALE FOR SAMPLING DESIGNS

The rationale for the sampling designs to be employed during the Residential Soil Study is detailed in Worksheet #17 (Sampling Design and Rationale) of the QAPP Addendum. The sampling design for each DU takes into account the anticipated depth of exposure to soil, with IC sampling depths of 0 to 1 in., 0 to 3 in., 0 to 6 in., and 0 to 12 in. bgs. Discrete soil samples will also be obtained at depths of 0 to 1 in. and 1 to 6 in. bgs in selected DUs within the UCR Study Area (Attachment D1).

The locations and extent of sampling DUs at each property were determined based on property-specific information obtained during field reconnaissance conducted in April and May 2016.

2.3 RATIONALE FOR ANALYTE LIST

Target analytes for the Residential Soil Study include TAL metals (except mercury) and lead and arsenic bioaccessibility in soil. These analytes were targeted for consistency with the analyte list selected for EPA's 2014 residential soil study.

2.4 SUMMARY OF SAMPLING ACTIVITIES

Soil sampling will be conducted at approximately 141 residential properties located in the study area. The majority of the samples will be collected using an IC sampling methodology. IC sampling entails the collection of multiple individual volumes of soil (termed "increments") from a target area (i.e., a DU) that are composited and subsampled prior to laboratory analysis (ITRC 2012). Discrete soil samples will also be obtained at a subset of DUs where the IC sample depth is 0 to 1 in. bgs (Attachment D1). The overall field sampling program is summarized in Table D1 and detailed in Table D2, which due to its size appears after the main text of the FSP.

Because field sampling methods associated with this investigation involve penetration and disturbance of the ground surface, the field teams will include cultural observers who will assess the effects of the planned work and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. A cultural resources coordination plan has been prepared to describe known or likely physical impacts of proposed sediment/soil sampling, provide relevant background information, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and tribal parties with interests in the cultural resources of the UCR Study Area and surrounding areas for this study. The plan is provided as Attachment H to the QAPP Addendum for this study.

Table D1. Summary of Residential Soil Sampling Program

Total Properties	Total Decision Units	Decision Unit Size Range (acres)	Total Incremental Composite Samples	Total Discrete Samples
141	448	<0.01 to 5.54	730	348

Table D2. Residential Soil Sampling Program by Location[1]

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
075	075-H1	House	0.11	0-1	3			
075	075-A1	Agriculture Area	3.66	0-1	1			
075	075-O1	Other	1.15	0-1	1			
075	075-B1	Beach	0.21	0-6	1			
076	076-H1	House	0.28	0-1	1			
076	076-H2	House	0.50	0-1	3			
076	076-D1	Lead-Based Paint Concern	0.01	0-1	1			
076	076-G1	Garden	0.05	0-12	1			
076	076-G2	Garden	0.11	0-12	1			
076	076-N1	Animal/Livestock	0.12	0-3	1			
077	077-H1	House	1.18	0-1	1			
077	077-H2	House	0.44	0-1	3			
077	077-D1	Lead-Based Paint Concern	0.02	0-1	1			
077	077-G1	Garden	0.81	0-12	1			
077	077-N1	Animal/Livestock	0.39	0-3	1			
077	077-A1	Agriculture Area	0.27	0-1	1			
077	077-A2	Agriculture Area	0.13	0-1	1			
078	078-H1	House	0.36	0-1	3	0-1, 1-6	5, 5	1, 1
078	078-G1	Garden	0.04	0-12	1			
078	078-O1	Other	<0.01	0-1	1			
078	078-N1	Animal/Livestock	0.05	0-3	1			
079	079-H1	House	0.36	0-1	1			
079	079-H2	House	0.06	0-1	3			
080	080-H1	House	0.03	0-1	1			
080	080-O1	Other	0.12	0-1	3			
081	081-O1	Other	0.01	0-1	1			
081	081-A1	Agriculture Area	0.03	0-1	1			
081	081-H1	House	0.23	0-1	3			
081	081-D1	Lead-Based Paint Concern	0.02	0-1	1			
082	082-H1	House	0.36	0-1	1			
082	082-G1	Garden	0.02	0-12	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
082	082-G2	Garden	0.05	0-12	1			
082	082-O1	Other	0.10	0-1	3	0-1, 1-6	5, 5	1, 1
082	082-N1	Animal/Livestock	0.57	0-3	1			
082	082-N2	Animal/Livestock	0.02	0-3	1			
083	083-H1	House	0.08	0-1	3			
083	083-G1	Garden	0.05	0-12	1			
083	083-G2	Garden	0.03	0-12	1			
084	084-H1	House	0.53	0-1	3			
084	084-D1	Lead-Based Paint Concern	0.01	0-1	1			
085	085-H1	House	0.33	0-1	3			
085	085-H2	House	0.02	0-1	1			
085	085-D1	Lead-Based Paint Concern	0.02	0-1	1			
085	085-O1	Other	0.10	0-1	1			
086	086-H1	House	0.38	0-1	1			
086	086-H2	House	0.62	0-1	1			
086	086-G1	Garden	0.06	0-12	3			
087	087-H1	House Under Construction	0.41	0-1	3			
088	088-H1	House	0.29	0-1	1			
088	088-D1	Lead-Based Paint Concern	0.02	0-1	1			
088	088-H2	House	0.19	0-1	3			
088	088-O1	Other	0.22	0-1	1			
089	089-H1	House	0.60	0-1	1			
089	089-A1	Agriculture Area	0.15	0-12	1			
089	089-O1	Other	0.22	0-1	3			
090	090-H1	House	0.14	0-1	3			
090	090-O1	Other	0.07	0-1	1			
091	091-H1	House	0.25	0-1	3			
091	091-G1	Garden	<0.01	0-10	1			
092	092-O1	Other	0.28	0-1	3			
092	092-O2	Other	0.20	0-1	1			
093	093-H1	House Under Construction	0.22	0-1	3			
094	094-H1	House	0.37	0-1	3			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
094	094-P1	Play Area	0.22	0-1	1			
095	095-H1	House	0.42	0-1	1			
095	095-O1	Other	0.51	0-1	3			
095	095-O2	Other	0.20	0-1	1			
095	095-A1	Agriculture Area	2.75	0-1	1			
096	096-H1	House	0.41	0-1	1			
096	096-O1	Other	0.54	0-1	3			
097	097-H1	House	0.26	0-1	1			
097	097-H2	House	0.19	0-1	3			
098	098-H1	House	0.20	0-1	1			
098	098-G1	Garden	0.16	0-12	3			
098	098-O1	Other	0.08	0-1	1			
099	099-H1	House	0.04	0-1	3			
099	099-G1	Garden	<0.01	0-12	1			
099	099-G2	Garden	<0.01	0-12	1			
099	099-O1	Other	0.04	0-1	1			
099	099-A1	Agriculture Area	0.07	0-1	1			
100	100-H1	House	0.12	0-1	1			
100	100-N1	Animal/Livestock	0.14	0-3	1			
100	100-N2	Animal/Livestock	<0.01	0-3	1			
100	100-O1	Other	0.10	0-1	3			
100	100-G1	Garden	0.01	0-12	1			
101	101-H1	House	0.38	0-1	3			
101	101-G1	Garden	<0.01	0-12	1			
101	101-O1	Other	0.08	0-1	1	0-1, 1-6	5, 5	1, 1
102	102-H1	House	0.03	0-1	3	0-1, 1-6	5, 5	1, 1
102	102-G1	Garden	<0.01	0-6	1			
103	103-H1	House	0.28	0-1	1			
103	103-O1	Other	0.42	0-1	3			
104	104-H1	House	0.05	0-1	1			
104	104-H2	House	0.29	0-1	1			
104	104-N1	Animal/Livestock	0.52	0-3	3			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
105	105-H1	House	0.18	0-1	1			
105	105-P1	Play Area	0.26	0-1	3			
106	106-H1	House	0.04	0-1	1			
106	106-G1	Garden	0.30	0-12	1			
106	106-G2	Garden	0.18	0-12	1			
106	106-O1	Other	0.05	0-1	3			
107	107-H1	House	0.24	0-1	3			
108	108-O1	Other	1.59	0-1	3			
108	108-O2	Proposed Future House Location	0.50	0-1	3			
109	109-H1	House	0.06	0-1	3			
110	110-H1	House	0.93	0-1	3			
110	110-O1	Other	4.25	0-1	1			
110	110-O2	Other	0.39	0-1	1			
110	110-G1	Garden	<0.01	0-12	1			
110	110-G2	Garden	0.01	0-12	1			
110	110-A1	Agriculture Area	0.14	0-1	1	0-1, 1-6	5, 5	1, 1
111	111-H1	House Under Construction	0.04	0-1	3	0-1, 1-6	5, 5	1, 1
112	112-H1	House	0.48	0-1	1			
112	112-O1	Other	0.35	0-1	3			
112	112-G1	Garden	0.01	0-12	1			
113	113-G1	Garden	<0.01	0-12	1			
113	113-G2	Garden	0.01	0-12	1			
113	113-G3	Garden	0.22	0-12	1			
113	113-O1	Other	0.17	0-1	3			
114	114-H1	House	0.33	0-1	1			
114	114-G1	Garden	0.01	0-12	1			
114	114-O1	Other	0.35	0-1	3			
115	115-O1	Other	0.31	0-1	3			
116	116-O1	Other	0.24	0-1	3			
117	117-O1	Other	0.25	0-1	3			
118	118-H1	House	0.51	0-1	1	0-1, 1-6	5, 5	1, 1

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
118	118-N1	Animal/Livestock	0.16	0-3	1			
118	118-N2	Animal/Livestock	0.02	0-3	1			
118	118-G1	Garden	0.31	0-12	1			
118	118-G2	Garden	0.55	0-12	3			
119	119-P1	Play Area	1.00	0-1	3	0-1, 1-6	5, 5	1, 1
120	120-H1	House	0.24	0-1	1			
120	120-D1	Lead-Based Paint Concern	0.02	0-1	1			
120	120-G1	Garden	0.36	0-12	3			
120	120-A1	Agriculture Area	0.26	0-1	1			
120	120-O1	Other	0.65	0-1	1			
121	121-H1	House	1.06	0-1	3			
121	121-G1	Garden	0.10	0-12	1			
121	121-N1	Animal/Livestock	1.46	0-3	1			
121	121-N2	Animal/Livestock	0.52	0-3	1			
122	122-H1	House	0.17	0-1	1			
122	122-P1	Play Area	0.76	0-1	1			
122	122-O1	Other	0.15	0-1	3			
122	122-H2	House	1.08	0-1	1			
122	122-G1	Garden	0.10	0-12	1			
122	122-G2	Garden	0.08	0-12	1			
122	122-O2	Other	0.09	0-1	1			
123	123-H1	House	0.10	0-1	1			
123	123-O1	Other	0.02	0-1	1			
123	123-G1	Garden	0.17	0-12	1			
123	123-G2	Garden	0.20	0-12	3			
123	123-O2	Other	0.26	0-1	1			
124	124-H1	House	0.07	0-1	1			
124	124-G1	Garden	0.02	0-12	1			
124	124-G2	Garden	0.03	0-12	3			
124	124-O1	Other	0.27	0-1	1	0-1, 1-6	5, 5	1, 1
124	124-N1	Animal/Livestock	0.03	0-3	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
124	124-B1	Beach	0.12	0-6	3			
124	124-N2	Animal/Livestock	0.06	0-3	1			
125	125-O1	Other	0.04	0-1	3			
126	126-H1	House	0.18	0-1	1			
126	126-A1	Agriculture Area	0.57	0-1	1			
126	126-O1	Other	1.79	0-1	1			
126	126-O2	Other	0.08	0-1	1			
126	126-O3	Other	0.62	0-1	1			
126	126-P1	Play Area	0.36	0-1	3			
126	126-G1	Garden	0.35	0-12	1			
126	126-G2	Garden	0.02	0-12	1			
127	127-H1	House	0.51	0-1	1			
127	127-H2	House	0.70	0-1	1			
127	127-G1	Garden	0.48	0-12	1			
127	127-G2	Garden	0.05	0-12	1			
127	127-A1	Agriculture Area	5.54	0-12	1			
127	127-N1	Animal/Livestock	0.36	0-3	3			
127	127-O1	Other	0.40	0-1	1			
128	128-H1	House	0.10	0-1	1			
128	128-H2	House Under Construction	0.02	0-1	1			
128	128-G1	Garden	0.03	0-12	1			
128	128-G2	Garden	0.21	0-12	3			
128	128-G3	Garden	0.39	0-12	1			
128	128-N1	Animal/Livestock	0.07	0-3	1			
128	128-O1	Other	0.46	0-1	1			
129	129-H1	House	0.25	0-1	1			
129	129-H2	House	0.18	0-1	3	0-1, 1-6	5, 5	1, 1
130	130-H1	House	0.10	0-1	1			
130	130-G1	Garden	0.33	0-12	3			
130	130-H2	House	0.83	0-1	1			
131	131-H1	House	0.20	0-1	1			
131	131-B1	Beach	0.11	0-6	3			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
132	132-H1	House	0.05	0-1	3			
132	132-G1	Garden	0.01	0-12	1			
132	132-G2	Garden	0.02	0-12	1			
132	132-O1	Other	0.13	0-1	1			
133	133-H1	House	0.06	0-1	1	0-1, 1-6	5, 5	1, 1
133	133-G1	Garden	0.04	0-12	3			
134	134-O1	Proposed Future House Location	1.11	0-1	3			
135	135-H1	House	0.62	0-1	1			
135	135-G1	Garden	0.15	0-12	3			
135	135-O1	Other	0.11	0-1	1			
136	136-H1	House	0.37	0-1	3			
136	136-G1	Garden	0.09	0-12	1			
136	136-A1	Agriculture Area	0.61	0-1	1			
136	136-O1	Other	1.72	0-1	1	0-1, 1-6	5, 5	1, 1
137	137-O1	Other	0.80	0-1	3			
138	138-H1	House	1.21	0-1	1			
138	138-G1	Garden	0.19	0-8	1			
138	138-G2	Garden	1.36	0-12	1			
138	138-O1	Other	0.61	0-1	1			
138	138-O2	Other	0.70	0-1	3			
139	139-H1	House	0.74	0-1	3			
139	139-G1	Garden	0.01	0-12	1			
139	139-G2	Garden	0.02	0-12	1			
139	139-N1	Animal/Livestock	0.47	0-3	1			
140	140-H1	House	0.09	0-1	1			
140	140-G1	Garden	0.01	0-12	1			
140	140-O1	Other	0.02	0-1	1			
140	140-O2	Other	0.05	0-1	1			
141	141-H1	House	0.19	0-1	3			
141	141-H2	House	0.03	0-1	1			
141	141-H3	House	0.24	0-1	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
141	141-N1	Animal/Livestock	0.16	0-3	1			
141	141-N2	Animal/Livestock	0.91	0-3	1			
141	141-N3	Animal/Livestock	0.08	0-3	1			
141	141-N4	Animal/Livestock	0.98	0-3	1			
141	141-O1	Other	0.27	0-1	1			
141	141-O2	Other	0.53	0-1	1			
141	141-A1	Agriculture Area	0.21	0-1	1			
142	142-H1	House Under Construction	0.16	0-1	3			
142	142-O1	Other	0.27	0-1	1			
143	143-H1	House	0.66	0-1	1			
143	143-G1	Garden	0.26	0-12	3			
143	143-G2	Garden	0.02	0-12	1			
143	143-A1	Agriculture Area	0.08	0-1	1			
144	144-H1	House	1.19	0-1	1			
144	144-G1	Garden	0.61	0-12	3			
145	145-H1	House	0.73	0-1	1			
145	145-A1	Agriculture Area	0.14	0-1	3	0-1, 1-6	5, 5	1, 1
146	146-H1	House	0.25	0-1	3			
147	147-H1	House	0.91	0-1	1	0-1, 1-6	5, 5	1, 1
147	147-G1	Garden	0.06	0-12	3			
147	147-G2	Garden	0.20	0-12	3			
148	148-H1	House	0.46	0-1	1			
148	148-O1	Other	0.25	0-1	1			
148	148-O2	Other	0.02	0-1	1			
148	148-O3	Other	0.10	0-1	3			
149	149-H1	House	0.30	0-1	1			
149	149-D1	Lead-Based Paint Concern	0.02	0-1	1			
149	149-A1	Agriculture Area	0.29	0-1	3			
149	149-G1	Garden	0.11	0-12	1			
149	149-G2	Garden	0.02	0-12	1			
149	149-N1	Animal/Livestock	0.08	0-3	1			
150	150-H1	House	0.06	0-1	3	0-1, 1-6	5, 5	1, 1

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
150	150-G1	Garden	0.16	0-12	1			
151	151-H1	House	0.28	0-1	3	0-1, 1-6	5, 5	1, 1
152	152-H1	House	0.20	0-1	1			
152	152-G1	Garden	0.04	0-12	1			
152	152-O1	Other	0.05	0-1	3			
153	153-H1	House	0.68	0-1	1			
153	153-P1	Play Area	0.18	0-1	1			
153	153-G1	Garden	0.15	0-12	1			
153	153-G2	Garden	0.01	0-12	1			
153	153-O1	Other	0.38	0-1	3			
153	153-O2	Other	0.24	0-1	1			
153	153-O3	Other	0.74	0-1	1			
153	153-O4	Other	0.04	0-1	1			
153	153-O5	Other	0.06	0-1	1			
153	153-O6	Other	0.11	0-1	1			
153	153-O7	Other	0.78	0-1	1			
154	154-H1	House	0.17	0-1	3			
154	154-G1	Garden	0.01	0-12	1			
155	155-H1	House	0.07	0-1	1			
155	155-H2	House	0.05	0-1	1	0-1, 1-6	5, 5	1, 1
155	155-G1	Garden	0.20	0-12	1			
155	155-G2	Garden	0.01	0-12	1			
155	155-O1	Other	0.06	0-1	1			
155	155-O2	Other	0.70	0-1	3			
156	156-H1	House	0.08	0-1	1			
156	156-O1	Other	0.23	0-1	3			
157	157-H1	House	0.22	0-1	1			
157	157-H2	House	0.26	0-1	1			
157	157-G1	Garden	0.07	0-12	1			
157	157-O1	Other	0.46	0-1	3			
157	157-B1	Beach	0.11	0-6	1			
157	157-B2	Beach	0.03	0-6	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
158	158-H1	House	0.29	0-1	3			
158	158-O1	Other	0.17	0-1	1	0-1, 1-6	5, 5	1, 1
159	159-H1	House	0.36	0-1	3			
159	159-H2	House Under Construction	0.15	0-1	1			
159	159-O1	Other	0.91	0-1	1			
159	159-O2	Other	0.77	0-1	1			
159	159-G1	Garden	0.16	0-12	1			
160	160-H1	House	0.57	0-1	1			
160	160-G1	Garden	0.01	0-12	3			
160	160-O1	Other	0.35	0-1	1			
161	161-H1	House	0.36	0-1	1			
161	161-D1	Lead-Based Paint Concern	0.01	0-1	1			
161	161-N1	Animal/Livestock	0.32	0-3	3			
162	162-H1	House	0.42	0-1	3			
163	163-H1	House	0.13	0-1	1			
163	163-G1	Garden	0.07	0-12	3			
163	163-O1	Other	0.28	0-1	1			
164	164-H1	House	0.09	0-1	3			
165	165-H1	House	0.15	0-1	3			
165	165-O1	Other	0.48	0-1	1			
166	166-O1	Proposed Future House Location	1.28	0-1	3			
167	167-O1	Proposed Future House Location	0.58	0-1	1			
167	167-O2	Proposed Future House Location	0.70	0-1	1			
167	167-O3	Proposed Future House Location	0.70	0-1	3			
167	167-O4	Proposed Future House Location	0.70	0-1	1			
167	167-O5	Proposed Future House Location	0.70	0-1	1			
168	168-H1	House	0.07	0-1	3			
168	168-D1	Lead-Based Paint Concern	0.02	0-1	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
168	168-G1	Garden	0.06	0-12	1			
168	168-G2	Garden	0.01	0-12	1			
168	168-N1	Animal/Livestock	0.20	0-3	1			
169	169-H1	House	1.14	0-1	1	0-1, 1-6	5, 5	1, 1
169	169-G1	Garden	<0.01	0-12	1			
169	169-G2	Garden	0.61	0-12	1			
169	169-G3	Garden	0.56	0-12	3			
169	169-G4	Garden	0.04	0-12	3			
170	170-H1	House	0.07	0-1	3			
170	170-G1	Garden	0.12	0-12	1			
170	170-G2	Garden	0.38	0-12	1			
171	171-H1	House	0.16	0-1	1			
171	171-G1	Garden	0.07	0-12	1			
171	171-B1	Beach	1.18	0-6	3			
172	172-O1	Other	0.07	0-1	3			
173	173-H1	House	0.36	0-1	3			
173	173-G1	Garden	0.01	0-12	1			
173	173-G2	Garden	0.03	0-12	1			
173	173-G3	Garden	0.04	0-12	1			
173	173-G4	Garden	0.02	0-12	1			
173	173-G5	Garden	<0.01	0-12	1			
173	173-G6	Garden	<0.01	0-12	1			
173	173-P1	Play Area	0.46	0-1	1			
174	174-H1	House	0.16	0-1	3			
174	174-A1	Agriculture Area	0.16	0-1	1	0-1, 1-6	5, 5	1, 1
174	174-G1	Garden	0.07	0-12	1			
175	175-H1	House	0.31	0-1	1			
175	175-G1	Garden	0.01	0-12	1			
175	175-G2	Garden	0.10	0-12	3			
176	176-H1	House	0.71	0-1	1			
176	176-H2	House	0.16	0-1	1			
176	176-P1	Play Area	0.21	0-1	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
176	176-A1	Agriculture Area	0.40	0-1	3			
177	177-H1	House	0.19	0-1	3			
177	177-G1	Garden	0.01	0-12	1			
178	178-H1	House	0.05	0-1	3	0-1, 1-6	5, 5	1, 1
179	179-H1	House	0.04	0-1	3			
180	180-H1	House	0.11	0-1	1			
180	180-O1	Other	0.08	0-1	3			
181	181-H1	House	0.05	0-1	1			
181	181-H2	House	0.02	0-1	1			
181	181-G1	Garden	0.01	0-12	1			
181	181-G2	Garden	0.03	0-12	3			
181	181-A1	Agriculture Area	0.12	0-1	1			
181	181-N1	Animal/Livestock	0.09	0-3	1			
181	181-N2	Animal/Livestock	0.20	0-3	1			
181	181-O1	Other	0.09	0-1	1			
182	182-H1	House	0.46	0-1	1			
182	182-H2	House	0.20	0-1	1			
182	182-O1	Other	0.12	0-1	1			
182	182-O2	Other	0.20	0-1	1	0-1, 1-6	5, 5	1, 1
182	182-O3	Other	1.10	0-1	3			
182	182-G1	Garden	0.01	0-12	1			
182	182-G2	Garden	0.35	0-12	1			
183	183-O1	Proposed Future House Location	0.03	0-1	3			
184	184-H1	House	0.59	0-1	3			
185	185-H1	House	0.05	0-1	1			
185	185-G1	Garden	<0.01	0-12	1			
185	185-A1	Agriculture Area	0.07	0-1	3			
186	186-O1	Other	1.48	0-1	3			
187	187-H1	House	0.14	0-1	3	0-1, 1-6	5, 5	1, 1
188	188-H1	House	0.02	0-1	1			
188	188-A1	Agriculture Area	1.42	0-1	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
188	188-G1	Garden	0.28	0-12	1			
188	188-G2	Garden	0.09	0-12	1			
188	188-G3	Garden	0.25	0-12	1			
188	188-P1	Play Area	0.67	0-1	3			
189	189-H1	House	0.13	0-1	3			
189	189-H2	House	0.06	0-1	1			
189	189-O1	Other	0.03	0-1	1			
189	189-G1	Garden	0.01	0-12	1			
190	190-H1	House	1.12	0-1	3			
190	190-O1	Other	0.41	0-1	1			
190	190-G1	Garden	0.03	0-12	1			
190	190-N1	Animal/Livestock	0.19	0-3	1			
190	190-N2	Animal/Livestock	0.37	0-3	1			
190	190-N3	Animal/Livestock	0.31	0-3	1			
191	191-H1	House	0.22	0-1	3	0-1, 1-6	5, 5	1, 1
192	192-H1	House	0.48	0-1	3			
192	192-G1	Garden	0.01	0-12	1			
192	192-A1	Agriculture Area	0.10	0-1	1			
193	193-H1	House	1.26	0-1	1			
193	193-G1	Garden	0.11	0-12	3			
194	194-H1	House	0.26	0-1	3			
194	194-N1	Animal/Livestock	0.15	0-3	1			
195	195-O1	Proposed Future House Location	0.06	0-1	3			
195	195-G1	Garden	0.01	0-12	1			
195	195-G2	Garden	0.01	0-12	1			
196	196-O1	Other	0.45	0-1	3			
196	196-A1	Agriculture Area	2.73	0-1	1			
196	196-A2	Agriculture Area	1.66	0-1	1			
196	196-G1	Garden	0.03	0-12	1			
197	197-H1	House	0.17	0-1	3			
198	198-H1	House	0.45	0-1	1			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
198	198-G1	Garden	0.05	0-12	3			
199	199-G1	Garden	0.02	0-12	1			
199	199-O1	Other	0.12	0-1	3			
200	200-H1	House	0.32	0-1	3			
200	200-G1	Garden	0.01	0-12	1			
200	200-O1	Other	0.02	0-1	1			
201	201-O1	Other	0.18	0-1	3			
202	202-H1	House	0.21	0-1	3			
202	202-N1	Animal/Livestock	<0.01	0-3	1			
202	202-O1	Other	0.29	0-1	1	0-1, 1-6	5, 5	1, 1
203	203-H1	House	0.27	0-1	1			
203	203-O1	Other	0.81	0-1	3	0-1, 1-6	5, 5	1, 1
203	203-O2	Other	0.22	0-1	1			
204	204-H1	House	0.93	0-1	3			
204	204-G1	Garden	0.28	0-12	1			
204	204-A1	Agriculture Area	0.08	0-1	1			
205	205-O1	Proposed Future House Location	1.42	0-1	3			
206	206-H1	House	0.10	0-1	3			
206	206-H2	House	0.13	0-1	1			
206	206-G1	Garden	0.09	0-12	1			
206	206-A1	Agriculture Area	0.18	0-1	1			
206	206-O1	Other	0.14	0-1	1			
207	207-O1	Other	0.65	0-1	3	0-1, 1-6	5, 5	1, 1
801	801-O1	Other	0.15	0-1	3			
801	801-O2	Other	0.08	0-1	1			
801	801-O3	Other	1.53	0-1	1			
802	802-O1	Other	0.35	0-1	3			
803	803-O1	Other	0.53	0-1	3			
803	803-O2	Other	0.24	0-1	1			
803	803-O3	Other	0.28	0-1	1			
804	804-O1	Other	0.43	0-1	3			

Table D2. Residential Soil Sampling Program by Location[1] (continued)

				Incremental Composite Sample		Deep (Discrete) Core Samples		
Residential Property	DU	Rationale for Sampling	DU Size (acres)	Sample Depth (in.)	No. of Samples	Sample Depths (in.)	No. of Samples[2]	Field Duplicates[3]
804	804-O2	Other	1.27	0-1	1			
805	805-O1	Other	0.20	0-1	1			
805	805-O2	Other	0.39	0-1	3			
806	806-O1	Other	0.85	0-1	1			
806	806-O2	Other	0.37	0-1	1			
806	806-O3	Other	0.03	0-1	1	0-1, 1-6	5, 5	1, 1
806	806-O4	Other	0.32	0-1	3			
806	806-O5	Other	0.12	0-1	1			
807	807-O1	Other	0.06	0-1	3			
808	808-O1	Other	0.52	0-1	3			
808	808-O2	Other	0.17	0-1	1	0-1, 1-6	5, 5	1, 1

[1] Matrix is soil.

[2] Number of samples 5, 5 refers to 0-1 and 1-6 respectively.

[3] Field duplicates are collected at a rate of one per sample depth per DU selected.

2.5 PROJECT ORGANIZATION

The Residential Soil Study is being conducted by TAI. The study organization for the field investigation is illustrated on Figure D2.

2.6 PROJECT COMMUNICATIONS

Frequent and detailed communication between field personnel and management staff is essential to successful completion of the sampling events. The anticipated lines of communication for different elements of the field effort are as follows:

1. **Project Kickoff Meeting**—Approximately 10 days before the start of field work, all personnel will participate in a project kickoff meeting to review the scope of work, schedule, and health and safety and project quality requirements for the project.
2. **Property Owner Notifications**—Approximately 7 days before the start of field work, a TAI representative will call property owners to inform them of the sample collection effort and, if needed, schedule an appointment for sampling.
3. **Utility Locates**—Approximately 7 days before the start of field work (or sooner, if needed), a TAI field contractor representative will contact the 811 (call before you dig) number and request utility locates at all of the properties with physical addresses. A TAI field contractor representative will also call the property owner before sampling is scheduled to take place to conduct a short interview about possible buried utilities at the property. Specific procedures for locating underground utilities are detailed in Attachment D2, SOP-1.
4. **Day-to-Day Operations**—The sampling teams and sample management team will participate in meetings to coordinate logistics and plan each day's work. These meetings will include daily safety briefings. These meetings will also be attended by TAI field personnel, cultural observers, and other interested parties who may be present during sampling activities. At the end of the sampling day, each field team leader and the sample manager will provide daily reports (by telephone or email) to the TAI Project Coordinator, summarizing each day's activities and describing activities planned for the next day. Any issues regarding schedule, safety, cultural resources, or logistics that cannot be resolved in the field should also be reported immediately to the TAI Project Coordinator who will bring the issue to the attention of the EPA Project Manager or other EPA designee, as appropriate.

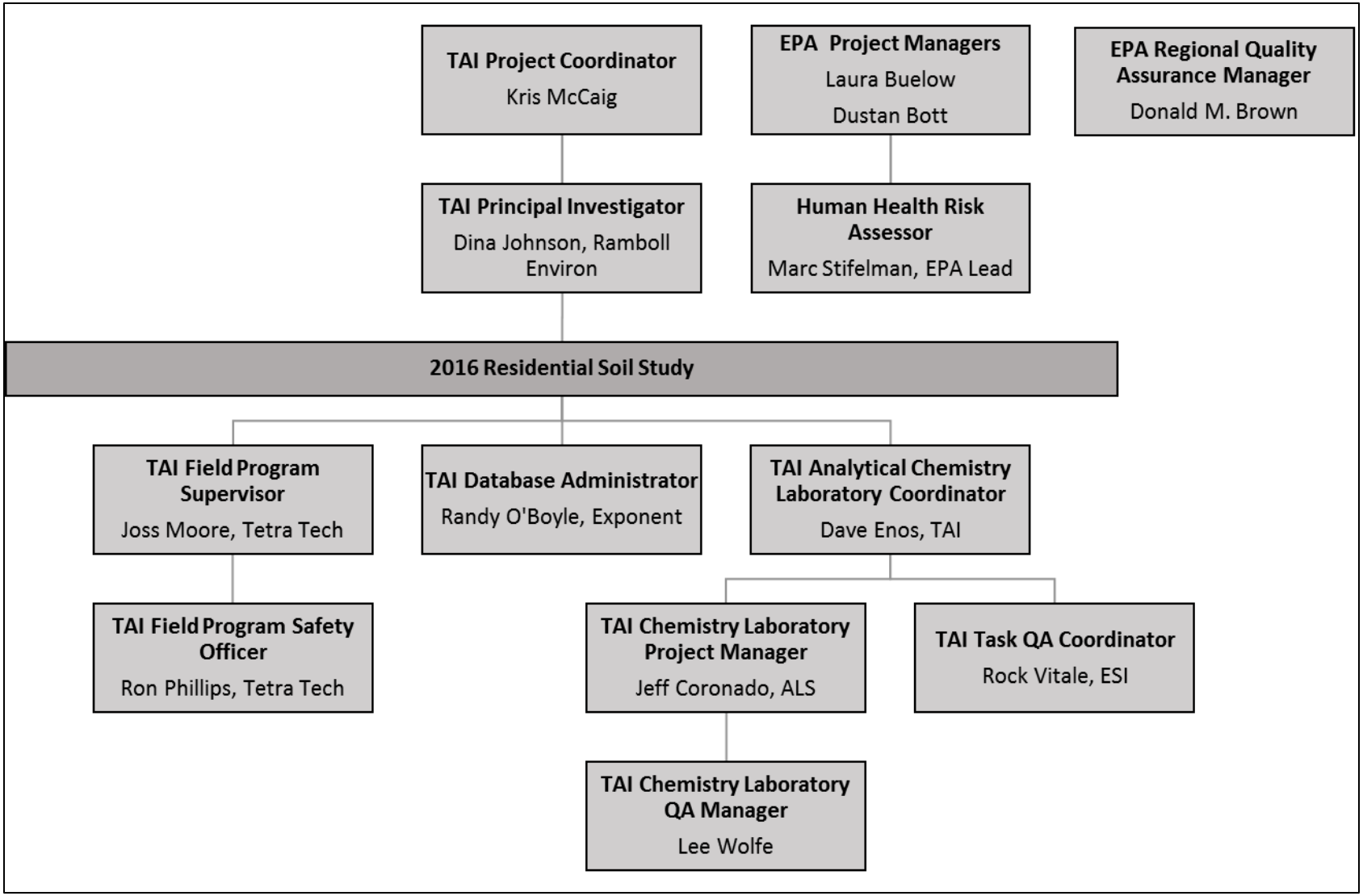


Figure D2. Study Organization Chart

5. **Deviations from QAPP, FSP, and SOPs**—Any changes to the sampling program or changes in procedures will be recorded in the field logbook and on a field change form (see Attachment D1). The field form will document the reason for the changes and the names of people making and authorizing the changes. Modifications to DU boundaries and/or sample depths constitute significant changes, which require consultation by the TAI Field Program Supervisor with EPA (or their designee) in the field and communication with the TAI Project Coordinator, who will contact the EPA Project Manager to confirm agreement and document via a change request prior to making the change, to ensure the IC subsample and/or discrete sample locations are appropriately distributed within the modified location or dimensions of the DU.
6. **Sample Receipts**—On behalf of EPA, the TAI field team leaders will provide property owners with a receipt (see Attachment D1) detailing the samples collected on the property (receipts will be mailed to owners who are not present during sample collection).
7. **Laboratory Communications**—The TAI Analytical Chemistry Laboratory Coordinator will be the primary liaison with the contract analytical laboratory. The field team sample manager will generate labels, chains of custody, and tracking forms for all sample shipments. Any issues identified by the laboratory will be communicated to TAI's Analytical Chemistry Laboratory Coordinator and to the TAI Project Coordinator.
8. **Quality and Completeness Issues**—Changes to the sampling program that have the potential to affect quality and completeness will be communicated directly (telephone or email) to TAI's Project Coordinator as soon as possible or at the end of each day. The TAI Project Coordinator will contact the EPA Project Manager to determine an appropriate path forward if direct communication between field personnel and EPA is not possible.
9. **Health and Safety**—All field work will be conducted in accordance with the SHSP, which is included as Attachment D3 to this FSP. Compliance with the SHSP, including records of meetings, updates, and monitoring will be documented in the field notebook during the course of the field work.

3 FIELD PROCEDURES

This section describes the required sampling equipment and procedures for collection of soil and quality assurance and quality control (QA/QC) samples and documentation of the sampling efforts.

3.1 TASKS TO BE PERFORMED

Implementation of the FSP includes the following tasks at each property to be sampled:

- Mobilize and demobilize field crew.
- Locate and establish the boundary of each DU using listed global positioning system (GPS) coordinates, and adjust boundaries, as needed, based on site-specific conditions.
- Locate and mark each subsample increment and discrete soil sample location using listed GPS coordinates, and adjust locations, as needed, in the event of rocks or other obstructions.
- Collect IC and discrete soil samples at each designated DU.
- Identify and label samples.
- Decontaminate soil sampling equipment between DUs and discrete sample locations.
- Ensure proper sample handling and custody.
- Document sample collection activities.
- Manage investigation derived waste (IDW).

3.2 FIELD EQUIPMENT AND SUPPLIES

The following equipment and materials will be needed for soil sampling:

- Project-specific documents (such as QAPP Addendum No. 1, FSP with attachments)
- GPS handheld unit (for example Trimble GeoXT or GeoXH)
- Compass
- Calculator
- Engineering tape measure (minimum 100 m, 300 ft)

- Tape measure
- Survey stakes
- Pin-flags
- Survey twine
- Stake hammer (2 lbs)
- Stainless-steel soil sample coring device, minimum diameter of 16 mm (such as a Multi-Incremental Sampling Tool [MIST™])
- Large stainless-steel spoons (rectangular and flat-bottomed) or scoops
- Pre-certified clean plastic buckets (1 to 2 gal) and lids
- Laboratory supplied and pre-cleaned 16-oz wide mouth glass jars
- Chain-of-custody records, custody seals, and sample labels
- Disposable gloves and appropriate personal protective equipment (PPE) as stated in the SHSP
- Field data sheets and field notebook
- Pens
- Ruler
- Dry-erase white boards and markers
- Indelible markers
- Digital camera
- Cellular telephone (and/or satellite telephone or radios if no cellular reception)
- Decontamination supplies (potable water, Liquinox, plastic wash tubs, brushes, etc.)
- Plastic trash bags.

3.3 IC SOIL SAMPLE COLLECTION

Collection and processing of IC samples will be conducted in accordance with the incremental sampling guidance (ITRC 2012). Each IC sample will consist of 30 increments or subsamples located within the boundary of each DU. Triplicate IC samples will be collected with a frequency of 20 percent of DUs or a minimum of one DU per property sampled. For most DUs, the increment locations have been pre-selected using visual

sampling plan (VSP) software and the results of field reconnaissance conducted in April and May 2016. GPS equipment will be used to locate the increment locations (see SOP-2). However, in situations where GPS reception is poor, the increment locations will be determined in the field (see SOP-3). Adjustment of locations as needed in the event of rocks or other obstructions will also be determined in the field (see SOP-4). The sampling depth for each DU has been pre-determined based on the results of field reconnaissance and cultural resource considerations. For example, beaches will generally be sampled at a depth of 0 to 6 in. bgs. However, beaches with cultural resources concerns will be sampled at a depth of 0 to 1 in. bgs. The sampling plan for each property, including the sample depth for each DU, is summarized in Table D2.

The IC samples will be dried and processed, and the entire sample will be sieved in the laboratory to a target particle size of less than 150 μm or 250 μm (the latter applies to beach DUs only). The resulting samples will be analyzed for TAL metals (except mercury). In 20 percent of DUs with a measured IC soil concentration that is greater than or equal to 100 mg/kg lead and/or 20 mg/kg arsenic, one IC sample will be submitted for IVBA analysis of lead and arsenic in soil. If the selected DU has one or more replicate IC samples that meet the lead or arsenic concentration criteria, the IC sample submitted for IVBA analysis will be randomly selected from among those that meet the criteria. All remaining sieved soil samples will be archived for later use after analytical samples are obtained.

The SOP-for IC sample collection (SOP-4) in Attachment D2 provides more details about IC sample collection procedures. Sample collection details for each sample will be recorded on the Soil Sample Collection Form (see Attachment D1).

As indicated in Worksheet #17 of QAPP Addendum No. 1, based on the type of soil found in the study area (generally sandy loam and gravelly loam), the amount of soil in the particle size of interest (150 μm) is expected to be limited (5 to 10 percent of total grain size distribution); therefore, at least 1,000 g of soil must be collected for each IC sample in order to have sufficient mass for analysis and quality control (QC) samples (i.e., splits and matrix spike/matrix spike duplicates [MS/MSDs]) after sieving and subsampling. This means that at least 34 g (1.16 oz) of soil need to be collected at each of the 30 increment locations. The estimated volumes and weights that would result for each interval, assuming sandy and gravelly loam soil (~1.65 g/cm^3), are as follows:

- 0 to 1 in. x 4 cm bit = 1,580 g
- 0 to 3 in. (7.62 cm) x 2 cm bit = 1,185 g
- 0 to 6 in. (15.24 cm) x 2 cm bit = 2,370 g
- 0 to 12 in. (30.48 cm) x 2 cm bit = 4,740 g
- 0 to 18 in. (46 cm) x 2 cm bit = 7,000 g

The 2 cm bit will also provide sufficient mass of beach sediment for the 0 to 6 in. IC samples collected from beach DUs. When necessary to avoid disturbing cultural artifacts, the 4 cm bit is required for the 0 to 1 in. bgs depth IC samples collected from beach DUs.

A variety of bucket sizes, ranging from 1 to 5 gal, will be available to hold and transport the samples. However, most samples are expected to fit in 1 or 2.4 gal buckets.

3.4 DISCRETE SAMPLE COLLECTION

In addition to the IC samples, discrete samples will be obtained at five random (as determined by VSP) locations within a selected subset[3] of DUs where the IC sample depth is 0 to 1 in. bgs. These discrete samples will be obtained from the 0 to 1 in. and 1 to 6 in. bgs intervals at each location within the designated DU. The discrete soil sample locations will be separate from the IC subsample locations in the DU. The DUs where discrete samples will be collected are listed on Table D2 and the detailed sampling plan for each property specifies the DUs where discrete soil samples will be collected. The samples will be collected using hand tools, including trowels and/or the MIST™ (or equivalent) sampling device. The sample will be transferred to a laboratory-supplied jar in the field as indicated in SOP-5.

The SOP for discrete soil sample collection (SOP-5, Attachment D2) provides more details about discrete soil sample collection procedures including adjustment of locations, as needed, in the event of rocks or other obstructions. Sample collection details for each sample will be recorded on the Soil Sample Collection Form (see Attachment D1).

The discrete soil samples will be dried and sieved in the laboratory to a target particle size of less than 150 μm. The resulting samples will be analyzed for TAL metals (except mercury). As indicated in Worksheet #17 of QAPP Addendum No. 1, at least 200 g of soil must be collected for each discrete sample interval in order to have sufficient mass for analysis after sieving. Assuming use of the 4 cm bit and 5 in. of sandy or gravelly loam soil (1.65 g/cm^3), each discrete sample should weigh about 263 g.

3.5 QA/QC SAMPLE COLLECTION

This section describes procedures for collecting and submitting QA/QC samples for analysis.

[3] Selection of the subset of DUs will be determined by the EPA Project Manager, in consultation with the TAI Project Coordinator.

3.5.1 Replicates of IC Samples

Replicate (duplicate and triplicate) IC samples will be collected at some DUs (see Table D2) to ensure reliable estimates of the mean concentration of target analytes within the DU. The locations for the replicate IC subsample increments within a DU may be pre-determinedor will be determined in the field using a systematic approach based on the spacing between primary subsample increments (see SOP-3). The replicates will be analyzed for TAL metals (except mercury) and some of the replicates may be submitted for IVBA analysis of lead and arsenic in soil.

3.5.2 Discrete Sample Field Duplicates

Field duplicate samples will be collected to assess the precision of the discrete soil sampling process. One field duplicate sample per sample interval will be collected from one of the five discrete sample locations in each DU where discrete samples are collected. The field duplicate samples will be submitted to the laboratory for analysis of TAL metals (except mercury).

3.5.3 Equipment Rinsate Blank

Equipment rinsate blanks are used to evaluate sampling device cleanliness and potential carryover of target contaminants from equipment contribution. The equipment rinsate samples will consist of ASTM Type II water (purchased and certified from a commercial vendor) poured over or through the sampling device and collected in a pre-preserved, laboratory-supplied sample container. One equipment rinsate blank will be collected for each type of sampling equipment used during the sampling event (at an interval of one per day) and will be analyzed for TAL metals (except mercury).

3.5.4 MS/MSD Samples

Analyses of MS/MSD samples will be performed in the laboratory to assess the accuracy of the analyses. These analyses will be performed according to the laboratory protocols and will occur at a frequency of once every 20 samples using extra volumes of sample matrices obtained after laboratory processing (i.e., the volume of field-collected samples listed in Sections 3.3 and 3.4 accounts for potential MS/MSD volumes).

3.6 INDIVIDUAL SAMPLE IDENTIFICATION NUMBERS

All samples will be initially labeled in the field at the time of collection and shall contain the following information:

- Unique sample identification number
- Property identification (parcel ID)

- Property number
- DU type (and number, if more than one of that type at a given property)
- Sample date and time
- Sample type (IC or discrete)
- QA/QC type (field duplicate, IC replicate)
- Sample team initials
- Preservative (if applicable).

Sample information will be entered onto the sample label with an indelible marker. If necessary, corrections will be made on the sample labels by drawing a single line through the error and entering the correct information with an indelible marker. All corrections will be initialed and dated by the person performing the correction (i.e., the individual who made the error). The following sections describe how the unique sample identification numbers will be determined.

3.6.1 Soil Samples

Each IC and discrete sample will be assigned a unique sample identification number that includes the study name, medium, sample location (i.e., property number), DU type, sample type, and sample type number. The unique sample number will be entered in the field notebook, field tracking sheets, chain-of-custody forms, and other records documenting sampling activities.

The following sample numbering convention will be used for IC samples:

Study Prefix – Study Location – DU Type – Sample Type – IC Sample Number

Explanation

Study Prefix:	16R = 2016 Residential Soil Study
Study Location:	Property number (unique numbers assigned to individual properties)
DU Type:	H for house, A for agriculture, P for play area, G for garden, D for dripline, N for animal activity area, B for beach, and O for other (if more than one DU of same type at a given property, letter code followed by number)
Sample Type:	IC = incremental composite

IC Sample Number: 01 = primary sample

02 = primary field replicate

03 = secondary field replicate.

The following sample numbering convention will be used for discrete samples:

Study Prefix – Study Location – DU Type – Sample Type – Discrete Sample Number

Explanation

Study Prefix: 16R = 2016 Residential Soil Study

Study Location: Property number (unique numbers assigned to individual properties)

DU Type: H for house, A for agriculture, P for play area, G for garden, D for dripline, N for animal activity area, B for beach, and O for other (if more than one DU of same type at a given property, letter code followed by number)

Sample Type: D1A through D1E = discrete samples collected from 0 to 1 in. bgs at locations A, B, C, D, and E

D6A through D6E = discrete samples collected from 1 to 6 in. bgs at locations A, B, C, D, and E

Discrete Sample Number: 01 = primary sample

02 = field duplicate sample.

For example:

- 16R-137-H-IC-01 is a primary IC soil sample collected at property 137, house DU.
- 16R-137-H-D1A-01 is a primary discrete surface soil sample collected from the 0 to 1 in. depth interval at location A of property 137, house DU.
- 16R-137-G1-IC-03 is a primary field replicate IC soil sample collected at property 137, first garden DU where more than one garden DU was established.
- 16R-137-H-D6B-02 is a field duplicate discrete subsurface soil sample collected from the 1 to 6 in. depth interval at location B of property 137, house DU.

Preliminary sample identification numbers for all designated 2016 soil samples are listed by property in Table D2.

3.6.2 Equipment Rinsate Blank Samples

Each equipment rinsate blank will be assigned a unique sample identification number that includes the study name, medium, study location and DU type, sample type, and equipment type. The unique sample number will be entered in the field notebook, field tracking sheets, chain-of-custody forms, and other records documenting sampling activities. The following sample numbering convention will be used for equipment blanks:

Study Prefix – Medium – Study Location – DU Type – Sample Type – Equipment Type

Explanation

Study Prefix:	16R = 2016 Residential Soil Study
Medium:	EB = Equipment Blank
Study Location:	Property number (unique numbers assigned to individual properties)
DU Type:	H for house, A for agriculture, P for play area, G for garden, D for dripline, N for animal activity area, B for beach, and O for other (if more than one DU of same type at a given property, letter code followed by number)
Sample Type:	IC for incremental composite or D for discrete core
Equipment Type:	SO for soil probe, SH for shovel, TR for trowel, SP for spoon

For example:

- 16R-EB-137-H-IC-SO is an equipment blank collected from a soil probe used for IC sampling at property 137, house DU.

3.7 SAMPLE MANAGEMENT

This section discusses various sample management procedures that will be followed after collection of the samples in the field and before transfer to the laboratory (sample management after samples are received by the laboratory and transfer of samples for IVBA analysis is not covered here). Procedures for sample storage, packaging, and shipping are detailed in SOP-6. Sample custody procedures are detailed in SOP-7. Sample volume, container, preservative, and holding time requirements are listed in Table D3. Note that the EPA Regional Quality Assurance Manager has approved storage and shipment of the soil samples without refrigeration or use of ice.

Table D3. Field Sample Volumes, Containers, Preservatives, and Holding Times

Medium	Analyses	Analytical and Preparation Method	Minimum Sample Volume	Container	Preservative	Maximum Holding Time	Quantity (includes IC Replicates and Field Duplicates)
Soil (IC)	Total TAL Metals (except Hg)	3050B, 6020, ICP-AES 6010c	1,000 g	Pre-cleaned plastic bucket (1 to 5 gal)	None	180 days	730
Soil (discrete)	Total TAL Metals (except Hg)	3050B, 6020, ICP-AES 6010c	200 g	Pre-cleaned 16-oz glass jar	None	180 days	348
Water	Total TAL Metals (except Hg)	6020	250 mL	HNO_3 preserved 250-mL polyethylene	None	180 days	144

Notes:
IC = incremental composite
Hg = mercury
mL = milliliter
HNO_3 = nitric acid

The samples will be shipped to the laboratory by courier on a weekly basis. The sample manager will notify the analytical laboratory coordinator that the samples will be delivered to the laboratory and the estimated arrival time. Copies of all chain-of-custody forms will be provided to the analytical laboratory coordinator.

3.8 EQUIPMENT DECONTAMINATION

Sampling equipment must be decontaminated consistently to ensure the quality of the samples collected. All equipment that comes into contact with potentially contaminated soil will undergo a thorough decontamination between each discrete soil sample location and between each DU (IC samples). Temporary decontamination stations and related containment will be established near the work area at each DU. Disposable equipment intended for one-time use that is factory-wrapped generally does not need to be decontaminated before it is used unless there is evidence of contamination present. All one-time use, disposable sampling equipment and accessories will be discarded once used and a new set of equipment will be used for each subsequent sample. Procedures for decontamination of soil sampling equipment are detailed in Attachment D2, SOP-8.

3.9 MANAGEMENT OF INVESTIGATION DERIVED WASTE

Sampling activities are anticipated to generate limited quantities of potentially contaminated materials that will require handling and disposal as described below:

- Field sampling activities will be conducted in Level D PPE and/or modified Level D PPE. Used PPE (primarily nitrile gloves) will be temporarily containerized in heavy-duty trash bags and transported and disposed of in an off-site licensed waste facility (i.e., active Municipal Solid Waste Landfill operated under Chapter 173-351 of the Washington Administrative Code).
- The sampling programs detailed in this plan are not expected to generate surplus soil that will not be submitted to the testing laboratory for analysis. If surplus soil is generated, the surplus will be returned to the portion of the property where it was collected. Equipment decontamination will take place in the individual DUs where samples are collected. Decontamination fluids will be containerized and transported back to the Field Office where the fluids will be transferred to a dedicated holding tank daily.

  .

3.10 FIELD DOCUMENTATION

The following sections provide information regarding field documentation procedures.

3.10.1 Field Forms

All sampling and associated activities will be documented on activity-specific field forms (see Attachment D1).

3.10.2 Field Logbook

Daily field activities will be documented through journal entries in a bound field logbook, which is dedicated to each field team for the residential sampling effort. The field logbook will be water-resistant, and all entries will be made in indelible ink. The field logbook will contain all pertinent information about sampling activities, site conditions, field methods used, general observations, and other pertinent technical information. Language used will be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded; however, they must be clearly identified as such and only relate to the subject of observation. Field logbooks will become part of the permanent project record. Examples of typical field logbook entries include the following:

- Personnel present

- Subcontractors' names and companies
- Time of arrival and departure at each site
- Daily temperature and other climatic conditions
- Field measurements, activities, and observations, including discussions resulting in pertinent field decisions
- Referenced sampling location description (in relation to a stationary landmark) and maps
- Sample collection methods and equipment
- Date and time of sample collection
- Types of sample containers used, sample identification and cross-referencing, sample types and preservatives used, and analytical parameters
- QC sample (duplicate or blank), sample location, and sampling method
- Field instrument calibration information
- Documentation of equipment decontamination
- Site sketches and/or reference to photographs taken
- Instrument calibration procedures and frequency
- Visitors to the site.

The field team leader or designee will be responsible for the daily maintenance of all field records. Each page of the field logbook will be sequentially numbered, dated, and signed by the person making the entry. Corrections to the field logbook will be made by using a single strike mark through the entry to be corrected, then recording and initialing the correct entry. For corrections made later, the date of the correction will be noted. Unused portions of the pages will be crossed out, signed, and dated at the end of each day.

3.10.3 Chain-of-Custody Procedures

Chain-of-custody procedures should be followed to document sample possession as follows.

Definition of Custody

A sample is under custody if one or more of the following criteria are met:

- The sample is in a person's physical possession.
- The sample is in a person's view after being in his or her physical possession.

- The sample was in a person's physical possession and was then locked up or sealed to prevent tampering.
- The sample is kept in a designated secured area.

Field Custody

Only enough material to provide a good representation of the media being sampled will be collected. To the extent possible, the quantity and types of samples and sample locations are determined before the actual fieldwork. As few people as possible should handle samples.

The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly.

The field supervisor will determine whether proper custody procedures were followed during the fieldwork, and will decide whether additional samples are required.

Transfer of Custody and Shipment

Samples should be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving the samples should sign, date, and note the time on the record. This record documents custody transfer from the sampler, often through another person, to the analyst at the laboratory.

Samples should be packaged properly for shipment, and dispatched to the appropriate laboratory for analysis with a separate chain-of-custody record accompanying each shipment. Courier names and other pertinent information are entered in the "Received by" section of the chain-of-custody record.

All shipments should be accompanied by the chain-of-custody record identifying the contents. The original record and one copy should accompany the shipment to the laboratory, and a second copy will be retained by the sample manager.

Freight bills, postal service receipts, and bills of lading should be retained as part of the permanent documentation.

Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample numbers match those on the chain-of-custody records. Pertinent information regarding shipment, pickup, and courier should be in the "Remarks" section. The custodian should enter the sample numbers into a bound notebook. The laboratory custodian will use the sample identification number or assign a unique laboratory number

to each sample, and will be responsible for ensuring that all samples are transferred to the proper analyst or stored in the appropriate secure area.

The laboratory custodian will distribute samples to the appropriate analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received, until the sample is exhausted or returned to the custodian. The data from sample analyses should be recorded on the laboratory report form.

When sample analyses and necessary QC checks have been completed in the laboratory, the unused portion of the sample will be archived until the EPA notifies TAI in writing that the samples are no longer needed. TAI will then notify the laboratory. All identifying sample tie tags, data sheets, and laboratory records will be retained as part of the documentation. Sample containers and remaining samples should be disposed of by the laboratory in compliance with all federal, state, and local regulatory requirements.

3.11 DIGITAL PICTURES

Digital photographs of DUs and discrete soil sample locations will be taken using a camera-lens system with a perspective similar to the naked eye. When practical, photographs will include a measured scale in the picture (e.g., ruler, pencil, coin). Color digital pictures taken during sampling activities will be numbered to correspond to photo log entries. The name or initials of the photographer, the date, the time of the photograph, and the general direction faced (orientation) will be documented in the field logbook. Photograph number and scene description will be entered sequentially in the photo log as photographs are taken. At a minimum, one digital photograph will be taken of each DU after increment locations are flagged and at each discrete soil sample locations at the time of sampling. A dry-erase white board, bearing the location identification, date, and time, will be held by a field team member for its inclusion in the photograph. Upon completion of the field sampling event, the field supervisor will be responsible for submitting all photographic materials to be copied to a compact disc (CD). The CDs will be placed in the project files (at the field supervisor's location). Photo logs and any supporting documentation from the field logbooks will be photocopied and placed in the project files with the CDs.

4 REFERENCE

ITRC. 2012. Technical and Regulatory Guidance: Incremental Sampling Methodology. Interstate Technology and Regulatory Council: Washington, DC. 475 pp. Available at: http://www.itrcweb.org/gd.asp.

ATTACHMENT D1

DISCRETE DECISION UNIT SELECTION
APPROACH MEMORANDUM, FIELD FORMS,
SAMPLE RECEIPT, AND THE WASHINGTON STATE
DEPARTMENT OF ECOLOGY REAL ESTATE
DISCLOSURE REQUIREMENTS

RAMBOLL ENVIRON

ENVIRONMENT & HEALTH

MEMO

Job	**3023907E**
Client	**Teck American Incorporated**
Memo no.	**1**
Date	**July 20, 2016**
To	**Kris McCaig**
From	**Dina L. Johnson**
Copy to	**File**

1. Purpose and Background

The purpose of this memorandum is to summarize the approach used to select specific decision units (DUs) for collection of discrete core soil samples as part of the 2016 Upper Columbia River (UCR) Residential Soil Study. Based on discussion between the US Environmental Protection Agency and Teck American Incorporated, discrete core soil samples are to be collected from one DU at 20 percent of the 141 residential properties ("residences") where incremental composite (IC) samples will be collected. One DU from each of 29 residences was selected as described below.

2. Selection Approach

The process for selecting specific DUs for discrete core sampling was guided by the following criteria:

1. Selection of 29 residences would be spatially representative of the study area.
2. Selected DUs would be designated for IC sampling of the 0 to 1-inch depth interval.
3. Selection of DUs would be random.

Given these criteria, the first step in the selection approach involved dividing the study area into three geographic subareas as shown in the attached figure. Within the green subarea, 8 tribal allotments were treated separately. The total number of properties within each of the subareas and tribal allotments is as follows:

- 13 residences within the pink subarea;

Date July 20, 2016

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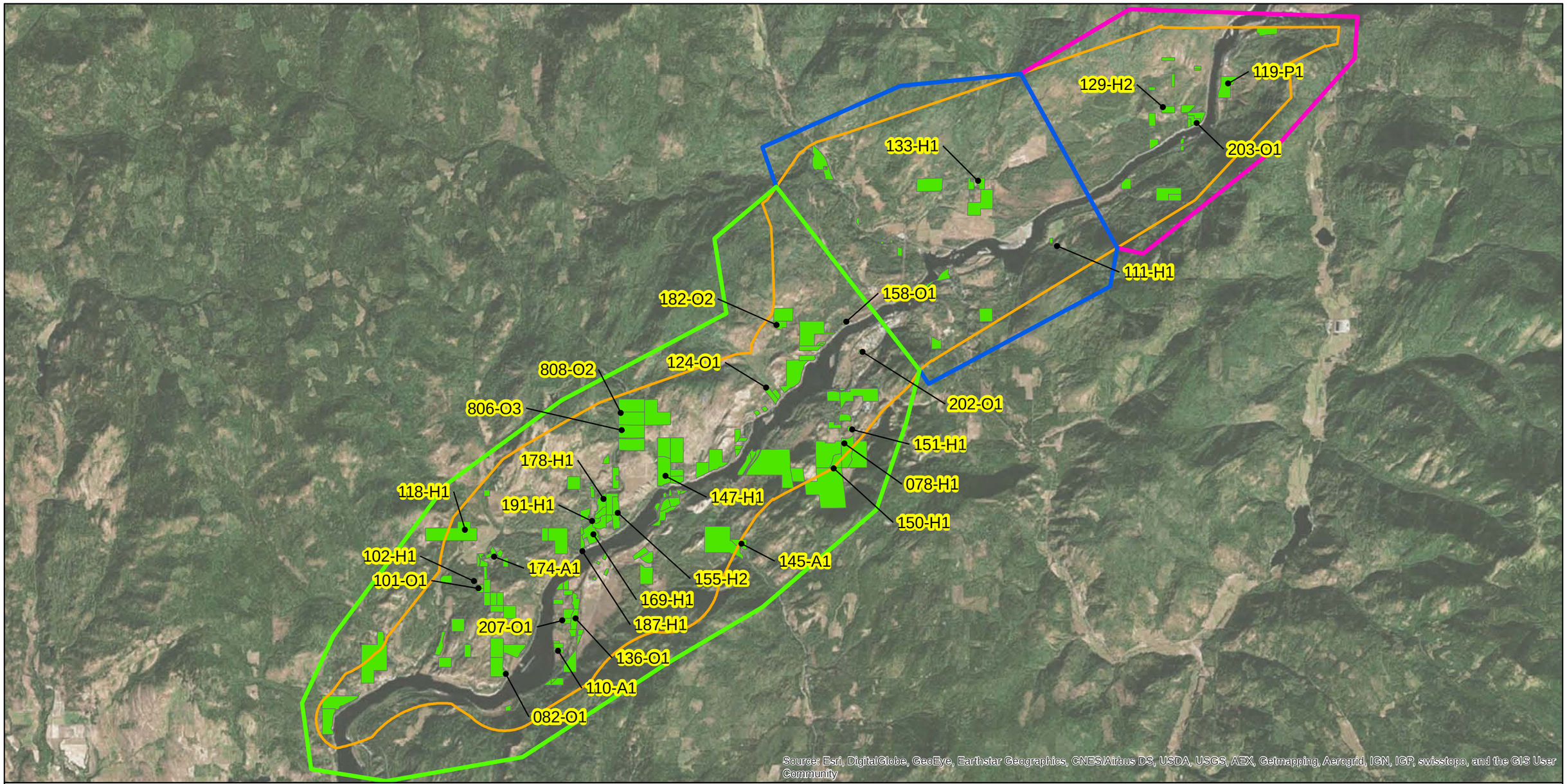
Ref 2016 UCR Residential Soil Study – Selection of DUs for Discrete Core Sampling

- 11 residences within the blue subarea;
- 109 residences within the green subarea (excluding 8 tribal allotments); and
- 8 tribal allotments within the green subarea.

The second step was to randomly select the 29 residences. Within each subarea and the set of tribal allotments, individual residences were assigned a number using a random number generator within the ArcGIS environment. The residences for each grouping were then sorted in ascending order based on the random number assignments. The 29 residences were selected from the top of each list as follows:

- 3 residences from the pink subarea;
- 2 residences from the blue subarea;
- 22 residences from the green subarea (excluding tribal allotments);
- 2 residences from the tribal allotments.

At some residences, more than one DU was identified for IC sampling of the 0 to 1-inch sample depth interval based on the field reconnaissance. In these cases, a third step was applied to randomly select the discrete core sample DU using the same approach as described above for residences (i.e., random numbers were assigned to applicable DUs within the residence, the DUs were sorted by the random numbers, and the DU at the top of the list was selected for discrete core sampling).



Residences 2016

Sample Area

101-O1 Decision Unit ID

N

0 2.5 5

Miles

Decision Units Selected for Discrete Soil Sampling

Teck

TETRA TECH

I:\projects\TeckSoilSampling\projects\2016 0722 RezMap\Residence_Recon_Visted_072216.mxd

CHAIN OF CUSTODY FORM

Project: _____

Samplers: _____

Example

Project Contact:

Office _____

Phone _____

Ship to:

Lab Name _____

Address _____

_____

_____

Contact _____

Phone _____

Soil Sample No.	Date	Time	Matrix	Preservative (if any)	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:

SO - Soil

Other:

Relinquished by: _____ **Date/Time:** _____ **Received by:** _____ **Date/Time:** _____

(signature) *(signature)*

Relinquished by: _____ **Date/Time:** _____ **Received by:** _____ **Date/Time:** _____

(signature) *(signature)*

Special Intructions:

	Field Change Request	

Field Change No.:_____
Page _____ to _____

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 Coordinator)

FIELD COORDINATOR RECOMMENDATION

Recommended Disposition:

Recommended by:
Date: ____/____/____

PROJECT MANAGER APPROVAL

Final Disposition:

Approved/Disapproved by:
Date: ____/____/____

CORRECTIVE ACTION RECORD

Page ___ of ___

Audit Report No. : _____ Date: _____

Report Originator:

Person Responsible for Response:

DESCRIPTION OF THE 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:

SOIL COLLECTION FIELD FORM

Project Name:_____ Project No.:_____ Page: _____

Date:_____ Sampling Crew: _____

Weather: _____

Time:_____ Station No.:_____ Elevation: _____

Latitude:_____ Longitude: _____ Accuracy: _____

Sample ID: _____ Soil pH: _____

Sample analysis: _____ No. sample containers:____

Vegetation: _____

_____

Photograph numbers: _____

_____

Comments: _____

_____

Time:_____ Station No.:_____ Elevation: _____

Latitude:_____ Longitude: _____ Accuracy: _____

Sample ID: _____ Soil pH: _____

Sample analysis: _____ No. sample containers:____

Vegetation: _____

_____

Photograph numbers: _____

_____

Comments: _____

_____

Time:_____ Station No.:_____ Elevation: _____

Latitude:_____ Longitude: _____ Accuracy: _____

Sample ID: _____ Soil pH: _____

Sample analysis: _____ No. sample containers:____

Vegetation: _____

_____

Photograph numbers: _____

_____

Comments: _____

_____

UCR Residential Soil Study – Sample Receipt Form	
Property Number:	Date:
Owner Name:	
Field Team:	
Decision Unit Types:	

Samples Collected at Property		
Sample ID	Sample Depth	Comments

Field Team Leader

Date

RCW 64.06.020

Improved residential real property—Seller's duty—Format of disclosure statement—Minimum information.

(1) In a transaction for the sale of improved residential real property, the seller shall, unless the buyer has expressly waived the right to receive the disclosure statement under RCW **64.06.010**, or unless the transfer is otherwise exempt under RCW **64.06.010**, deliver to the buyer a completed seller disclosure statement in the following format and that contains, at a minimum, the following information:

INSTRUCTIONS TO THE SELLER

Please complete the following form. Do not leave any spaces blank. If the question clearly does not apply to the property write "NA." If the answer is "yes" to any * items, please explain on attached sheets. Please refer to the line number(s) of the question(s) when you provide your explanation(s). For your protection you must date and sign each page of this disclosure statement and each attachment. Delivery of the disclosure statement must occur not later than five business days, unless otherwise agreed, after mutual acceptance of a written contract to purchase between a buyer and a seller.

NOTICE TO THE BUYER

THE FOLLOWING DISCLOSURES ARE MADE BY SELLER ABOUT THE CONDITION OF THE PROPERTY LOCATED AT. . . .

("THE PROPERTY"), OR AS LEGALLY DESCRIBED ON ATTACHED EXHIBIT A.

SELLER MAKES THE FOLLOWING DISCLOSURES OF EXISTING MATERIAL FACTS OR MATERIAL DEFECTS TO BUYER BASED ON SELLER'S ACTUAL KNOWLEDGE OF THE PROPERTY AT THE TIME SELLER COMPLETES THIS DISCLOSURE STATEMENT. UNLESS YOU AND SELLER OTHERWISE AGREE IN WRITING, YOU HAVE THREE BUSINESS DAYS FROM THE DAY SELLER OR SELLER'S AGENT DELIVERS THIS DISCLOSURE STATEMENT TO YOU TO RESCIND THE AGREEMENT BY DELIVERING A SEPARATELY SIGNED WRITTEN STATEMENT OF RESCISSION TO SELLER OR SELLER'S AGENT. IF THE SELLER DOES NOT GIVE YOU A COMPLETED DISCLOSURE STATEMENT, THEN YOU MAY WAIVE THE RIGHT TO RESCIND PRIOR TO OR AFTER THE TIME YOU ENTER INTO A SALE AGREEMENT.

THE FOLLOWING ARE DISCLOSURES MADE BY SELLER AND ARE NOT THE REPRESENTATIONS OF ANY REAL ESTATE LICENSEE OR OTHER PARTY. THIS INFORMATION IS FOR DISCLOSURE ONLY AND IS NOT INTENDED TO BE A PART OF ANY WRITTEN AGREEMENT BETWEEN BUYER AND SELLER.

FOR A MORE COMPREHENSIVE EXAMINATION OF THE SPECIFIC CONDITION OF THIS PROPERTY YOU ARE ADVISED TO OBTAIN AND PAY FOR THE SERVICES OF QUALIFIED EXPERTS TO INSPECT THE PROPERTY, WHICH MAY INCLUDE, WITHOUT LIMITATION, ARCHITECTS, ENGINEERS, LAND SURVEYORS, PLUMBERS, ELECTRICIANS, ROOFERS, BUILDING INSPECTORS, ON-SITE WASTEWATER TREATMENT INSPECTORS, OR STRUCTURAL PEST INSPECTORS. THE PROSPECTIVE BUYER AND SELLER MAY WISH TO OBTAIN PROFESSIONAL ADVICE OR INSPECTIONS OF THE PROPERTY OR TO PROVIDE APPROPRIATE PROVISIONS IN A CONTRACT BETWEEN THEM WITH RESPECT TO ANY ADVICE, INSPECTION, DEFECTS OR WARRANTIES.

Seller . . . . is/ . . . . is not occupying the property.

I. SELLER'S DISCLOSURES:

*If you answer "Yes" to a question with an asterisk (*), please explain your answer and attach documents, if available and not otherwise publicly recorded. If necessary, use an attached sheet.

1. TITLE

[ ] Yes	[ ] No	[ ] Don't know	A. Do you have legal authority to sell the property? If no, please explain.
[ ] Yes	[ ] No	[ ] Don't know	*B. Is title to the property subject to any of the following? (1) First right of refusal (2) Option (3) Lease or rental agreement (4) Life estate?
[ ] Yes	[ ] No	[ ] Don't know	*C. Are there any encroachments, boundary agreements, or boundary disputes?
[ ] Yes	[ ] No	[ ] Don't know	*D. Is there a private road or easement agreement for access to the property?
[ ] Yes	[ ] No	[ ] Don't know	*E. Are there any rights-of-way, easements, or access limitations that may affect the Buyer's use of the property?
[ ] Yes	[ ] No	[ ] Don't know	*F. Are there any written agreements for joint maintenance of an easement or right-of-way?
[ ] Yes	[ ] No	[ ] Don't know	*G. Is there any study, survey project, or notice that would adversely affect the property?
[ ] Yes	[ ] No	[ ] Don't know	*H. Are there any pending or existing assessments against the property?
[ ] Yes	[ ] No	[ ] Don't know	*I. Are there any zoning violations, nonconforming uses, or any unusual restrictions on the property that would affect future construction or remodeling?
[ ] Yes	[ ] No	[ ] Don't know	*J. Is there a boundary survey for the property?
[ ] Yes	[ ] No	[ ] Don't know	*K. Are there any covenants, conditions, or restrictions recorded against the property?

2. WATER

A. Household Water

(1) The source of water for the property is:

[ ] Private or publicly owned water system

[ ] Private well serving only the subject property . . . . . .

*[ ] Other water system

[ ] Yes	[ ] No	[ ] Don't know	*If shared, are there any written agreements?
[ ] Yes	[ ] No	[ ] Don't know	*(2) Is there an easement (recorded or unrecorded) for access to and/or maintenance of the water source?
[ ] Yes	[ ] No	[ ] Don't know	*(3) Are there any problems or repairs needed?
[ ] Yes	[ ] No	[ ] Don't know	(4) During your ownership, has the source provided an adequate year-round supply of potable water? If no, please explain.
[ ] Yes	[ ] No	[ ] Don't know	*(5) Are there any water treatment systems for the property? If yes, are they [ ]Leased [ ]Owned
[ ] Yes	[ ] No	[ ] Don't know	*(6) Are there any water rights for the property associated with its domestic water supply, such as a water right permit, certificate, or claim?
[ ] Yes	[ ] No	[ ] Don't know	(a) If yes, has the water right permit, certificate, or claim been assigned, transferred, or changed?
			*(b) If yes, has all or any portion of the water right not been used for five or more successive years?

[ ] Yes	[ ] No	[ ] Don't know	*(7) Are there any defects in the operation of the water system (e.g. pipes, tank, pump, etc.)?
			B. Irrigation Water
[ ] Yes	[ ] No	[ ] Don't know	(1) Are there any irrigation water rights for the property, such as a water right permit, certificate, or claim?
[ ] Yes	[ ] No	[ ] Don't know	*(a) If yes, has all or any portion of the water right not been used for five or more successive years?
[ ] Yes	[ ] No	[ ] Don't know	*(b) If so, is the certificate available? (If yes, please attach a copy.)
[ ] Yes	[ ] No	[ ] Don't know	*(c) If so, has the water right permit, certificate, or claim been assigned, transferred, or changed?
[ ] Yes	[ ] No	[ ] Don't know	*(2) Does the property receive irrigation water from a ditch company, irrigation district, or other entity? If so, please identify the entity that supplies water to the property:
			C. Outdoor Sprinkler System
[ ] Yes	[ ] No	[ ] Don't know	(1) Is there an outdoor sprinkler system for the property?
[ ] Yes	[ ] No	[ ] Don't know	*(2) If yes, are there any defects in the system?
[ ] Yes	[ ] No	[ ] Don't know	*(3) If yes, is the sprinkler system connected to irrigation water?

3. SEWER/ON-SITE SEWAGE SYSTEM

A. The property is served by:

[ ] Public sewer system,

[ ] On-site sewage system (including pipes, tanks, drainfields, and all other component parts)

[ ] Other disposal system, please describe:

[ ] Yes [ ] No [ ] Don't know B. If public sewer system service is available to the property, is the house connected to the sewer main? If no, please explain.

[ ] Yes [ ] No [ ] Don't know *C. Is the property subject to any sewage system fees or charges in addition to those covered in your regularly billed sewer or on-site sewage system maintenance service?

D. If the property is connected to an on-site sewage system:

[ ] Yes [ ] No [ ] Don't know *(1) Was a permit issued for its construction, and was it approved by the local health department or district following its construction?

(2) When was it last pumped?

. . . . . .

[ ] Yes [ ] No [ ] Don't know *(3) Are there any defects in the operation of the on-site sewage system?

[ ] Don't know (4) When was it last inspected?

. . . . . .

By whom: . . . .

[ ] Don't know (5) For how many bedrooms was the on-site sewage system approved?

. . . . bedrooms

[ ] Yes [ ] No [ ] Don't know E. Are all plumbing fixtures, including laundry drain, connected to the sewer/on-site sewage system? If no, please explain: . . . .

[ ] Yes	[ ] No	[ ] Don't know	*F. Have there been any changes or repairs to the on-site sewage system?
[ ] Yes	[ ] No	[ ] Don't know	G. Is the on-site sewage system, including the drainfield, located entirely within the boundaries of the property? If no, please explain.
			. . . .
[ ] Yes	[ ] No	[ ] Don't know	*H. Does the on-site sewage system require monitoring and maintenance services more frequently than once a year?
			. . . .

NOTICE: IF THIS RESIDENTIAL REAL PROPERTY DISCLOSURE STATEMENT IS BEING COMPLETED FOR NEW CONSTRUCTION WHICH HAS NEVER BEEN OCCUPIED, THE SELLER IS NOT REQUIRED TO COMPLETE THE QUESTIONS LISTED IN ITEM 4. STRUCTURAL OR ITEM 5. SYSTEMS AND FIXTURES

4. STRUCTURAL

[ ] Yes	[ ] No	[ ] Don't know	*A. Has the roof leaked within the last five years?
[ ] Yes	[ ] No	[ ] Don't know	*B. Has the basement flooded or leaked?
[ ] Yes	[ ] No	[ ] Don't know	*C. Have there been any conversions, additions, or remodeling?
[ ] Yes	[ ] No	[ ] Don't know	*(1) If yes, were all building permits obtained?
[ ] Yes	[ ] No	[ ] Don't know	*(2) If yes, were all final inspections obtained?
[ ] Yes	[ ] No	[ ] Don't know	D. Do you know the age of the house? If yes, year of original construction:
[ ] Yes	[ ] No	[ ] Don't know	*E. Has there been any settling, slippage, or sliding of the property or its improvements?
[ ] Yes	[ ] No	[ ] Don't	*F. Are there any defects with the following: (If yes,

know please check applicable items and explain.)

□ Foundations □ Decks □ Exterior Walls
□ Chimneys □ Interior Walls □ Fire Alarm
□ Doors □ Windows □ Patio
□ Ceilings □ Slab Floors □ Driveways
□ Pools □ Hot Tub □ Sauna
□ Sidewalks □ Outbuildings □ Fireplaces
□ Garage Floors □ Walkways □ Siding
□ Other □ Woodstoves □ Elevators
□ Incline Elevators □ Stairway Chair Lifts □ Wheelchair Lifts

[ ] Yes [ ] No [ ] Don't know *G. Was a structural pest or "whole house" inspection done? If yes, when and by whom was the inspection completed? . . .

[ ] Yes [ ] No [ ] Don't know H. During your ownership, has the property had any wood destroying organism or pest infestation?

[ ] Yes [ ] No [ ] Don't know I. Is the attic insulated?

[ ] Yes [ ] No [ ] Don't know J. Is the basement insulated?

5. SYSTEMS AND FIXTURES

*A. If any of the following systems or fixtures are included with the transfer, are there any defects? If yes, please explain.

[ ] Yes [ ] No [ ] Don't know Electrical system, including wiring, switches, outlets, and service

[ ] Yes [ ] No [ ] Don't know Plumbing system, including pipes, faucets, fixtures, and toilets

[ ] [ ] [ ] Hot water tank

Yes	No	Don't know	
[ ]	[ ]	[ ]	Garbage disposal
Yes	No	Don't know	
[ ]	[ ]	[ ]	Appliances
Yes	No	Don't know	
[ ]	[ ]	[ ]	Sump pump
Yes	No	Don't know	
[ ]	[ ]	[ ]	Heating and cooling systems
Yes	No	Don't know	
[ ]	[ ]	[ ]	Security system
Yes	No	Don't know	[ ] Owned [ ] Leased
			Other . . . .

*B. If any of the following fixtures or property is included with the transfer, are they leased? (If yes, please attach copy of lease.)

[ ]	[ ]	[ ]	Security system . . . . .
Yes	No	Don't know	
[ ]	[ ]	[ ]	Tanks (type): . . . . .
Yes	No	Don't know	
[ ]	[ ]	[ ]	Satellite dish . . . . .
Yes	No	Don't know	Other: . . . . .

*C. Are any of the following kinds of wood burning appliances present at the property?

[ ]	[ ]	[ ]	(1) Woodstove?
Yes	No	Don't know	
[ ]	[ ]	[ ]	(2) Fireplace insert?
Yes	No	Don't know	
[ ]	[ ]	[ ]	(3) Pellet stove?
Yes	No	Don't know	
[ ]	[ ]	[ ]	(4) Fireplace?
Yes	No	Don't know	
[ ]	[ ]	[ ]	If yes, are all of the (1)
Yes	No	Don't	woodstoves or (2)

		know	fireplace inserts certified by the U.S. Environmental Protection Agency as clean burning appliances to improve air quality and public health?
[ ] Yes	[ ] No	[ ] Don't know	D. Is the property located within a city, county, or district or within a department of natural resources fire protection zone that provides fire protection services?
[ ] Yes	[ ] No	[ ] Don't know	E. Is the property equipped with carbon monoxide alarms? (Note: Pursuant to RCW **19.27.530**, seller must equip the residence with carbon monoxide alarms as required by the state building code.)
[ ] Yes	[ ] No	[ ] Don't know	F. Is the property equipped with smoke alarms?
			6. HOMEOWNERS' ASSOCIATION/COMMON INTERESTS
[ ] Yes	[ ] No	[ ] Don't know	A. Is there a Homeowners' Association? Name of Association and contact information for an officer, director, employee, or other authorized agent, if any, who may provide the association's financial statements, minutes, bylaws, fining policy, and other information that is not publicly available:
[ ] Yes	[ ] No	[ ] Don't know	B. Are there regular periodic assessments: $ . . . per [ ] Month [ ] Year [ ] Other . . . .
[ ] Yes	[ ] No	[ ] Don't know	*C. Are there any pending special assessments?

[ ] Yes	[ ] No	[ ] Don't know	*D. Are there any shared "common areas" or any joint maintenance agreements (facilities such as walls, fences, landscaping, pools, tennis courts, walkways, or other areas co-owned in undivided interest with others)?

7. ENVIRONMENTAL

[ ] Yes	[ ] No	[ ] Don't know	*A. Have there been any flooding, standing water, or drainage problems on the property that affect the property or access to the property?
[ ] Yes	[ ] No	[ ] Don't know	*B. Does any part of the property contain fill dirt, waste, or other fill material?
[ ] Yes	[ ] No	[ ] Don't know	*C. Is there any material damage to the property from fire, wind, floods, beach movements, earthquake, expansive soils, or landslides?
[ ] Yes	[ ] No	[ ] Don't know	D. Are there any shorelines, wetlands, floodplains, or critical areas on the property?
[ ] Yes	[ ] No	[ ] Don't know	*E. Are there any substances, materials, or products in or on the property that may be environmental concerns, such as asbestos, formaldehyde, radon gas, lead-based paint, fuel or chemical storage tanks, or contaminated soil or water?
[ ] Yes	[ ] No	[ ] Don't know	*F. Has the property been used for commercial or industrial purposes?
[ ] Yes	[ ] No	[ ] Don't know	*G. Is there any soil or groundwater contamination?
[ ] Yes	[ ] No	[ ] Don't know	*H. Are there transmission poles or other electrical utility equipment installed,

maintained, or buried on the property that do not provide utility service to the structures on the property?

[ ] Yes [ ] No [ ] Don't know *I. Has the property been used as a legal or illegal dumping site?

[ ] Yes [ ] No [ ] Don't know *J. Has the property been used as an illegal drug manufacturing site?

[ ] Yes [ ] No [ ] Don't know *K. Are there any radio towers in the area that cause interference with cellular telephone reception?

8. MANUFACTURED AND MOBILE HOMES

If the property includes a manufactured or mobile home,

[ ] Yes [ ] No [ ] Don't know *A. Did you make any alterations to the home? If yes, please describe the alterations: . . . . . .

[ ] Yes [ ] No [ ] Don't know *B. Did any previous owner make any alterations to the home?

[ ] Yes [ ] No [ ] Don't know *C. If alterations were made, were permits or variances for these alterations obtained?

9. FULL DISCLOSURE BY SELLERS

A. Other conditions or defects:

[ ] Yes [ ] No [ ] Don't know *Are there any other existing material defects affecting the property that a prospective buyer should know about?

B. Verification:

The foregoing answers and attached explanations (if any) are complete and correct to the best of my/our knowledge and I/we have received a copy hereof. I/we authorize all of my/our real estate licensees, if any, to deliver

a copy of this disclosure statement to other real estate licensees and all prospective buyers of the property.

DATE . . . SELLER . . SELLER . . . .
. . .

NOTICE TO THE BUYER

INFORMATION REGARDING REGISTERED SEX OFFENDERS MAY
BE OBTAINED FROM LOCAL LAW ENFORCEMENT AGENCIES. THIS NOTICE IS INTENDED ONLY TO INFORM YOU OF WHERE TO OBTAIN THIS INFORMATION AND IS NOT AN INDICATION OF THE PRESENCE OF REGISTERED SEX OFFENDERS.

II. BUYER'S ACKNOWLEDGMENT

A. Buyer hereby acknowledges that: Buyer has a duty to pay diligent attention to any material defects that are known to Buyer or can be known to Buyer by utilizing diligent attention and observation.

B. The disclosures set forth in this statement and in any amendments to this statement are made only by the Seller and not by any real estate licensee or other party.

C. Buyer acknowledges that, pursuant to RCW **64.06.050**(2), real estate licensees are not liable for inaccurate information provided by Seller, except to the extent that real estate licensees know of such inaccurate information.

D. This information is for disclosure only and is not intended to be a part of the written agreement between the Buyer and Seller.

E. Buyer (which term includes all persons signing the "Buyer's acceptance" portion of this disclosure statement below) has received a copy of this Disclosure Statement (including attachments, if any) bearing Seller's signature.

DISCLOSURES CONTAINED IN THIS DISCLOSURE STATEMENT ARE PROVIDED BY SELLER BASED ON SELLER'S ACTUAL KNOWLEDGE OF THE PROPERTY AT THE TIME SELLER

COMPLETES THIS DISCLOSURE STATEMENT. UNLESS BUYER AND SELLER OTHERWISE AGREE IN WRITING, BUYER SHALL HAVE THREE BUSINESS DAYS FROM THE DAY SELLER OR SELLER'S AGENT DELIVERS THIS DISCLOSURE STATEMENT TO RESCIND THE AGREEMENT BY DELIVERING A SEPARATELY SIGNED WRITTEN STATEMENT OF RESCISSION TO SELLER OR SELLER'S AGENT. YOU MAY WAIVE THE RIGHT TO RESCIND PRIOR TO OR AFTER THE TIME YOU ENTER INTO A SALE AGREEMENT.
BUYER HEREBY ACKNOWLEDGES RECEIPT OF A COPY OF THIS DISCLOSURE STATEMENT AND ACKNOWLEDGES THAT THE DISCLOSURES MADE HEREIN ARE THOSE OF THE SELLER ONLY, AND NOT OF ANY REAL ESTATE LICENSEE OR OTHER PARTY.
DATE . . . . . BUYER . . . . . BUYER. . . .

(2) If the disclosure statement is being completed for new construction which has never been occupied, the disclosure statement is not required to contain and the seller is not required to complete the questions listed in item 4. Structural or item 5. Systems and Fixtures.

(3) The seller disclosure statement shall be for disclosure only, and shall not be considered part of any written agreement between the buyer and seller of residential property. The seller disclosure statement shall be only a disclosure made by the seller, and not any real estate licensee involved in the transaction, and shall not be construed as a warranty of any kind by the seller or any real estate licensee involved in the transaction.

[**2015 c 110 § 1; 2012 c 132 § 2; 2011 c 200 § 4.** Prior: **2009 c 505 § 3; 2009 c 130 § 2; 2007 c 107 § 4; 2004 c 114 § 1; 2003 c 200 § 1; 1996 c 301 § 2; 1994 c 200 § 3.**]

NOTES:

Application—2015 c 110 § 1: "Section 1 of this act applies only to real estate transactions for which a purchase and sale agreement is entered into after July 24, 2015." [**2015 c 110 § 2.**]

Findings—2012 c 132: "The legislature finds that the state building code council has adopted rules relating to laws on installation of carbon monoxide alarms in homes and buildings. The legislature finds that amending the state's real estate seller disclosure forms and ensuring that the responsibility for carbon monoxide alarms is that of the seller, will aid in implementing this law." [**2012 c 132 § 1.**]

Application—2012 c 132 §§ 2 and 3: "Sections 2 and 3 of this act only apply to real estate transactions for which a purchase and sale agreement is entered into after June 7, 2012." [**2012 c 132 § 5.**]

Application—2009 c 505: See note following RCW **64.06.005**.

Findings—Intent—2007 c 107: See note following RCW **64.06.015**.

Application—Effective date—2004 c 114: See notes following RCW **64.06.021**.

Effective date—1996 c 301 § 2: "Section 2 of this act shall take effect July 1, 1996." [**1996 c 301 § 7.**]

ATTACHMENT D2

RESIDENTIAL SOIL STUDY
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE SOP-1

UNDERGROUND UTILITY LOCATION

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes the procedures used for ensuring that the areas where samples are to be collected for the Residential Soil Study are clear of underground utilities.

Procedures

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during collection of soil samples. The assessment must be conducted before any intrusive subsurface activity and must include at least the following elements:

1. Performing a background and records assessment of known utilities or other subsurface obstructions. ***Specifically, the resident will be asked if any lines are buried on their property (e.g., water, gas, electric), and the avoidance techniques listed below will be followed.***
2. Contacting and using the designated local utility locating service (e.g., 811)**.** ***The locating service will be notified of all properties to be sampled via fax approximately 7 days before sampling is scheduled to start.***
3. Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above. **NOTE: This requirement has been removed for the Residential Soil Study only if all of the other three provisions are followed, and the employee using the soil probe is wearing insulated "lineman" gloves when pushing the instrument into the ground (no exceptions).**
4. Conducting a visual survey of the area to validate the chosen location.

Procedures for conducting each of the assessments are as follows:

- **Background and Records Assessment of Known Utilities**—Interview the landowner about the locations of any buried utilities within or adjacent to the

decision unit (DU). If possible, obtain available utility diagrams and/or as-built drawings for the property. Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, electrical fences, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings because they are rarely 100 percent accurate.

- **Designated Local Utility Locating Service**—Contact the designated local utility locating service (811 in Washington) to identify and mark the location of utilities at each property to be sampled. Contacting the local utility locating service is a legal requirement in most jurisdictions.
- **Independent Field Survey**—As noted above, this requirement has been removed for the Residential Soil Study due to the remote nature of the properties.
- **Visual Assessment Before and During Intrusive Activities**—Perform a "360 degree" assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the sampling area.

  The visual survey shall include all surface landmarks, **sheds or shops with power running to them, partially day-lighted lines**, manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, well heads, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

- **Subsurface Activities within 5 ft of an Underground Utility or if there is Uncertainty**—When intrusive activities will be conducted within 5 ft (1.5 m) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing or hand digging. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 ft (1.5 m) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 ft (30.5 m). Check to see if the utility can be isolated during intrusive work.
- **Intrusive Activities within 2 ft of a "Day-lighted" Underground Utility**—Use non-aggressive methods (hand digging) to perform intrusive activities within 2 ft of a high risk utility (i.e., a utility that cannot be de-energized or would cause significant impacts to repair or replace). Hazardous utilities shall be de-energized whenever possible.
- **Spotter**—Use a spotter to monitor for signs of utilities during advancement of intrusive work (e.g., presence of pea gravel or sand in soils, presence of concrete or other debris in soils). If any suspicious conditions are encountered, stop work

immediately and contact the TAI Field Program Safety Officer to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

When any of these steps identifies an underground utility within 5 ft (1.5 m) of intrusive work, then non-aggressive means must be used to physically locate the utility. Aggressive methods (including the soil probe) are never allowed within 2 ft of an identified high risk utility. Any deviation from these requirements must be approved by the TAI Field Program Safety Officer and the TAI Project Coordinator.

STANDARD OPERATING PROCEDURE SOP-2

POSITIONING AT SOIL SAMPLE COLLECTION AREAS

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures used for locating soil sampling stations during the Residential Soil Study. Accurate station positioning is required to ensure quality and consistency in sample collection and data 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. The methods described in this SOP are usable for any handheld global positioning system (GPS) unit; however, the owner's manual should be consulted for any GPS unit used to support this SOP.

Equipment and Materials

The following is a list of equipment and materials needed by the field sampling team:

- Handheld GPS unit (e.g., Trimble GeoXH)
- Spare batteries
- Charging unit.

A GPS hardware system will be used for locating sampling stations, such as a Trimble GeoXH GPS (or equivalent device). The GPS unit will be loaded with previously selected soil sampling locations prior to any visit to the Site. The standard projection method to be used during field activities is the horizontal datum of World Geodetic System of 1984 (WGS 1984).

Positioning System Verification

GPS does not require any calibration because all signal propagation is controlled by the U.S. government (the Department of Defense for satellite signals, and the U.S. Coast Guard and U.S. Forest Service for differential corrections). Verification of the accuracy of the GPS requires that coordinates be known for one (or more) horizontal control points within the study area. The GPS position reading at any given station can then be compared to the known control point. GPS accuracy will be verified at the beginning or at the end of each sampling day by logging the location of known reference points.

Procedures and Guidelines

Pre-selected sampling station locations, along with other applicable geographic information system (GIS) data layers (e.g., aerial photographs, topography), will be uploaded into the

handheld GPS unit(s) prior to the sampling effort. Any errors in location data or GPS projection will be noted in the field notes. In the event that GPS coordinates are not provided for a DU, or if GPS reception is poor, refer to SOP-3 (Field Determination of Incremental Sample Locations) to locate sample increments.

A consistent routine will be used for each day's positioning activities. At the beginning of a sampling day, the field team leader will define the order in which the increment and discrete sample locations at each DU will be visited. The increment locations then will be selected one at a time from the pre-determined increment locations. Upon selection of a target increment location, the positioning data of the increment location will be displayed on the handheld unit to assist the field team in proceeding to the location.

A brief summary of procedures to locate a specific increment location using a handheld GPS unit follows:

- Turn on the unit.
- Wait for it to acquire the location of satellites.
- Select desired soil increment location.
- Follow GPS directions to desired increment location.
- If a soil sample is not accessible, move north within 2 ft of the GPS location. If still inaccessible, move 2 ft west, south, and east, until a soil sample is obtained.
- Charge the unit and batteries when not in use.

STANDARD OPERATING PROCEDURE SOP-3

FIELD DETERMINATION OF INCREMENTAL SAMPLE LOCATIONS

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures for creating decision unit (DU) boundaries and incremental composite (IC) sample locations in the field during the Residential Soil Study. This SOP is needed because the DU boundaries and incremental sample locations for certain beach DUs will not be pre-determined by the Contractor prior to the onset of field work, or because of poor global positioning system (GPS) reception in some portions of the study area. The IC samples will be collected in accordance with SOP-4 (Incremental Composite Soil Sample Collection) after the DU boundaries and increment locations are established.

The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

Equipment and Materials

The following is a list of equipment and materials needed by the field sampling team:

- Handheld global positioning system (GPS) device
- 100-m (300 ft) reel tape
- Tape measure
- Camera and digital storage card
- Survey flags (separate colors for primary, duplicate, and triplicate IC samples)
- Aerial photographs showing approximate DU boundaries
- Calculator
- Random number generator, or dice
- 2-lb sledge hammer
- Twine/string

- Field logbook
- Pens and pencils
- Project-specific field sampling plan (FSP) and health and safety plan (SHSP).

Procedures for Determining DU Boundary and Incremental Sample Locations for Beaches

The steps below detail the procedures for marking the beach DUs for sampling.

1. Locate the beach where the DU needs to be established.
2. Conduct a visual inspection of the beach. The DU should extend throughout the beach area (i.e., area of non-vegetated, exposed sediment) to the water line.
3. Perform DU-specific utility location procedures (see SOP-1) and mark the locations of any underground utilities in the beach area and any other locations that are unacceptable for sampling (e.g., cobbles or exposed bedrock), because these areas will be excluded from sampling. Take multiple photographs of the DU and record all observations on the field notes.
4. Once the location and extent of the DU is determined, install stakes or pin-flags at the corners of the beach. Record the coordinates of each corner using a handheld GPS unit with sub-meter accuracy. Draw a sketch of the DU on the site map.
5. Measure the dimensions of the DU and calculate its area by multiplying the length by the width. Divide the total DU area by 30 to get the size of each sampling grid cell (each grid cell should be the same size). Based on that area, determine the most practical dimensions for each grid cell.
6. Mark the corners of each grid cell with pin-flags, or use string tied to stakes to make a grid. Number the grid cells from 1 to 30 and conceptually split each cell into 4 quadrants.
7. Use a random number generator (or dice), determine which quadrant of the cells will be sampled. If using dice, re-roll any 5 or 6 until a 1, 2, 3, or 4 is rolled. The same quadrant will be sampled in all of the grid cells. Document the basis for selecting the quadrant in the field notes.
8. For each increment that will be collected from the center of the determined quadrant for each cell, mark the increment location.
9. Follow SOP-4, Incremental Composite Soil Sample Collection, to collect the IC sample. Remove all stakes and pin-flags upon completion of sampling.

Procedures for Determining Incremental Sample Locations in Established DUs without GPS Reception

The steps below detail the procedures for determining IC sample locations within an established DU without GPS reception.

1. Locate the corners of the DU using GPS or landmarks.
2. Perform DU-specific utility location procedures (see SOP-1) and mark the locations of any underground utilities and any other locations that are unacceptable for sampling (e.g., cobbles or exposed bedrock), because these areas will be excluded from sampling. Take multiple photographs of the DU and record all observations on the field notes.
3. Measure the dimensions of the DU and calculate its area by multiplying the length by the width. Divide the total DU area by 30 to get the size of each sampling grid cell (each grid cell should be the same size). Based on that area, determine the most practical dimensions for each grid cell.
4. Mark the corners of each grid cell with pin-flags, or use string tied to stakes to make a grid. Number the grid cells from 1 to 30 and conceptually split each cell into 4 quadrants.
5. Use a random number generator (or dice) to determine which quadrant of the cells will be sampled. If using dice, re-roll any 5 or 6 until a 1, 2, 3, or 4 is rolled. The same quadrant will be sampled in all of the grid cells. Document the basis for selecting the quadrant in the field notes.
6. For each increment that will be collected from the center of the determined quadrant for each cell, mark the increment location.
7. Follow SOP-4, Incremental Composite Soil Sample Collection, to collect the IC sample. Remove all stakes and pin-flags upon completion of sampling.

STANDARD OPERATING PROCEDURE SOP-4

INCREMENTAL COMPOSITE SOIL SAMPLE COLLECTION

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures used for collecting incremental composite (IC) soil samples during the Residential Soil Study. The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

Equipment and Materials

The following is a list of equipment and materials needed by the field sampling team:

- Handheld global positioning system (GPS) device
- Soil probes capable of collecting soil cores 2 to 4 cm in diameter and 1 to 12 in. deep
- Stainless-steel shovel, trowel, or rectangular and flat-bottomed spoons
- Insulated lineman gloves
- Tape measure
- Survey flags (separate colors for primary, duplicate, and triplicate IC samples)
- Aerial photographs showing decision unit (DU) boundaries and increment locations
- Camera and digital storage card
- Field logbook (bound and paginated)
- Pens and pencils
- Chain-of-custody records and custody seals
- Field forms
- Sample labels
- Pre-cleaned plastic buckets (1 to 2 gal)
- Re-sealable plastic bags
- Plastic sheeting on which to work with collected samples

- Disposable nitrile gloves for handling soil samples
- Decontamination supplies
- Rubber-headed mallet
- Radios (for communication)
- Project-specific field sampling plan (FSP) and health and safety plan (SHSP).

Procedures for Soil Sample Collection

The steps below detail the soil collection procedures for each primary and replicate (duplicate and triplicate) IC sample to be collected within a DU. NOTE, not all DUs will require collection of replicate samples (see the sampling design for each DU summarized in Table D2 of the FSP).

Preparation for Sampling

1. Transport field personnel and sampling equipment to the DU selected for sampling.
2. Perform DU-specific utility location procedures (see SOP-1).
3. Check the sample location map and data table for the DU to determine whether replicates are required and the depth interval for the samples.
4. Locate each increment location for the primary IC sample using a handheld GPS unit or by laying out the sampling grid (see SOP-3). Place a flag at the location. Pre-selected increment locations and coordinates will be provided on maps prior to field mobilization.

   If replicates are required and locations are not pre-selected, locate each increment location for the replicate (duplicate and triplicate) IC samples using the following process:

   a. Refer to the DU map to determine the spacing between primary increments
   b. Divide the spacing by 3; this is the offset distance for the replicates
   c. Place a flag at the location where each duplicate IC increment will be collected directly north or south of the primary increment (use the same direction for all increments) at the specified offset distance.
   d. Place a flag at the location where each triplicate IC increment will be collected directly east or west (use the same direction for all increments) at the specified offset distance.

   Flags marking primary, duplicate, and triplicate IC increment locations should be different colors and also be different from the color of flags used to mark discrete soil

sample locations. Take digital photographs of the flagged area (record in the photo log).

5. Label each IC sample bucket in accordance with the labeling requirements described in the FSP prior to filling. The primary, duplicate, and triplicate IC samples will be placed in separate buckets.

Incremental Sample Collection (to be performed at each subsample increment location)

1. Document notable surface conditions in the vicinity of the increment location in the field notebook.
2. Obtain sample increments from an accessible location within 2 ft of the flagged increment location for the DU. If an increment cannot be obtained at the actual sample location, to avoid sampler bias, the sampler should first attempt to move 2 ft north of the GPS location and collect a sample. If this location is inappropriate for sampling, the sampler will move 2 ft west of the GPS location and attempt a sample. If a sample is still unattainable, the sampler will attempt to move 2 ft in either of the other two cardinal directions (south or east) of the GPS location. It is not necessary to adjust the planned locations for replicate increments if a primary increment location is changed.
3. Wear a clean pair of nitrile gloves and clear large surface debris away by hand at the increment location. Surface debris includes all identifiable debris such as twigs, intact leaves, pine needles, woody debris, duff, vegetation (including grass and grass roots), and rocks.
4. Collect the sample from each increment location using a soil punch or equivalent sampling device. Wear insulated lineman gloves as appropriate and use a spotter when operating the soil probe to mitigate possible encounters with unidentified underground utilities. The appropriate sample interval for each increment within a DU is DU-specific and listed on Table D2 of the FSP. For samples collected in yards or in areas with thick vegetation, the sample depth should be measured from below the thatch or root zone. Retrieve the sample from the sampler and remove the root 'plug' from the top of the sample leaving the soil for collection. Measure the sample for thickness and remove any excess material from the bottom of the core to ensure the proper depth interval is collected so as not to bias the composite sample. Place any excess material back in the ground at the sample location.
5. Place the increment into a quart-sized re-sealable plastic bag dedicated to the IC sample.
6. Allow the cultural resources representative to inspect the increment in the quart-sized bag(s).

a. If the increment passes the cultural resources review, continue sampling procedures.

b. If the increment does not pass the cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management of change procedures.

7. Transfer the increment from the quart-sized inspection bag into the plastic bucket containing any previously collected increments for the sample.
8. Once an increment is successfully collected, remove the flag from its location.
9. Complete field documentation for the increment location (see Soil Sample Collection Form in Attachment D1) and note any deviations to the sampling program on the form and in the field logbook.
10. Brush off the sample collection equipment between increment locations within one DU.
11. Continue collecting increments until all of the flags marking increment locations for the individual IC sample have been removed.

Decontamination and Incremental Sample Management (to be performed after all increments are collected)

1. Place a custody seal on the bucket to ensure its integrity during transport to the sample management area.
2. Fully decontaminate the sampling equipment between DUs as described in SOP 8. Decontamination fluids will be containerized and transported back to the Field Office where the fluids will be transferred to a dedicated holding container daily.
3. Discard DU-dedicated sampling equipment such as gloves and quart-sized inspection bags into plastic trash bags for later disposal as solid waste.
4. At the close of the field day, transfer the IC sample containers to the sample manager, who will label and ship the IC sample containers to the analytical chemistry laboratory along with all appropriate documentation.

Collection of Quality Assurance/Quality Control Samples

Other than the replicate samples described above, no additional sample volumes will be collected in the field for quality assurance/quality control purposes.

STANDARD OPERATING PROCEDURE SOP-5

DISCRETE SOIL SAMPLE COLLECTION

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes the procedures used for collecting discrete soil samples during the Residential Soil Study. The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

Equipment and Materials

The following is a list of equipment and materials needed by the field sampling team:

- Soil probes capable of collecting soil cores 2 to 4 cm in diameter and 1 to 12 in. deep
- Stainless-steel shovel, trowel, or spoons
- Insulated lineman gloves
- Tape measure
- Survey flags (separate colors for primary, duplicate, and triplicate discrete soil samples)
- Aerial photographs showing decision unit (DU) boundaries and increment locations
- Camera and digital storage card
- Field logbook (bound and paginated)
- Pens and pencils
- Chain-of-custody records and custody seals
- Field forms
- Sample labels
- Re-sealable plastic bags
- Plastic sheeting on which to work with collected samples
- Disposable nitrile gloves for handling soil samples
- Laboratory supplied and pre-cleaned 16-oz wide mouth glass jars

- Decontamination supplies
- Rubber-headed mallet
- Radios (for communication)
- Project-specific field sampling plan (FSP) and health and safety plan (SHSP).

Procedures for Soil Sample Collection

The steps below detail the soil collection procedures for this sampling effort.

Preparation for Sampling

1. Transport field personnel and sampling equipment to the DU selected for sampling.
2. Perform DU-specific utility location procedures (see SOP 2).
3. Locate each discrete sample location using a handheld global positioning system (GPS) unit. Place a flag labeled with the Location ID at the location. Flags marking discrete sample locations should be a different color than flags marking incremental composite subsample locations.

Sample Collection

1. Document notable surface conditions and anthropogenic changes in the vicinity of the sample location in the field notebook. Take digital photographs of the sample location (record in the photo log).
2. Collect the discrete sample from an accessible location within 2 ft of the GPS sample location specified for the DU. If a soil sample cannot be obtained at the actual sample location, to avoid sampler bias, the sampler should first attempt to move 2 ft north of the GPS location and collect a sample. If this location is inappropriate for sampling, move 2 ft west of the GPS location and attempt a sample. If a sample is still unattainable, move 2 ft in either of the other two cardinal directions (south or east) of the GPS location.
3. Wear a clean pair of nitrile gloves and clear large surface debris from the sample location. Surface debris includes all identifiable debris such as twigs, intact leaves, pine needles, woody debris, duff, vegetation (including grass and grass roots), and rocks. Retain topsoil overlying the mineral soil.
4. Collect the discrete sample using a soil punch or equivalent sampling device. As indicated in SOP 2, wear insulated lineman gloves and use a spotter to mitigate possible encounters with unidentified underground utilities. Obtain discrete soil samples from the 0 to 1 and 1 to 6 in. below ground surface interval, as listed on Table D2 of the FSP.
5. Place the sample into a quart-sized re-sealable plastic bag.

6. Allow the cultural resources representative to inspect the sample in the quart-sized bag.
    a. If the sample passes the cultural resources review, continue sampling procedures.
    b. If the sample does not pass the cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management of change procedures.
7. Transfer the sample into the laboratory-supplied sample bottle.
8. Apply custody seals to the container and lid to maintain integrity of sample during transport to the sample management area.
9. Complete field documentation for the sample location (see Soil Sample Collection Form in Attachment D1) and note any deviations to the sampling program on the form and in the field logbook.

Decontamination and Sample Management

1. Fully decontaminate sampling and homogenization equipment between discrete sample locations as described in SOP-8. Decontamination fluids will be containerized and transported back to the Field Office where the fluids will be transferred to a dedicated holding container daily.
2. Discard dedicated sampling equipment such as gloves and quart-sized inspection bags.

At the close of the field day, transfer the sample containers to the sample manager, who will label and ship the sample containers to the analytical chemistry laboratory along with all appropriate documentation.

Collection of Quality Assurance/Quality Control Samples

Field duplicate samples will be collected for discrete samples at a rate of one field duplicate (per depth interval) per DU where discrete samples are collected. The field duplicates will be collected using the Procedures for Soil Sample Collection above.

STANDARD OPERATING PROCEDURE SOP-6

SAMPLE STORAGE, PACKAGING, AND SHIPPING

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures for the method to be used when packaging samples that will either be hand-delivered or shipped by commercial carrier to the analytical chemistry laboratory during the Residential Soil Study. Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

Equipment and Materials

Specific equipment or supplies necessary to properly package and ship environmental samples include the following:

- Project-specific field logbook(s)
- Resealable airtight bags (assorted sizes)
- Coolers
- Bubble wrap
- Fiber-reinforced packing tape and duct tape
- Clear plastic packing tape
- Scissors or knife
- Chain-of-custody (COC) forms (these may be produced electronically and printed)
- Custody seals
- Large plastic garbage bags (preferably 3 mil [0.003 in.] thick) for cooler liningPaper towels
- "Fragile," "This End Up," or "Handle With Care" labels
- Mailing labels
- Airbills for overnight shipment.

Procedures

In some cases, samples may be transferred from the field to a secure, local storage facility. Depending on the logistics of the operation, field personnel may transport samples to the laboratory themselves or use a commercial courier or shipping service. If a courier service is used, then field personnel must be aware of potentially limiting factors to timely shipping (e.g., availability of overnight service and weekend deliveries to specific areas of the country) prior to shipping the samples.

Sample Storage Prior to Shipment

Samples will be placed in secure storage (i.e., locked room or vehicle) or remain in the possession of sampling personnel before shipment. Sample storage areas will be locked and secured to maintain sample integrity and COC requirements. In the field, samples will be maintained in coolers until they are packaged for shipping to the off-site analytical chemistry laboratory.

Sample Preparation

The following steps will be followed to ensure the proper transfer of samples from the field to the laboratory:

At the Sample Collection Site

1. Appropriately document all samples using the proper logbooks or field forms and required sample container identification (i.e., sample labels with unique identifiers [IDs]) using the sample labeling techniques described in Section 3.6 of the Field Sampling Plan (FSP).
2. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
3. Store each IC sample in either a 1 -gal or 2 gal plastic bucket depending on sample volume.
4. Store each discrete soil sample in a laboratory supplied and pre-cleaned 16-oz wide mouth glass jar.
5. Store each rinsate sample in laboratory provided nitric acid preserved polyethylene 250 mL bottle.
6. Store all sample containers under custody until ready for shipping.

To Prepare Discrete Soil and Rinsate Samples and Coolers for Shipping

1. Choose the appropriate size cooler(s) and make sure that the outside and inside of the cooler is clean of gross contamination. If the cooler has an external drain, the drain must be capped and thoroughly taped shut with duct tape.
2. Use bubble wrap to line the cooler and place an opened large plastic bag (preferably a bag with a thickness of 3 mil) inside the cooler.

3. Individually wrap each sample container in bubble wrap using either tape or a rubber band to hold the bubble wrap in place. Place the wrapped sample into the large plastic bag in the cooler.
4. While the samples are being placed in the shipping cooler(s), the field supervisor will fill out the COC form and include the sample IDs and laboratory analyses to be performed (see example blank and filled out COC forms in Attachment D1 to the FSP).
5. Make sure all applicable laboratory quality control sample designations have been made on the COC forms.
6. Check sample containers against the COC form to ensure all samples intended for shipment are included. Information on the COC shall only include sample information for the samples within the individual cooler.
7. After all samples have been added to the cooler, use bubble wrap (or other available clean packing material) to fill any empty space to keep the samples from shifting during transport.
8. The field supervisor will sign and date the completed COC form and retain a copy for the project files. Place the signed COC form in a resealable bag and tape the bag containing the form to the inside of the cooler lid. Each cooler must contain an individual (or multiple) COC form(s) for the samples contained in that particular cooler.
9. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut with fiber-reinforced packing tape. The cooler must be taped shut around the opening between the lid and the bottom of the cooler and around the circumference of the cooler at both hinges.
10. Apply three COC seals across the opening of the cooler lid—one on the front of the cooler and one on each side—to prevent unauthorized handling of the samples. Place additional clear packing tape across each seal so they are not inadvertently removed during transport.
11. Notify the TAI Analytical Chemistry Laboratory Coordinator that samples will be shipped and the estimated arrival time. Upon completion of field activities, the field supervisor will provide copies of all COC forms to the Analytical Chemistry Laboratory Coordinator.

To Prepare IC Soil Samples for Shipping

1. Once each individual sampling location soil bucket has been sealed, the lid will be taped closed and custody sealed. A project label will be completed and taped to the side of the bucket.

2. The field supervisor will fill out the COC form and include the sample IDs and laboratory analyses to be performed (see example blank and filled out COC forms in Attachment D1 to the FSP).
3. Make sure all applicable laboratory quality control sample designations have been made on the COC forms.
4. Check sample containers against the COC form to ensure all samples intended for shipment are included.
5. The buckets will then be transported to the testing laboratory either by hand delivery by one of the field staff, or by a contracted courier.

Sample Shipping

Hand Delivery to the Testing Laboratory

1. The field supervisor will notify the Analytical Chemistry Laboratory Coordinator that samples will be delivered to the laboratory and the estimated arrival time.
2. In most instances, environmental samples that are hand-delivered to the testing laboratory will be received by the laboratory on the same day that they were packed in the coolers.
3. Copies of all COC forms will be provided to the Analytical Chemistry Laboratory Coordinator.

Shipped by Commercial Carrier to the Laboratory

1. Use a mailing label and label 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 is expected to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the outside of the cooler and to protect it from the weather. This is a secondary label in case the airbill is lost during shipment.
2. Fill out the airbill as required and fasten it to handle tags provided by the shipper (or the top of the cooler if handle tags are not available).
3. The field supervisor will notify the Analytical Chemistry Laboratory Coordinator that samples will be shipped and the estimated arrival date and time. All environmental samples are to be shipped overnight for next morning delivery. The field supervisor will provide copies of all COC forms to the Analytical Chemistry Laboratory Coordinator upon completion of the study.

STANDARD OPERATING PROCEDURE SOP-7

SAMPLE CUSTODY

Scope and Applicability

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures for maintaining custody of environmental samples during the Residential Soil Study. The procedures outlined herein will be used in conjunction with sample labeling procedures outlined in Section 3.6 of the Field Sampling Plan (FSP) and SOP-6, which covers sample packaging and shipping. The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

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 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 designated personnel's custody unless the samples have been transferred to a secure area (i.e., locked up and custody sealed) or transferred to the analytical chemistry laboratory. If the samples cannot be placed in a secure area, then a field team member must physically remain with the samples at all times (e.g., at meal times).

Materials and Methods

The following materials are required:

- COC forms (if COCs will be produced in an electronic format using a database program [e.g., FORMS II Lite], a computer and printer also need to be available)
- Custody seals
- Shipping airbills (if samples will be sent by air).

Chain-of-Custody Forms

The COC form is a critical document that records sample possession from the time of collection through the final disposition of the sample. The form also provides information to the laboratory regarding what analyses are to be performed on the shipped samples. Therefore, COCs must include information only on the samples within the shipping container, and samples shall not be shipped without an associated COC within the container.

The COC form will be completed after each field collection activity and before the samples are shipped to the laboratory. Project-assigned sample identifiers (IDs) will be recorded on the COC form. The COC form will also identify the sample collection date and time, the type of sample, the project, and the sampling personnel. The COC form will be sent to the laboratory along with the samples. The COC form(s) will be placed into a plastic resealable bag and secured to the inside lid of each cooler. A copy of the COC forms will be retained by the field supervisor for filing in the project files by the TAI Analytical Chemistry Laboratory Coordinator at the completion of the study.

Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the COC form(s), indicating the time and date that the transfer occurs.

Procedures

The following guidelines will be followed to ensure the integrity of the samples:

1. Prior to sample shipping or storage, COC entries will be made for all samples electronically on a secure computer or hard copy. Information on the COCs will be checked against field logbook entries.
2. At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples, and to note the time and date that the transfer occurred. The time that the samples were relinquished should exactly match the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.
3. The COC form should not be signed until the information has been checked for inaccuracies by the field supervisor. All changes should be made by drawing a single line through the incorrect entry, and initialing and dating the revision. Revised entries should be made in the space below the entries. Any blank lines remaining on the COC form after corrections are made should be marked out with single lines that are initialed and dated. This procedure will preclude any unauthorized additions.
4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express (FedEx) or United Parcel Service (UPS), the name of the carrier should be recorded on the COC form. Any tracking numbers supplied by the carrier should

be also entered on the COC form. The time of transfer should be as close to the actual drop-off time as possible. After the COC form(s) are signed, they should be sealed inside the transfer container. A signed copy will be retained by the field supervisor.

5. If errors are found after the shipment has left the custody of sampling personnel, a corrected version of the forms must be made and sent to all relevant parties. Minor errors can be rectified 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. Upon completion of the field sampling event, the field supervisor will be responsible for submitting all project-related COC forms to TAI.

Custody Seal

To prevent unauthorized handling of the samples during shipping, three custody seals will be affixed to each sample cooler. Custody seals will be placed across all three unhinged sides of the cooler lid prior to shipping. Field personnel will ensure that the seals are securely affixed to the cooler so they cannot be accidently removed during shipping. To ensure this is done, use additional tape across the seals.

Shipping Airbills

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), an airbill or receipt is provided by the shipper. Upon completion of the field sampling event, the field supervisor will be responsible for submitting the sender's copy of all shipping airbills to the TAI Analytical Chemistry Laboratory Coordinator. The airbill number (or tracking number) must be noted on the applicable COC forms before they are sealed inside the cooler.

Acknowledgement of Sample Receipt

In most cases, the laboratory will confirm sample receipt with the TAI laboratory coordinator on the day samples are received by the testing laboratory. This confirmation may be viae-mail or an official laboratory 'Acknowledgment of Sample Receipt' form that confirms the sample ID numbers and analysis to be performed. If an error is detected by the TAI laboratory coordinator, the laboratory will be immediately contacted. Decisions made during any telephone conversation will be documented in writing and archived in the project file by the Analytical Chemistry Laboratory Coordinator. If necessary, corrections will be made to the COC form and the corrected COC form sent to the laboratory (either via e-mail or facsimile) by the TAI laboratory coordinator.

STANDARD OPERATING PROCEDURE SOP-8

DECONTAMINATION OF SOIL SAMPLING EQUIPMENT

This standard operating procedure (SOP) is specific to the 2016 Residential Soil Study being conducted for Teck American Incorporated (TAI) in the northern portion of the Upper Columbia River site in northeastern Washington. This SOP describes procedures for decontaminating sampling and processing equipment contaminated by inorganic materials used for collecting soil samples during the Residential Soil Study. Sampling equipment must be decontaminated consistently to ensure the quality of the samples collected. All reusable equipment that comes into contact with potentially contaminated soil will undergo a thorough decontamination between discrete soil sample locations and between each decision unit (DU) where incremental composite (IC) samples are collected.

Reusable sampling equipment includes the soil punch, Lexan tub, spoons, and trowels, etc. Decontaminated equipment will be stored away from areas that may cause recontamination, and rinsate blanks will be collected. When handling decontamination chemicals, field personnel will follow all relevant procedures and will wear protective clothing as stipulated in the project-specific health and safety plan (SHSP). The procedures listed below may be modified in the field by the field supervisor (in consultation with TAI and the U.S. Environmental Protection Agency [EPA]) based on conditions encountered in the field. Such changes and the TAI and EPA representative authorizing the change should be noted in the field logbook and on field change forms.

Equipment and Materials

Equipment required for decontamination includes the following:

- Polyethylene or polypropylene tub (to collect solvent rinsate)
- Plastic bucket(s) (e.g., 5-gal bucket)
- Non-phosphate laboratory-grade detergent (e.g., Liquinox)
- Properly labeled squirt bottles (or large spray bottles if needed)
- Funnels
- Long-handled, hard-bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Tap water or site water
- Personal protective equipment as specified in the SHSP (e.g., safety glasses or goggles; disposable nitrile gloves).

Decontamination Procedures

Reusable sampling equipment will be decontaminated before and after the sampling effort, between DUs, and at any other times specified by the Field Sampling Plan (FSP). The specific procedures for decontaminating reusable sampling equipment are as follows:

1. Wear the appropriate personal protective equipment as required by the SHSP.
2. At the sampling site, rinse the equipment thoroughly with tap or site water to remove any gross contamination, such as soil or debris.
3. Pour a small amount of concentrated laboratory detergent into a bucket (e.g., about 1/2 tablespoon per 5-gal bucket) and fill it halfway with tap or site water.
4. Scrub the equipment in the detergent solution with a long-handled brush with rigid bristles using a back-and-forth motion. Be sure to clean the outside of samplers, bowls, and other tools that may be covered with soil. Remove all particulate matter and surface films.
5. Thoroughly rinse equipment with potable water (first rinse).
6. Thoroughly rinse equipment with distilled or deionized water (second rinse).
7. Set rinsed equipment right-side-up on a stable surface to drain.

9. Rinse the equipment with tap or site water.
10. Set the equipment in a clean location and allow it to air dry.
11. If the decontaminated sampling equipment is not to be used immediately, wrap small items in plastic bags (e.g., Ziploc bags).
12. 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 plastic bags (e.g., Ziploc bags) 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.
13. Transfer decontamination fluids to a sealable container and properly dispose of them.

ATTACHMENT D3

GENERAL SITE HEALTH AND SAFETY PLAN ADDENDUM
2016 RESIDENTIAL SOIL STUDY

CONTENTS

CONTENTS **D3-ii**
LIST OF TABLES **D3-iii**
ACRONYMS AND ABBREVIATIONS **D3-iv**
SITE HEALTH AND SAFETY PLAN ADDENDUM APPROVAL **D3-v**
SITE HEALTH AND SAFETY PLAN ADDENDUM ACKNOWLEDGEMENT **D3-vi**

1 INTRODUCTION **D3-1-1**

1.1 ORGANIZATION D3-1-2
1.2 SCOPE OF WORK D3-1-2
1.3 DEFINITIONS D3-1-2

2 SAFETY GUIDELINES FOR PHYSICAL HAZARDS **D3-2-1**

3 CHEMICAL HAZARD EVALUATION **D3-3-1**

4 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT **D3-4-1**

4.1 PERSONAL PROTECTIVE EQUIPMENT D3-4-1
4.2 SAFETY EQUIPMENT D3-4-1

5 AIR MONITORING **D3-5-1**

6 EMERGENCY PLANNING **D3-6-1**

7 WORK ZONES **D3-7-1**

8 DECONTAMINATION **D3-8-1**

9 VEHICLE SAFETY, SPILL CONTAINMENT, AND SHIPPING INSTRUCTIONS **D3-9-1**

10 TASK-SPECIFIC SAFETY PROCEDURES **D3-10-1**

11 REFERENCE **D3-11-1**

Attachment D3-1. Site Map and Hospital Location Maps

Attachment D3-2. Cold-Stress Fact Sheet

Attachment D3-3. Heat-Related Illness Fact Sheet

LIST OF TABLES

Table D3-2-1. Summary of Activities and Potential Hazards

Table D3-2-2. Potential Physical Hazards and Proposed Safety Procedures

Table D3-4-1. Level of Protection Required for Site Activities

Table D3-4-2. Levels of Protection and Personal Protective Equipment

Table D3-5-1. Site-specific Air Monitoring Requirements

Table D3-5-2. Action Levels Established to Determine the Appropriate Level of Personal Protection

Table D3-6-1. Local Emergency Telephone Numbers

Table D3-6-2. Corporate Emergency Telephone Numbers

Table D3-6-3. Project Area Hospital Information

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
COPC	chemical of potential concern
HAZWOPER	hazardous waste operations and emergency response
OSHA	Occupational Safety and Health Administration
PFD	personal flotation device
PPE	personal protective equipment
RI/FS	remedial investigation and feasibility study
SHSP	site health and safety plan
Site	Upper Columbia River site
TAI	Teck American Incorporated
UCR	Upper Columbia River
WISHA	Washington Industrial Safety and Health Act

SITE HEALTH AND SAFETY PLAN ADDENDUM APPROVAL

This addendum to the general site health and safety plan (SHSP) has been reviewed and approved by Teck American Incorporated's (TAI) lead technical consultant Ramboll Environ for the 2016 Residential Soil Study at the Upper Columbia River (UCR) site (Site) in support of the remedial investigation and feasibility study (RI/FS) for the Site.

Ramboll Environ Task Manager Date

Ramboll Environ Corporate Health and Safety Officer Date

SITE HEALTH AND SAFETY PLAN ADDENDUM ACKNOWLEDGEMENT

This addendum to the general SHSP (TCAI 2009) is approved for use at the Site. The general SHSP and addendum are the minimum health and safety standard for the Site and will be strictly enforced for all personnel conducting sediment sampling activities at the Site. Subcontracted personnel may request to adopt a subcontractor-specific plan in lieu of this addendum to the general SHSP, but must obtain prior written approval from TAI and provide written concurrence from the subcontractor that the subcontractor will assume direct responsibility and liability for administering the plan to its employees.

I have reviewed this addendum to the general SHSP for the study. I have had an opportunity to ask any questions I may have and have been provided with satisfactory responses. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines.

Employee signature	Company	Date
Employee signature	Company	Date
Employee signature	Company	Date
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1 INTRODUCTION

This addendum to the general site health and safety plan (SHSP) for the Upper Columbia River (UCR) site (Site) remedial investigation and feasibility study (RI/FS) provides specific Site information and health and safety provisions to protect workers from potential hazards during sediment and soil sampling at locations along the UCR.

Site background information and general health and safety provisions to protect workers from potential hazards during work at the Site are presented in the general SHSP (TCAI 2009).

Subcontractors that are contracted to perform field work associated with the RI/FS may adopt this SHSP or develop and follow their own SHSPs. However, subcontractor SHSPs must be consistent with the provisions outlined in this addendum and the general SHSP, and any discrepancies will follow the most protective practices.

It is Ramboll Environ's policy to provide a safe and healthful work environment. No aspect of the work is more important than protecting the health and safety of all workers.

Ramboll Environ cannot guarantee the health or safety of any person entering the Site. Because of the potentially hazardous nature of the Site and the activity occurring thereon, it is not possible to regulate personal diligence or to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the Site. The health and safety guidelines in this plan were prepared specifically for the Site and should not be used on any other site without prior evaluation by trained health and safety personnel.

A copy of this addendum and the general SHSP must be in the custody of the field team during field activities. All individuals performing field work must read, understand, and comply with this plan before undertaking field activities. Once the information has been read and understood, the individual must sign the Site Health and Safety Acknowledgment Form provided with this addendum to the general plan. Any changes to the plan will be written in the plan and initialed by all potentially affected field personnel. The signed form and any initialed changes will become part of Ramboll Environ's project file. A copy of the form will be provided to Teck American Incorporated (TAI).

This addendum may be modified at any time based on the judgment of the site safety officer in consultation with the corporate health and safety officer and project manager or designee.

Any modification will be presented to the on-site team during a safety briefing and will be recorded in the field logbook.

1.1 ORGANIZATION

Task-specific safety procedures associated with soil sampling are presented in this addendum to the general SHSP. In addition, this addendum provides detailed field site and hospital location maps, air monitoring requirements, specific requirements for personal protective equipment (PPE), work zone definitions, and key emergency contact information.

The general SHSP (TCAI 2009) provides background site information and general health and safety provisions to protect workers from potential hazards during field activities. The information includes general safety guidelines for physical hazards, a chemical hazard evaluation, health and safety training requirements, general PPE requirements, emergency planning, general decontamination procedures, vehicle safety, and spill containment.

1.2 SCOPE OF WORK

Residential soil samples will be collected from properties not previously sampled within the 2014 residential soil study area and in an expanded area extending south from the southern boundary of that study area to approximately the intersection of Williams Lake Road and Highway 25 on the east side of the river (see Site map, Attachment D3-1).

1.3 DEFINITIONS

Contamination reduction zone:	Area between the exclusion and support zones that provides a transition between contaminated and clean zones
Exclusion zone:	Any area of the Site where hazardous substances are present, or are reasonably suspected to be present, and pose an exposure hazard to personnel
HAZWOPER:	Hazardous Waste Operations and Emergency Response standard, as described in 29 Code of Federal Regulations (CFR) Part 1910.120
OSHA:	Occupational Safety and Health Administration
Support zone:	Any area of the Site, so designated, that is outside the exclusion and contamination reduction zones
WISHA:	Washington Industrial Safety and Health Act, as described in Chapter 49.17 Revised Code of Washington

2 SAFETY GUIDELINES FOR PHYSICAL HAZARDS

All work will be done using the buddy system. Depending upon the time of year and the location of work, biting insects may be an issue when accessing any of the sampling locations during the sampling event. Table D3-2-1 summarizes potential physical hazards posed by proposed Site activities. Table D3-2-2 presents potential physical hazards that are expected to be present during sediment sampling activities.

Table D3-2-1. Summary of Activities and Potential Hazards

Activity	Potential Hazard
Soil Sampling	Water hazards, slippery walking surfaces, cold/hypothermia (depending on sampling event), heat stress (depending on sampling event), material handling, adverse weather, work in remote areas

Table D3-2-2. Potential Physical Hazards and Proposed Safety Procedures

Potential Hazard	Yes	No	Proposed Safety Procedure
Slippery surfaces	X		Use caution; wear properly fitting shoes or boots with good gripping capacity; keep work area orderly.
Cold/hypothermia	X		Keep warm and dry, bring changes of clothes; do not work in extreme conditions without proper equipment and training; follow cold stress information (Attachment D3-2); potential for cold/hypothermia will depend on season.
Heat stress	X		Drink water frequently in hot weather; take work breaks; follow the heat-related illness information (Attachment D3-3); potential for heat stress will depend on season.
Material handling	X		Lift properly; seek assistance if necessary; do not overfill coolers or boxes.
Adverse weather	X		Seek shelter during storms; work in adverse weather conditions only with proper training, clothing, and equipment.
Drowning		X	Wear personal flotation devices (PFDs) at all times when working over water. Inspect the PFDs prior to use and do not use defective PFDs. Keep sampling equipment on boats organized at all times. Boats are required to be equipped with a throwable life ring, fire extinguisher, and warning horn, and each field member will be briefed on their storage location.
Work in remote areas	X		Use the buddy system; carry radio and/or cellular phone; bring sufficient equipment in case of accident or injury (first aid kit, shelter if appropriate).
Biting insects	X		Use repellents, as needed.

3 CHEMICAL HAZARD EVALUATION

A chemical hazard evaluation is presented in the general SHSP (TCAI 2009) and incorporated herein by reference.

4 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

The following sections address PPE and safety equipment required for completing the sediment sampling activities.

4.1 PERSONAL PROTECTIVE EQUIPMENT

Based on chemical and physical hazards associated with the soil sampling activities, Tables D3-4-1 and D3-4-2 identify the PPE required for sampling.

Table D3-4-1. Level of Protection Required for Site Activities

	Level of Protection	
Site Activity	Initial[a]	Contingency[b]
Soil sampling	MD	Leave Site, reassess situation
Sample handling	D	Leave Site, reassess situation

[a] See Table D3-4-2 for definitions

[b] Based on unexpected change in Site conditions

Table D3-4-2. Levels of Protection and Personal Protective Equipment

Protection Level	Required	Personal Protective Equipment
Level D	X	Long pants and shirt or work coveralls; safety glasses or goggles (as appropriate); and nitrile, neoprene, or Barrier® 5 layer laminate gloves (as appropriate). Hard hat and hearing protection as needed.
Level MD	X	Same as Level D with modification (M) of addition of rain gear and PFD, as needed.

Is there potential for a respirator to be donned during field work? Yes _____ No X

4.2 SAFETY EQUIPMENT

The following safety equipment will be on site during the proposed field activities.

Air Monitoring (Check the items required for this project)

☐ Photoionization Detector	☐ Air sampling pumps
☐ Lower Explosive Limit/Oxygen meter	☐ Miniram
☐ Hydrogen sulfide meter	☐ Radiation meter
☐ Detector pump and tubes	☐ Other _____

First Aid Kit (mandatory, including adhesive band-aids, gauze, tape, gloves, cardiopulmonary resuscitation shield, triangle bandage)

[X]	Emergency blanket	[X]	Sunscreen
[X]	Insect repellent	[ ]	Other _____

Other (Check the items required for this project)

[X]	Eyewash	[ ]	Fit test supplies
[X]	Drinking water	[X]	Fire extinguisher (boat)
[ ]	Stop watch for monitoring heart rate	[ ]	Windsock
[ ]	Thermoscan® thermometer (or equivalent) for heat stress monitoring	[X]	Cellular phone
		[ ]	Radio sets
[X]	Survival kit	[X]	Global positioning system
[ ]	Personal flotation device	[X]	Other: Satellite phone
[ ]	Cool vests		

5 AIR MONITORING

The principal chemicals of potential concern (COPCs) at the Site are not volatile (i.e., metals). There is a small chance for the COPCs to become airborne in dust form if the sediment is dry, although the sediments are unlikely to contain a significant amount of fine particles. In addition, the chemical hazard evaluation presented in the general SHSP (TCAI 2009) concluded that, based on previous evaluations, none of the sediment or soil chemicals is expected to pose a threat to field personnel during soil sampling activities. If windblown dust becomes problematic to the field crew, operations may be suspended. Tables D3-5-1 and D3-5-2 provide air monitoring requirements and action levels to be used during sampling activities.

Table D3-5-1. Site-specific Air Monitoring Requirements

Monitoring Instrument	Calibration Frequency	Parameters of Interest	Monitoring Frequency
Visual	N/A	Dust	Continuous

Table D3-5-2. Action Levels Established to Determine the Appropriate Level of Personal Protection

Instrument	Reading	Action[a]	Comments
Visual	Visual Dust	Leave Site, if necessary	

6 EMERGENCY PLANNING

In case of any emergency affecting the Site, all affected personnel must immediately evacuate the work area and report to the Site safety officer at the following predetermined location:

DESIGNATED ASSEMBLY LOCATION: Field vehicle

In case of injury, field personnel should take precautions to protect the victim from further harm and notify local or facility emergency services. In remote areas, it will be necessary to have first aid-trained personnel on the field team. The victim may require decontamination prior to treatment—requirements will vary based on Site conditions.

Emergency medical care will be provided by:

- [X] Local emergency medical provider (i.e., fire department; see Table D3-6-1 for local contact information)
- [X] Facility emergency medical provider
- [X] First aid-trained field staff (for remote areas only)

Table D3-6-1. Local Emergency Telephone Numbers

Local Resources	Name	Telephone	Notified Prior to Work (Yes/No)?
Fire	Varies by location	911	Yes. Notify the E911 coordinator for Stevens County (Debby McCanna; 509-684-2555) of the schedule and location of work.
Police	Varies by location	911	Yes (see above)
Ambulance	Varies by location	911	Yes (see above)
Main Hospital	Mount Carmel Hospital, Colville, WA	(509) 684-2561	No
Alternative Hospitals	Coulee Community Hospital, Grand Coulee, WA	(509) 633-1753	No
	Ferry County Memorial Hospital, Republic, WA	(509) 775-3333	No
	Lincoln Hospital, Davenport, WA	(509) 725-7101	No
	St Joseph's Hospital, Cheweleh, WA	(509) 935-8211	No
	Deer Park Hospital, Deer Park, WA	(509) 276-5061	No
	Deaconess Medical Center-Spokane, Spokane, WA	(509) 473-7178	No
	Holy Family Hospital, Spokane, WA	(509) 482-0111	No
	Sacred Heart Medical Center, Spokane, WA	(509) 474-3131	No
	Veterans Affairs Medical Center, Spokane, WA	(509) 434-7032	No

Table D3-6-1. Local Emergency Telephone Numbers (continued)

Local Resources	Name	Telephone	Notified Prior to Work (Yes/No)?
Site phone	Field cellular phone. Cellular phone coverage is spotty in the vicinity of the sampling areas. If cellular phone coverage is lost due to a mountain or hill, drive a little farther to get coverage. If cellular phone coverage is available, the 911 system will work. A satellite phone may be necessary for areas with limited cellular phone coverage.	(503) 320-1796	NA
Directions to Mount Carmel Hospital (from Highway 395)	Begin traveling SE on Highway 395. Highway 395 becomes Main Street in Colville. Turn LEFT on E. Columbia Ave. Go 0.6 mile. Arrive at 982 E. Columbia Ave. Hospital is on right. (See detailed hospital location maps in Attachment D3-1)		

In case of serious injuries, death, or other emergency, the TAI Project Coordinator and TAI Principal Investigator must be notified immediately. Contact numbers are listed in Table D3-6-2.

Table D3-6-2. Corporate Emergency Telephone Numbers

Corporate Resources	Name	Work/Cellular Telephone
TAI Project Coordinator	Kris McCaig	Work: (509) 623-4501 Cellular: (509) 434-8542
TAI Principal Investigator	Dina Johnson	Work: (206) 336-1662 Cellular: (425) 765-1218

Table D3-6-3 provides local hospital contact and location information. See Attachment D3-1 for a detailed hospital location map.

Table D3-6-3. Project Area Hospital Information

Facility Name	Hours of Operation	Phone Number	Address	City
Coulee Community Hospital	24 hours/ emergency	509-633-1753	411 Fortuyn Road	Grand Coulee
Ferry County Memorial Hospital	24 hours/ emergency	509-775-3333	36 Klondike Road	Republic
Lincoln Hospital	24 hours/ emergency	509-725-7101	10 Nichols Street	Davenport
St Joseph's Hospital	24 hours/ emergency	509-935-8211	500 East Webster Street	Chewelah
Mount Carmel Hospital	24 hours/ emergency	509-684-2561	982 East Columbia Street	Colville
Deer Park Hospital	24 hours/ emergency	509-276-5061	East 1015 'D' Street	Deer Park

Table D3-6-3. Project Area Hospital Information (continued)

Facility Name	Hours of Operation	Phone Number	Address	City
Deaconess Medical Center-Spokane	24 hours/ emergency	509-473-7178	West Fifth Avenue	Spokane
Holy Family Hospital	Dependent on case	509-482-0111	North 5633 Lidgerwood Avenue	Spokane
Sacred Heart Medical Center	24 hours/ emergency	509-474-3131	West 101 Eighth Avenue	Spokane
Veterans Affairs Medical Center	7:30 am to 4:00 pm	509-434-7032	North 4815 Assembly Street	Spokane

In the event any health or safety issue arises, after the victim(s) receive appropriate medical treatment, the relevant field crew member(s) will be interviewed to formally document the incident by, at a minimum, the field supervisor and TAI Project Coordinator. All incidents will be documented in the field logbook. If applicable, a corrective action record form will be filled out (see Attachment D1 to the Field Sampling Plan) to ensure future health and safety issues are addressed.

7 WORK ZONES

The following work zones are defined for the sediment and soil sampling activities.

Exclusion zone. The area immediately around the sampling activities will be designated as the exclusion zone. Traffic cones and/or caution tape will be used to delineate the specific area(s).

Contamination reduction zone. Not applicable. All sampling activities will occur within the exclusion zone.

Support zone. Not applicable. All sampling activities will occur within the exclusion zone.

Controls to be used to prevent entry by unauthorized persons. Sampling staff will remain cognizant of people approaching the exclusion zone. All unauthorized persons will be instructed to remain outside of the sampling area.

8 DECONTAMINATION

The field team will decontaminate all sampling equipment that comes into contact with soil prior to the commencement of sampling at each location and upon completion of the study. This will include equipment such as trowels, mixing bowls, and utensils. The decontamination will consist of thoroughly rinsing all of the equipment with potable water, then with soap (i.e., Alconox®) and rinsed with potable water after each use.

Clean gloves will be worn at each sampling location to avoid transfer of potential contaminants among samples. Otherwise, decontamination procedures will follow those presented in the general SHSP (TCAI 2009) and are incorporated herein.

9 VEHICLE SAFETY, SPILL CONTAINMENT, AND SHIPPING INSTRUCTIONS

Vehicle safety, spill containment, and shipping instructions are presented in the general SHSP (TCAI 2009) and are incorporated herein.

10 TASK-SPECIFIC SAFETY PROCEDURES

Slips, trips, and falls are anticipated to be the greatest hazards to field personnel during the soil sampling event, as well as unexpected contact with the sampling equipment. Always move about the shore or upland area with caution. Wear properly fitting shoes or boots with non-slip soles and good ankle support. Be aware of the location and movement of the grab sampler at all times.

The Site is located in a remote region with limited cellular phone coverage. All field crews will have a satellite phone to maintain communication with the field supervisor. The field crews will coordinate departure and expected return times for all field activities with the field supervisor. Field crews will provide the field supervisor with status updates at least every 4 hours while performing field collection activities.

The areas that will be sampled are accessible to the public. Always be aware of your surroundings. Use the buddy system and keep in line-of-sight contact with other sampling personnel at all times. Do not leave samples or sampling equipment unattended. If you feel threatened, or if the situation feels unpredictable, leave the area immediately.

Always wear nitrile gloves and safety glasses or goggles when handling sampling equipment, samples, or preservative chemicals (if required). Keep a 1-L eye wash bottle accessible during all field work. Avoid getting preservatives on your skin or clothes. If any preservatives are spilled or splashed on your skin or clothes, immediately rinse the affected area with potable water and get medical attention, if warranted. If any preservative is splashed in the eye, flush the eye with the eye wash solution and get immediate medical attention.

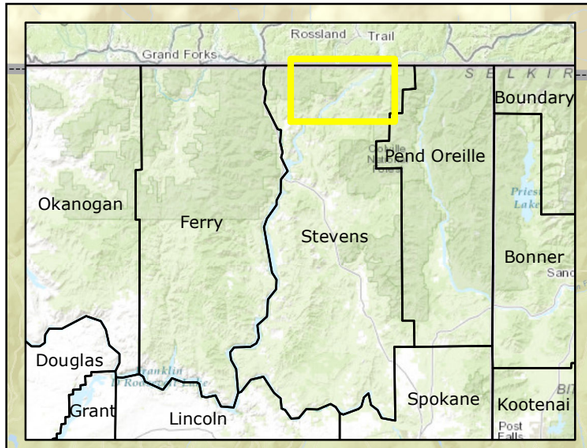
11 REFERENCE

TCAI. 2009. Upper Columbia River general site health and safety plan for the remedial investigation and feasibility study. Prepared for Teck American Incorporated. Integral Consulting Inc., Mercer Island, Washington, and Parametrix, Bellevue, WA.

ATTACHMENT D3-1

SITE MAP AND HOSPITAL LOCATION MAPS

U.S. - Canada Border



HWY 25 N

Northport

Cedar Lake

Pepoon Lake

Ansaldo Lake

Northport Flat Creek Road

China Bend

Lake Roosevelt National Recreation Area

HWY 25 N

Onion Creek Rd

Legend

- Northport Exclusion Area
- Marble
- 2014 Residential Soil Sampling Area
- 2016 Residential Soil Sampling Area

Ramboll Environ

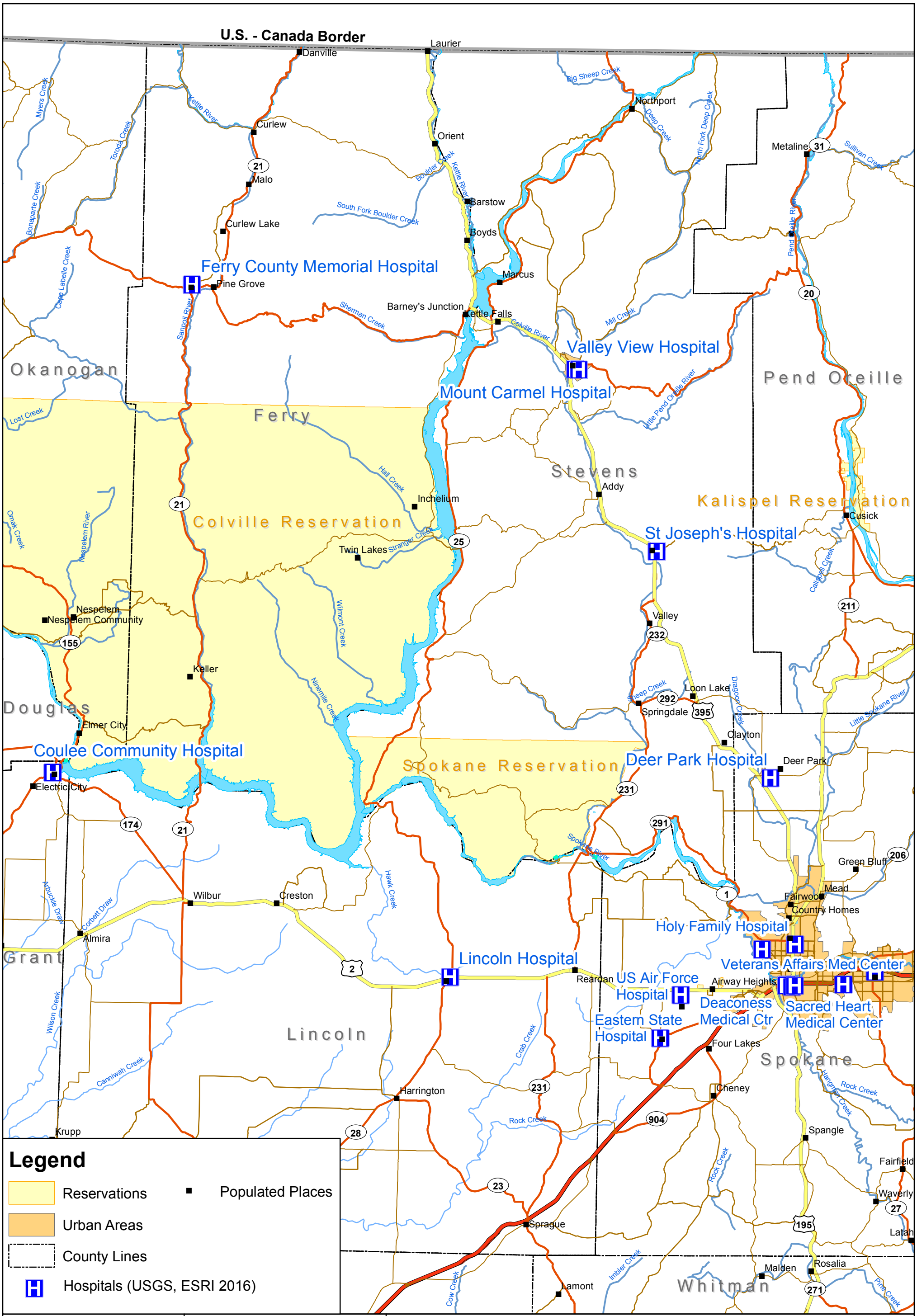
0 3 6 Km

0 2.5 5 Miles

N

Site Map

Upper Columbia River, WA


U.S. - Canada Border
Laurier
Danville
Myers Creek
Kettle River
Curlew
Orient
Big Sheep Creek
Northport
Deep Creek
North Fork Deep Creek
Metaline
31
Sullivan Creek
Toroda Creek
21
Malo
Boulder Creek
Kettle River
Barstow
Bonaparte Creek
South Fork Boulder Creek
Curlew Lake
Boyds
Pend Oreille River
Ferry County Memorial Hospital
Marcus
Cape Labelle Creek
Pine Grove
20
Barney's Junction
Kettle Falls
Sherman Creek
Mill Creek
Sanpoil River
Colville River
Valley View Hospital
Okanogan
Mount Carmel Hospital
Pend Oreille
Lost Creek
Ferry
Little Pend Oreille River
Stevens
Hall Creek
Addy
Kalispel Reservation
Inchelium
Onak Creek
Nespelem River
21
Colville Reservation
Cusick
St Joseph's Hospital
Twin Lakes
Stranger Creek
25
Callispell Creek
Wilmont Creek
211
Valley
Nespelem
Nespelem Community
232
155
Keller
Ninemile Creek
Sheep Creek
Loon Lake
Dragoon Creek
Douglas
292
Springdale
395
Little Spokane River
Elmer City
Clayton
Coulee Community Hospital
Spokane Reservation
Deer Park Hospital
Deer Park
Electric City
231
174
21
291
Spokane River
Green Bluff
206
Arbuckle Draw
Corbett Draw
Wilbur
Creston
Hawk Creek
1
Mead
Fairwood
Country Homes
Holy Family Hospital
Almira
Grant
Lincoln Hospital
2
Reardan
US Air Force Hospital
Airway Heights
Veterans Affairs Med Center
Deaconess Medical Ctr
Sacred Heart Medical Center
Wilson Creek
Eastern State Hospital
Lincoln
Crab Creek
Four Lakes
Spokane
Canniwah Creek
Harrington
231
Cheney
Hangman Creek
Rock Creek
904
Rock Creek
Spangle
Krupp
28
Fairfield
23
Waverly
27
Sprague
195
Latah
Malden
Rosalia
Imbler Creek
Lamont
Whitman
271
Cow Creek
Pine Creek
Legend
Reservations
Populated Places
Urban Areas
County Lines
Hospitals (USGS, ESRI 2016)
Ramboll Environ
Km
0 5.5 11
Miles
0 5 10
N
Hospital Location Map
Upper Columbia River, WA

ATTACHMENT D3-2

COLD-STRESS FACT SHEET

FROSTBITE

What happens to the body:

Freezing in deep layers of skin and tissue; pale, waxy-white skin color; skin becomes hard and numb; usually affects fingers, hands, toes, feet, ears, and nose.

What to do: (land temperatures)

- Move the person to a warm, dry area. Don't leave the person alone.
- Remove wet or tight clothing that may cut off blood flow to the affected area.
- **Do not** rub the affected area because rubbing damaged the skin and tissue.
- Gently place the affected area in a warm water bath (105°) and monitor the water temperature to **slowly** warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast, causing tissue damage. Warming takes 25-40 minutes.
- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. **Note:** If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible.

How to Protect Workers

- Recognize the environmental and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the signs and symptoms of cold-induced illnesses/injuries and what to do to help the worker.
- Train workers about cold-induced illnesses and injuries.
- Select proper clothing for cold, wet, and windy conditions. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear that will keep water away from the skin (polypropylene.)
- Take frequent short breaks in warm, dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system (work in pairs.)
- Drink warm, sweet beverages (sugar water, sports-type drinks.) **Avoid drinks with caffeine** (coffee, tea, or hot chocolate) **or alcohol**.
- Eat warm, high-calorie foods like hot pasta dishes.

Workers are at increased risk when…

- They have predisposing health conditions such as cardiovascular disease, diabetes, and hypertension.
- They take certain medications. Check with your doctor, nurse, or pharmacy and ask if medicines you take affect you while working in cold environments.
- They are in poor physical condition, have a poor diet, or are older.

HYPOTHERMIA - (Medical Emergency)

What happens to the body:

Normal body temperature (98.6°F/37°C) drops to or below 95°F/35°C; fatigue or drowsiness; uncontrolled shivering; cool, bluish skin; slurred speech; clumsy movements; irritable, irrational, or confused behavior.

What to do: (land temperatures)

- Call for emergency help (i.e., ambulance or 911).
- Move the person to a warm, dry area. Don't leave the person alone.
- Remove wet clothing and replace with warm, dry clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if he is alert. **Avoid drinks with caffeine** (coffee, tea, or hot chocolate) **or alcohol**.
- Have the person move his arms and legs to create muscle heat. If he is unable to do this, place warm bottles or hot packs in the armpits, groin, neck, and head areas. **Do not** rub the person's body or place him in a warm water bath. This may stop his heart.

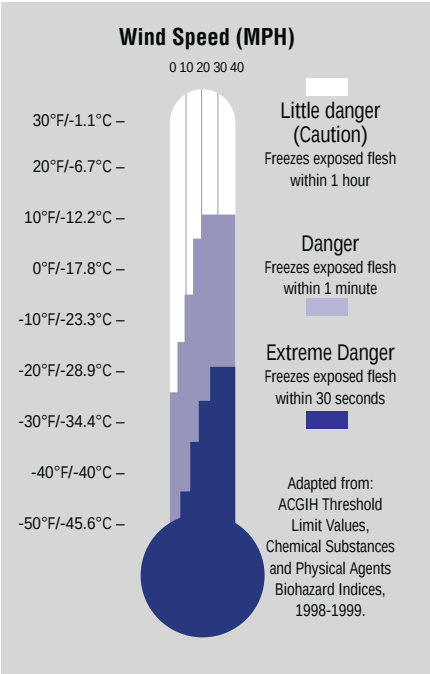
What to do: (water temperatures)

- Call for emergency help (i.e., ambulance or 911). Body heat is lost up to 25 times faster in water.
- **Do not** remove any clothing. Button, buckle, zip, and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.
- Get out of the water as quickly as possible or climb on anything floating. **Do not** attempt to swim unless a floating object or another person can be reached because swimming or other physical activity uses body heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

THE COLD STRESS EQUATION

LOW TEMPERATURE + WIND SPEED + WETNESS = INJURIES & ILLNESS

When the body is unable to warm itself, serious cold-related illnesses and injuries may occur, and permanent tissue damage and death may result. **Hypothermia** can occur when *land temperatures* are **above** freezing or *water temperatures* are below 98.6°F/37°C. Cold-related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing.



Oregon Occupational Safety & Health Division
440-3336E-S (9/03)

ATTACHMENT D3-3

HEAT-RELATED ILLNESS FACT SHEET

HEAT EXHAUSTION

What happens to the body:

Headaches, dizziness, or light-headedness, weakness, mood changes, irritability or confusion, feeling sick to your stomach, vomiting, fainting, decreased and dark-colored urine, and pale, clammy skin.

What should be done:

- Move the person to a cool shaded area. Don't leave the person alone. If the person is dizzy or light-headed, lay him on his back and raise his legs about 6-8 inches. If the person is sick to his stomach, lay him on his side.
- Loosen and remove heavy clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if he is not feeling sick to his stomach.
- Try to cool the person by fanning him. Cool the skin with a cool spray mist of water or wet cloth.
- If the person does not feel better in a few minutes call for emergency help (ambulance or call 911.)

(If heat exhaustion is not treated, the illness may advance to heat stroke.)

HEAT STROKE - A Medical Emergency

What happens to the body:

Dry, pale skin (no sweating); hot red skin (looks like a sunburn); mood changes; irritability, confusion, and not making any sense; seizures or fits, and collapse (will not respond).

What should be done:

- Call for emergency help (i.e., ambulance or 911.)
- Move the person to a cool, shaded area. Don't leave the person alone. Lay him on his back and if the person is having seizures, remove objects close to him so he won't hit them. If the person is sick to his stomach, lay him on his side.
- Remove heavy and outer clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if he is alert enough to drink anything and not feeling sick to his stomach.
- Try to cool the person by fanning him or her. Cool the skin with a cool spray mist of water, wet cloth, or wet sheet.
- If ice is available, place ice packs in armpits and groin area.

How to Protect Workers

- Learn the signs and symptoms of heat-induced illnesses and what to do to help the worker.
- Train workers about heat-induced illnesses.
- Perform the heaviest work during the coolest part of the day.
- Slowly build up tolerance to the heat and the work activity (usually takes up to 2 weeks.)
- Use the buddy system (work in pairs.)
- Drink plenty of cool water (one small cup every 15-20 minutes.)
- Wear light, loose-fitting, breathable (like cotton) clothing.
- Take frequent short breaks in cool, shaded areas (allow your body to cool down.)
- Avoid eating large meals before working in hot environments.
- Avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk of heat illnesses.)

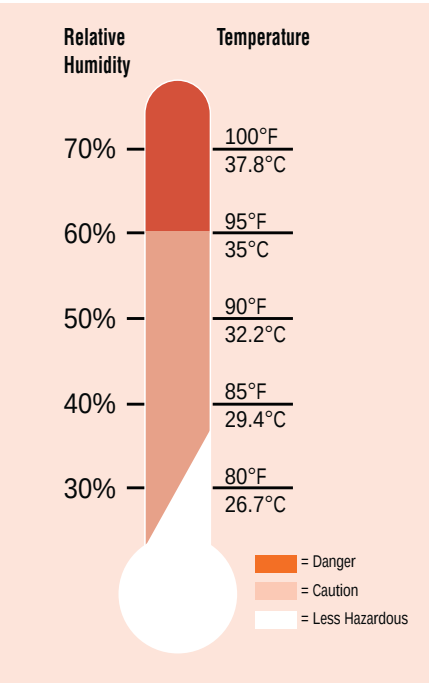
Workers are at increased risk when…

- They take certain medications. Check with your doctor, nurse, or pharmacy to see if medicines you take affect you when working in hot environments.
- They have had a heat-induced illness in the past.
- They wear personal protective equipment.

THE HEAT EQUATION

HIGH TEMPERATURE + HIGH HUMIDITY + PHYSICAL WORK = HEAT ILLNESS

When the body is unable to cool itself through sweating, **serious** heat illnesses may occur. The most severe heat-induced illnesses are **heat exhaustion** and **heat stroke**. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and **death**.



Oregon Occupational Safety & Health Division
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ATTACHMENT E

LABORATORY ANALYTICAL METHODS

ALS Standard Operating Procedure

DOCUMENT TITLE:	SUBSAMPLING AND COMPOSITING OF SAMPLES
REFERENCED METHOD:	N/A
SOP ID:	GEN-SUBS
REVISION NUMBER:	6
EFFECTIVE DATE:	04/01/2015

SUBSAMPLING AND COMPOSITING OF SAMPLES

ALS-KELSO

SOP ID:	GEN-SUBS	Rev. Number:	6	Effective Date:	04/01/2015

Approved By: _____ Date: 2/20/15
Department Supervisor/Technical Director – Harvey Jacky

Approved By: _____ Date: 2/20/15
QA Manager – Lee Wolf

Approved By: _____ Date: 2/24/15
Laboratory Director – Jeff Grindstaff

Issue Date: _____	Doc Control ID#: _____	Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

TABLE OF CONTENTS

1.SCOPE AND APPLICATION 3
2.METHOD SUMMARY 3
3.DEFINITIONS 3
4.INTERFERENCES 4
5.SAFETY 4
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE 4
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS 5
8.APPARATUS AND EQUIPMENT 5
9.PREVENTIVE MAINTENANCE 6
10.RESPONSIBILITIES 6
11.PROCEDURE 6
12.QA/QC REQUIREMENTS 15
13.DATA REDUCTION AND REPORTING 15
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA 15
15.METHOD PERFORMANCE 16
16.POLLUTION PREVENTION AND WASTE MANAGEMENT 16
17.TRAINING 16
18.METHOD MODIFICATIONS 17
19.REFERENCES 17
20.CHANGES SINCE THE LAST REVISION 18

SUBSAMPLING AND COMPOSITING OF SAMPLES

1. SCOPE AND APPLICATION

1.1. This standard operating procedure describes procedures for obtaining subsamples used for laboratory analysis. The procedure also describes general practices for making composite samples from multiple individual samples. Procedures are given for aqueous, soil, sediment, vegetation and miscellaneous matrices. The SOP does not apply to tissue samples. Procedures for tissue samples are described in the GEN-TISP and MET-TDIG SOPs.

1.2. The SOP describes routine, or default, procedures for samples that do not require VOC analyses. Handling of VOC samples is described in SOP VOC-5035. Program or project-specific requirements may differ from those described in the SOP. Samples analyzed by EPA CLP procedures are specifically excluded from this procedure, and will be handled according to the applicable SOW.

1.3. Multi-increment samples require special handling and subsampling procedures. In addition to routine procedures, this SOP also includes instructions for handling and sampling from multi-increment samples submitted to the laboratory.

1.4. This procedure does not apply to situations where the entire sample (container) is used for the analysis.

2. METHOD SUMMARY

2.1. Obtaining a representative analytical subsample from the field sample submitted is essential to providing meaningful data. The subsample must be taken to most closely reflect the predominant composition of the sample. For aqueous and liquid samples, this is usually accomplished by shaking or inverting the sample. For soil, sediment, powders, and other solids the procedures are more involved. Procedures for subsampling are based on the information given in the references listed.

2.2. Some projects may employ multi-increment (MI) sampling in the field. The primary objective of MI sampling is to control the certain statistical errors associated with discrete sampling. Some studies have shown that MI sampling, using 30+ sample increments within a decision unit (a defined field sampling area) may provide a more representative view of contaminant concentrations than traditional discrete sampling approaches. References listed provide additional background on MI sampling. When this approach is taken it is important that laboratory procedures are consistent with field procedures when taking samples.

2.3. Unique sample matrices such as vegetation, wood and wood chips, mechanical parts and filters, etc. pose additional challenges to obtaining representative samples. For these samples the laboratory staff should consult with the Project Manager to determine the subsampling strategy. These special situations will be handled on a case-by-case basis. Service requests should list any specific sample preparation required.

3. DEFINITIONS

3.1. Sample – A portion of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity (ASTM).

3.2. Subsample – A portion of a sample taken for the purpose of estimating properties or composition of the whole sample (ASTM).

3.3. Composite sample – A mixture of multiple samples or subsamples produced to result in one sample representative of multiple field samples.

3.4. Representative subsample – A subsample collected in such a manner that it reflects one or more characteristics of interest (a defined by the project objectives) of the laboratory sample from which it was collected (ASTM).

3.5. Multilayered sample – A sample consisting of two or more clearly differentiated components (ASTM).

3.6. Multi-increment sample (MIS) – A field sample consisting of multiple bulk containers from one decision unit (defined in a MIS sampling plan) submitted to the lab for subsampling into a representative sample for analysis. Also known as Incremental Sampling Methodology (ISM).

4. INTERFERENCES

4.1. When obtaining subsamples it is important to minimize any chances for sample contamination or cross-contamination between samples. Work should be performed in an organized and neat manner. Spilling of samples (from overfilled containers, etc.) should be minimized and spills cleaned up. Equipment and laboratory tools used with samples should be cleaned between samples to prevent cross-contamination.

4.2. Analysis-specific interferences are described in the applicable analytical SOP.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Refer to the analytical SOP for sample collection preservation and storage of samples. Subsamples and composite samples held for later analysis should be preserved and stored in the same manner as specified for field samples.

6.2. MIS Projects

6.2.1. Projects for MI samples may include additional instructions not found in the analytical SOP. The analyst should consult with the Project Manager, or refer to the Project Manager's instructions, prior to working with these samples.

6.2.2. LIMS test codes are used to specify which MIS-analytical tests are needed (e.g. ISM-PAH). These test codes will have holding times associated with them that will ensure the completion of the MIS work before the initial analytical holding times (e.g. sample extraction) lapse.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Dichloromethane, acetone, and acetonitrile may be used during the noted procedures for cleaning and decontamination of equipment.

8. APPARATUS AND EQUIPMENT

8.1. Laboratory balance capable of weighing the desired sample mass. There are various makes and models of balances available for use, with each department having balances appropriate for its use. For weighing solids and non-aqueous liquids (wastes), use a top-loader balance. Ensure that the mass (sample + container) to be placed on the pan is within the calibration-verified range of the balance.

8.2. Wiley laboratory mill, Model 4. Operate the Wiley mill following the manufacturer's recommendations.

8.3. Sieve shakers.

8.4. Shatter box.

8.5. Mechanical mixer and/or shaker.

8.6. Stainless steel or Glass mixing bowl.

8.7. Metal or disposable spoons and spatulas.

8.8. Aluminum foil.

8.9. Weighing boats, plastic or aluminum

8.10. Clean sample containers and lids (various sizes) as specified in the applicable test SOP.

8.11. Common laboratory glassware/apparatus (beakers, flasks, pipets, syringes, etc.).

8.12. Multi-Increment Samples

8.12.1. Flat spatula, modified to create sides perpendicular to the flat surface used to scoop.

8.12.2. Flat stainless steel masons trowel

8.12.3. Volatile sample containers.

8.12.3.1. 250-500 milliliter (ml) narrow mouth, amber bottles (recommended)

8.12.3.2. 4-8 ounce (oz.) amber jars with Teflon lined septum lids

8.12.4. Large stainless steel spoon or scoop

8.12.5. Large clean containers (a large stainless steel or glass bowl, Ziploc bags, or 5-gallon bucket)

8.12.6. #10 (2mm) sieve

8.12.7. Stainless steel cookie sheet or other tray.

9. PREVENTIVE MAINTENANCE

9.1. No preventive maintenance is required other than normal glassware and apparatus cleaning.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in ADM-TRAIN, *ALS-Kelso Training Procedure*.

11. PROCEDURE

11.1. Aqueous samples - Subsampling

11.1.1. Examine the sample. Thoroughly mix all samples by vigorous shaking. Immediately open the container and obtain the subsample. Additional filtering of the subsample may be required by the analytical SOP.

11.1.2. If the sample is multi-layered (a water layer with a sand/sediment layer that cannot be mixed or non-aqueous liquid layer) the Project Manager should be consulted on how to proceed with the sample. Additional analyses or sample preparations may be necessary depending on the client's data needs. Document the condition of the sample and decision made on subsampling.

11.2. Aqueous samples - Compositing

11.2.1. The customer may require compositing based on flow rates to create a flow proportional composite. The compositing instructions are included with the Form V or other project specification. Equal volume compositing is assumed if there are no specific instructions provided for compositing ratios.

11.2.2. Setup the necessary glassware and/or sample container receiving the composite sample. Ensure that proper measuring glassware is used, typically a graduated cylinder or volumetric flask for larger volumes and pipet or syringe for smaller volumes.

11.2.3. Working quickly, mix the individual samples (as described above), open the container(s) and obtain the composite aliquot. Add each aliquot to the composite container and cap between samples.

11.2.4. Once all composite aliquots are obtained, cap and mix the composite sample. Label the container appropriately. Complete all documentation necessary to describe the compositing procedure, including samples used, aliquot taken, etc.

11.3. General considerations – Non-liquid samples

11.3.1. The analyst must first understand what the sample matrix of interest is. The project information should be consulted. If the sample appears to be homogeneous (other than extraneous materials described below) particle size reduction is not necessary. Particle size reduction should is performed only when required by the project QAPP, project specifications, or client request. If particle size reduction is required, use the appropriate apparatus (Wiley mill, shatter box, etc.) to perform crushing, grinding, milling, or sieving, and document. Refer to ASTM D6323 for guidelines on performing particle size reduction.

11.3.2. Once the matrix of interest is known, examine the sample for presence of extraneous material. The default procedure is to remove these items, or not include in the representative subsample. However, the presence of these materials should be documented in lab records and the Project Manager should be consulted prior to subsampling. Some examples are given below.

- Soil, solid, and sediment samples may include such material as larger rocks, sticks, leaves, pieces of metal, man-made materials, etc.
- Wood or bark samples may include chunks of soil, mud, rocks, etc.
- Vegetation samples may include chunks of soil, mud, rocks, sticks (not of the sample type, etc.).
- Sediment samples may include rocks, twigs, vegetation, organisms, etc.
- Sediment/marine projects, organisms are typically analyzed under separate sampling and analysis plans.
- Mechanical parts, filters, etc., may include chunks of soil, mud, rocks, sticks, etc.

11.3.3. Examine soil samples to determine if the sample contains significant amounts of water. If the amount of water is greater than approximately 30%, treat the sample as a sediment sample.

11.3.4. Samples which are especially heterogeneous, as well as various special matrices, may require additional preparation. These will be handled on a case-by-case basis after consultation with the appropriate supervisors and Project Manager. Unique matrices for TCLP and other leaching procedures should be handled according to the applicable SOP or reference method.

11.4. Soil/solid Samples

11.4.1. Subsampling samples in jars

11.4.1.1. Using a spatula or other utensil made of an inert material, thoroughly mix and homogenize the sample, making sure to loosen sample from the sides of the container, and continue mixing the entire contents, breaking up soil clumps, etc., until there is no visible segregation of the sample by layer, grain size, color, etc. The sample should appear uniform in color and texture.

11.4.1.2. Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.4.2. Subsampling samples in sleeves (core samples) and large bulk containers.

11.4.2.1. Empty samples in sleeves into a metal or glass homogenizing container and thoroughly stir using a spatula or other utensil. When homogenized the appropriate sample portions are placed in jars. Perform additional drying and grinding only when specified for the project. Client specifications for drying and grinding will be communicated by the Project Manager.

11.4.2.2. When working with sleeves and resulting homogenized samples or subsamples, always double-check the sample ID on the sleeve against the sample numbers on the samples.

11.4.3. Compositing soil/solid samples

11.4.3.1. Thoroughly mix each individual sample as described above.

11.4.3.2. Combine equal masses from each of the individual samples into a clean stainless steel mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations.

11.4.3.3. Thoroughly homogenize the sample using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification, dated, and initialed.

11.4.3.4. Return the composite sample and remaining individual samples to storage.

11.5. Sediment Samples - Subsampling

11.5.1. Standard procedure calls for mixing overlying water into the sample. EPA SW-846 methods for organic extractions specify to decant and discard overlying water. However, the Puget Sound Protocols and others have options for decanting and discarding this water, decanting and performing a separate water analysis, or mixing the water into the sample. The analyst should confirm which option is to be used on the sample. For projects not within the scope of the Puget Sound Protocols or similar project plans, the overlying water should be decanted and discarded for organics analysis. For metals and inorganics, mix the overlying water into the sample.

Note: If water is decanted and discarded and percent solids is to be applied or determined, a separate solids determination must be made on the decanted sample.

11.5.2. Thoroughly mix and homogenize the sample, making sure to mix the entire contents of the jar. Additional steps may be needed to homogenize the sample (break up soil clumps, etc.). The sample should be mixed so there is a uniform color and texture. See section 11.4.1.1.

Note: Sediment samples may contain considerable amounts of organics matter. Ensure that samples and thoroughly mixed. Document the presence of substantial organic matter, shells, etc.

11.5.3. Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.5.4. The subsample is transferred to an appropriate, labeled container. The sample container is stored in the appropriate refrigerator in sample receiving and any empty sleeve can be stored at room temperature.

11.6. Sediment Samples - Compositing

11.6.1. Thoroughly mix each individual sample as described above.

11.6.2. Combine equal masses from each of the individual samples into a clean stainless steel mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations.

Note: Equal masses are used unless otherwise instructed. It may be required to use the entire jar or other measure.

11.6.3. The sample is thoroughly homogenized using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification, dated, and initialed.

11.6.4. The composite sample and remaining individual samples are returned to storage.

11.6.5. Samples should be received prepared from the field as sample increments. Although unlikely, in cases where proper preparation of increments from large bulk samples does not occur in the field, the following steps will be taken.

11.6.5.1. When obtaining sample increments from a large bulk container (bucket, large jar, large bag, etc.) be sure to sample from the center and remove the soil 1-2 inches deep. Using the large spoon or scoop, collect the sample increment according to the work plan. Scoop approximately 30-60 grams into a large, clean container and move on to the next sample increment location. Be cautious of oversize material, which means more mass may need to be taken from each increment to end with the 30–50 g sub-sample after sieving (a 5 kg field sample may not be uncommon). Increments can be sieved directly into the bucket, or they can be bagged and sieved later.

11.7. Multi-Incremental Sampling (or Incremental Sampling Methodology (ISM)) – When laboratory subsampling using MIS/ISM is to be used to produce the analytical subsample(s), the following procedures are used.

NOTE: Section 11.7.1 lists the default procedure that is to be used when no other client or project specifications or modifications are given. This section refers to two tables – one specifying default increment amounts for analytical and one listing a "large mass" option that is to be used only when project specified. Section 11.7.2 describes the procedures to be used when the State of Hawaii DOH protocol is specified. Section 11.7.3 describes procedures for analysis method 8330B.

If, after reviewing the project and Service Request information, the analyst has any uncertainty of the MIS approach to take, they must confirm with the Project Manager the protocol to be used.

11.7.1. Default procedure

11.7.1.1. After the 30-50 sample increments have been field collected into a container (a 5 kg field sample may not be uncommon) air dry the entire sample (all received containers) in aluminum pans pre-rinsed 3 times with DCM (dichloromethane/methylene chloride). Note, if Aluminum is a target analyte of interest then substitute the aluminum pans for glass or stainless steel. Air drying may take 2-4 days with occasional stirring.

11.7.1.2. The intent of air drying is to convert the sample to a more manageable form prior to sieving. The sample is considered air-dried when the material appears dry enough to enable disaggregation and sieving. Due to high variability of laboratory samples, sample dryness should be confirmed by a senior analyst or supervisor prior to going further with the procedure.

11.7.1.3. Rinse all utensils and equipment with DCM three times prior to use (stainless steel tray, mortar & pestle, 2mm sieve & catch pan, trowel, ISM spatula).

11.7.1.4. Lightly grind the air dried sample with a mortar & pestle in order to break up dirt and clay chunks (do not size reduce rocks or vegetation) and pass sample through a 2mm sieve.

11.7.1.5. Weigh the remaining +2mm fraction in an appropriate sized jar and record the weight on the ISM bench sheet. Describe the +2mm fraction on the bench sheet (size of rocks, type of any vegetation, etc.).

11.7.1.6. Weigh and record the weight of the -2mm fraction.

11.7.1.7. Mix the sample, dump on a DCM-rinsed stainless steel pan, and spread the sample out with a trowel, forming a rectangle no more than 1cm deep.

11.7.1.8. Divide the sample into a minimum of 30 equal sections (30 to 50 sections is recommended) using the trowel blade. Note that the entire sample should be included in the grid and amount of sample 'outside' the grid outer edges

minimized (however, do not overly manipulate the sample in an attempt to create a perfect grid).

11.7.1.8.1. Collect an equal (approximate) amount of sample from each of the sections based on the applicable table (Table 1 or Table 2) and place into a labeled container (see Tables 1 and 2). Scrape the modified flat spatula along the bottom of the tray and pull straight up to make sure all depths and particle sizes are represented in the collection area. Avoid collecting portions from the edge of gridlines (where the slab has been disturbed). Record the exact final weight of sample for each test on the ISM bench sheet and on the jar. Metals tests should be weighed on an analytical balance. All larger amounts can be done on a 2-place balance.

11.7.1.8.2. Since the each laboratory area must analyze the entire contents of the prepared (or submitted) jar, the subsampling process must be repeated for each separate analysis to be performed on the sample. The subsampling process must be performed for each individual QC sample as well. The entire mass in the jar will be analyzed (TOC is the exception). The results may be less defensible if only a subsample or fraction of the jar contents is analyzed.

11.7.1.8.3. If sample amount is sufficient, it is recommended to repeat the process to obtain a backup sample in the event that re-analysis is required. This 'As Received' backup is placed back in the original sample jar and returned to sample management/custody.

11.7.1.9. Labeling and storage

11.7.1.9.1. Refer to Table 3 for default storage conditions, which are based on how the MIS sample was prepared and on the stability/volatility of target analytes.

11.7.1.9.2. MIS subsamples do not need to be returned to SMO for barcode labeling. Label the sub-aliquots with LIMS sample labels and deliver them to the designated storage areas for each lab section performing analysis. Document the internal custody transfer in a logbook, on the benchsheet, or similar fashion. .

11.7.1.9.3. Place any remaining -2mm sample into jars labeled as "-2mm archive." If there are multiple jars, label them as "1 of 3", "2 of 3", etc. All remaining bulk sample jars must be returned to SMO for barcode labeling and storage.

Usually, the -2mm archive and test archive (back-up samples) jars are placed in a freezer, while the +2mm archive and test jars (with QC) are placed on the room temperature shelves.

11.7.2. Procedure for ISM following State of Hawaii DOH Protocol (see references)

11.7.2.1. Samples requesting the Hawaii DOH procedure require wet and/or dry sieving depending on the test/analytes for which subsamples are being

prepared. Refer to a copy of the Hawaii DOH procedure and/or the Project Manager for details before beginning.

11.7.2.2. Obtain instructions from the Project Manager or Service Request for increment amounts and test subsample amounts. Also refer to the *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, November 12, 2008, Section 4.2.2 for guidance on increment/sample amounts.

11.7.2.3. Subsample bulk MI samples to be tested for SVOCs, including TPH-D, some PAHs, and Mercury, unstable pesticides, should be subsampled without drying or sieving in order to minimize chemical loss or alteration and meet holding times for analysis. Refer to Table 2a. of *Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations* , March 2011, State of Hawaii, Department of Health, Reference document number 2011-143-RB.

11.7.2.4. If both SVOC and non-volatile PAHs are targeted contaminants of interest then include testing for both in laboratory subsamples collected from the multi-Increment sample prior to drying and sieving.

11.7.2.5. For wet ISM aliquots, organic tests (SVG/SVM) require a larger aliquot size to accommodate for the extra water content. In most cases, low-level organic tests will require a 40g wet aliquot (max weight capacity for most tests) and normal level tests will require a 20g wet aliquot (double the target dry weight).

11.7.2.6. Use a separate sample from the wet material and test for soil moisture in order to convert analytical results to dry-weight basis.

11.7.2.7. Not all samples from Hawaii require the State of Hawaii DOH procedure. See service request and/or verify with the Project Manager.

11.7.3. Procedure for ISM on 8330B Explosives

11.7.3.1. Samples from Ammunition Depots and anywhere except Firing Ranges (not DOD)

11.7.3.1.1. Follow the basic ISM procedure, except all utensils/pans need rinsed 3 times with Acetonitrile (instead of DCM). Collect a 10.00g aliquot and place in a 4oz amber jar (explosives are sunlight sensitive).

11.7.3.2. Samples from Firing Ranges

11.7.3.2.1. Grinding: For firing ranges, the entire -2mm portion collected from the sieving procedure must be ground to a powder in the shatter box.

11.7.3.3. Method 8330B DOD samples

11.7.3.3.1. Grinding: For DOD work, the entire -2mm portion collected from the sieving procedure must be ground to a powder in the shatter box prior to proceeding. Note: high-speed milling, such as in the shatter box, can elevate sample temperature due to friction. The thermal stability of the target analytes should be considered when performing this grinding procedure. Method 8330 B specifies a 2-minute (or longer) cool down period between five 60-second grinding intervals to maintain acceptable temperatures and minimize loss of volatile energetic contaminants.

11.7.3.3.2. An SRM (supplied by the Organic LC instrument lab) must be taken through the grinding and ISM procedure (already dry so doesn't need to be air dried or sieved). Shatter box 50g to 100g of the well-mixed SRM, and then make a 10g aliquot after grinding. Place the aliquot in 4oz amber jar. Archive the remaining SRM in an amber jar.

11.7.3.3.3. Grinding Blank: Matrix sand blanks (use baked sand) must be ground in the shatter box between each sample and aliquoted following the ISM procedure. The blanks can be ground in equal portions and then recombined at the end to make one sample requiring one ISM aliquot procedure. (Example: To ISM a 200g portion for use in making the final 10g aliquot, divide 200g by the number of samples needing shatter box and grind that amount of matrix sand between each sample. Recombine all ground matrix sand at the end and ISM one 10g aliquot from the 200g of ground matrix sand.) Archive the remaining matrix sand in an amber jar.

11.8. Analyte-Specific Considerations

11.8.1. Metals

11.8.1.1. It has been proven that grinding can greatly improve the reproducibility for metals analyses. However, erosion of the metals surfaces used in grinding may contribute to a high bias in the samples. It is recommended that the tungsten carbide grinding mill is used when grinding soils in the shatter box thereby limiting the amount of potential bias in the prepared samples.

11.8.1.2. When grinding soil samples that may potentially contain ores of malleable metals (e.g. Lead, Copper, Tin) be aware that the malleable particles may tend to smear during grinding, and may be lost from the samples to equipment surfaces. This anomaly may bias sample results low, decontamination of equipment surfaces may be difficult and could result in high bias in subsequent samples from carry over.

11.8.1.3. Reproducibility for Lead analyses in unground, incrementally sampled (IS) samples from small arms firing ranges may have an unacceptable large variability. The large variability for Lead may be due to single particles of Lead between one and two millimeters in diameter being present in only some of the replicate splits. If the end data is to assess risk of accidental ingestion of Lead, precision for the concentration of lead contained in larger particles may be of less interest then the Lead contained in the finer, less than 0.25 mm, fraction. Using a finer mesh sieve (0.25 mm rather than 2

mm) may improve precision and reproducibility. However, sieving unground samples through sieves finer than two millimeters is not appropriate if analyzing for high explosives or propellants. Typical mass sizes for energetic analytes are in particles sizes greater than 0.59 millimeters.

11.8.1.4. MI samples collected for Arsenic analyses that contain greater than 20 mg/K total Arsenic should be tested for bioaccessible Arsenic. This should be discussed with the project manager. If deemed appropriate, the entire <2mm fraction of the respective samples should be sieved to a ≤0.25 mm, representatively sub-sampled and analyzed for bioaccessible Arsenic using SBRC methodology, 1-2 grams are required.

11.8.2. Polycyclic Aromatic Hydrocarbons (PAHs)

Currently there is little information in published procedures specific to the laboratory processing of ISM samples for PAHs. The default procedure above is used, but the 8330B procedure is an acceptable option if specified.

11.8.3. Perchlorate

11.8.3.1. Currently there is little information in published procedures specific to the laboratory processing of ISM samples for Perchlorate. Laboratory processing of samples per EPA Method 8330B as described in Section 11.7.3 is recommended. A 10 gram sample is required for propellants and explosives. It is recommended that a 10 gram ISM sample should be extracted with 100mL of DI water for Perchlorate analysis by EPA Method 314.0.

11.9. Vegetation samples

Since vegetation samples often are not amenable to standard mixing and homogenization techniques, or because specific sections of the vegetation are targeted, these are handled on a case-by-case basis with instructions from the Project Manager. The PM will obtain sample-specific instructions from the client, and then communicate the specifications to the lab personnel using the ALS Form V or similar project specification document for the project. If the client makes reference to specific procedures, methods, or technical references, the PM will make the document(s) available to the laboratory personnel.

11.10. Paperboard samples

11.10.1. In general, prepare paperboard samples as described below. Project-specific instructions may replace these.

11.10.2. Review the Service Request and determine the jars you will need. In general, the jars needed are as follows:

Metals = 8 oz. jar.
Voa = 8 oz jar.
Dioxins = 8 oz jar.
SVG = 32 oz jar.
SVM = 32 oz jar.
PHC (8315) = 8 oz jar.
Gen Chem (not Biology) = 8 oz jar.

11.10.3. Make sample labels according to test and put on appropriate jar.

11.10.4. If FDA Ext is on the Service Request for PHC you will need a 16 oz jar per sample. Do Not Composite into one sample. Each sample is a separate sample.

11.10.5. Prepare the FDA Ext first.

- Cut the sheet of paper into one 10" x 10" square.
- Cut the 10" x 10" into strips at the cut lines 7 ½, 5, and 2 ½.
- Cut the strips at the cut lines 7 ½, 5, and 2 ½. This will make 16 2" squares.
- Put each sample into its own jar and label accordingly. i.e. (1, 2 3, etc.); PHC will composite in the lab.

11.10.6. Put one sheet of paper into shredder, run the shredder back and forth to get the entire sample out. Use tongs to remove any remaining sample in bottom of shredder (make sure to turn off before you do this)

11.10.7. Shred equal amounts of each sample (1 or more sheets) to create the composite sample. Homogenize sample thoroughly and aliquot into each jar needed for analysis. Put sample storage on lid of jar.

11.10.8. Dioxins are sent out to Houston. Label the lid "Out".

11.10.9. Take all composites to Sample Management for ALS labeling and shelving.

11.10.10. Update composites as being done….Open Starlims, double click on Ad Hoc by Test (Under Results entry), highlight samples composited and click the Update to Done button at the top of page. Do not add jars when asked. Just click the X on the right hand corner.

12. QA/QC REQUIREMENTS

12.1. Ongoing QC Samples required for each sample batch (20 or fewer samples) are described in the SOP for Sample Batches and in the determinative SOPs.

13. DATA REDUCTION AND REPORTING

13.1. All compositing and subsampling data must be recorded into the bench records by the analyst. In addition to sample volumes and masses, sample identifications, etc., this should include descriptions of unique samples or sample components. Figure 1 shows the current MIS benchsheet template used to record MIS subsampling. Other project-specific benchsheets may apply.

13.2. It is the supervisor's responsibility to ensure that analytical data is reviewed and to ensure that all quality control requirements have been met.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for corrective action procedures. Personnel at all levels and positions in the laboratory are to be alert to

identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example. Table 4 lists typical actions taken.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. Not applicable.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS EH&S Manual.

16.2. It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

16.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

16.4. This method uses Dichloromethane and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

17. TRAINING

17.1. Training outline – Training Plan

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of time. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.2. Training is documented following the SOP for *Documentation of Training*.

17.2.1. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. Not applicable.

19. REFERENCES

19.1. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples, U.S. Environmental Protection Agency, EPA/600/R-03/027, November 2003.

19.2. Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities, ASTM D 6323, Annual Book of ASTM Standards, 1999.

19.3. Test Methods for Evaluating Solid Waste, EPA SW-846, Final Update III, December 1996.

19.4. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, January, 1996.

19.5. Draft Guidance on Multi-Increment Soil Sampling State of Alaska, Department of Environmental Conservation, March 2007.

19.6. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, November 12, 2008.

19.7. Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations, March 2011, State of Hawaii, Department of Health, 2011-143-RB.

19.8. Standard operating Procedure, In Vitro Method for Determination of Lead and Arsenic Bioavailability; Solubility/Bioavailability Research Consortium, Document 8601-102.011-0601-1099-RN01.

19.9. Figure 1: Multi Incremental Sampling Worksheet.

20. CHANGES SINCE THE LAST REVISION

20.1. Updated entire SOP to current ALS format and sections.
20.2. Corrected various typographical and grammatical errors, and similar minor changes made to improve readability.
20.3. Changed Project Manager to Project Manager throughout.
20.4. Section 3.6 – updated MIS definition to include ISM.
20.5. Section 6.2 – revised to add MIS holding time discussion.
20.6. Section 8.12.1 – revised to specify modified spatula with perpendicular sides.
20.7. Section 10.2 – New (default language added).
20.8. Section 11 – much of the section is reorganized with previous content to improve the relationship of topics and reading flow.
20.9. Section 11.7 – beginning note is new.
20.10. Section 11.7.1.2 – revised language on air drying completeness.
20.11. Section 11.7.1.8 – significant revision to improve association of topics and provide not detailed instructions. Moved Table from section to end of SOP.
20.12. Section 11.7.1.8 and 11.7.1.8.1 – revised to add detail to increment sampling technique.
20.13. Sections 11.7.1.9 – revised to implement new processes.
20.14. Section 11.7.2 – added note to see references.
20.15. Section 11.8.2 – revised to indicate default procedure.
20.16. Section 13 – updated to refer to MIS benchsheet in Figure 1 and use of other MIS sheets.
20.17. Section 14 – New (default format).
20.18. Section 15 – New (default format).
20.19. Section 16 – New (default format).
20.20. Section 17 – updated with default language.
20.21. Section 18 – New (default format).
20.22. Section 19 – Updated references to Hawaii DOH documents.
20.23. Table 1 – added default basis and container columns.
20.24. Table 2 – new table.
20.25. Table 3 – new table.
20.26. Figure 1 – updated.

TABLE 1
Default Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container	QC Requirement
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar	DUP per 10
200.7 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 10
6010 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 20
200.8 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 10
6020 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 20
Mercury	Air Dried	0.5000 g	0.0167 g	Mercury digestion cup	DUP/MS per 20
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	None
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar	N/A

* For DOD projects refer to the DOD 8330B protocols.
** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 2
"Large Mass" Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container	QC Requirement
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar	DUP per 10
200.7 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 10
6010 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 20
200.8 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 10
6020 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 20
Mercury	Air Dried	5.00 g	0.167 g	Mercury digestion cup or 2 oz. soil jar	DUP/MS per 20
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	None
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar	N/A

* For DOD projects refer to the DOD 8330B protocols.
** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 3
Storage of Multi-Incremental Subsamples

Test	Storage
Total Solids	Room Temperature
200.7 Metals	Room Temperature
6010 Metals	Room Temperature
200.8 Metals	Room Temperature
6020 Metals	Room Temperature
Mercury	Room Temperature
8081 PEST	4 ± 2˚C
8081 PEST-LL	4 ± 2˚C
8082 PCB	Room Temperature
8082 PCB-LL	Room Temperature
8151	4 ± 2˚C
8270	4 ± 2˚C
8270 LL	4 ± 2˚C
PAH	4 ± 2˚C
PAH ULL	4 ± 2˚C
8290/Dioxin	Room Temperature
8330B*	4 ± 2˚C
Diesel or Residual Range Organics (DRO, RRO)*	4 ± 2˚C
TOC	Room Temperature
Backup Sample	4 ± 2˚C

* For DOD projects refer to the DOD 8330B protocols.

FIGURE 1

Multi-Incremental Sampling Benchsheet Template

Service Request #: _____

Analysis: **Multi Incrimental Sampling (MIS/ISM)**

Sample Number	+2mm Fraction Air Dried Weight (g)	Comments, Description of +2mm Fraction	-2mm Fraction Air Dried Weight (g)	-2mm Fraction Multi Incrimental Sample Aliquots									
				Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)

Comments:

Balance ID: K-BALANCE- 42

Prepared By:	**Date:**
Reviewed By:	**Date:**

ALS Standard Operating Procedure

DOCUMENT TITLE:	METALS DIGESTION
REFERENCED METHOD:	EPA 3050B
SOP ID:	MET-3050B
REVISION NUMBER:	14
EFFECTIVE DATE:	2/15/2015

ALS-Kelso Procedure Change Form

SOP Code: 3050B Revision: 14 Effective Date: 8-14-15			
SOP Section Number	**Description of Procedure Change**	**Date Procedure Change Implemented**	**Supervisor Initials & Date** Indicating Approval and Training of Staff
11.5	Wipe samples do not require the final two hour digestion process.	8-14-15	L.J
11.7	Wipe samples do not require the final two hour digestion process.	8-14-15	L.J.

METALS DIGESTION

ALS-KELSO

SOP ID:	MET-3050B	Rev. Number:	14	Effective Date:	02/15/2015

Approved By: _____ Date: 2/3/15
Department Manager/Technical Director – Jeff Coronado

Approved By: _____ Date: 2/3/15
QA Manager – Lee Wolf

Approved By: _____ Date: 2/3/15
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date

TABLE OF CONTENTS

1.SCOPE AND APPLICATION....3
2.METHOD SUMMARY....3
3.DEFINITIONS....3
4.INTERFERENCES....4
5.SAFETY....4
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE....4
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS....4
8.APPARATUS AND EQUIPMENT....6
9.PREVENTIVE MAINTENANCE....6
10.RESPONSIBILITIES....7
11.PROCEDURE....7
12.QA/QC REQUIREMENTS....9
13.DATA REDUCTION AND REPORTING....9
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA....10
15.METHOD PERFORMANCE....10
16.POLLUTION PREVENTION AND WASTE MANAGEMENT....10
17.TRAINING....11
18.METHOD MODIFICATIONS....11
19.REFERENCES....11
20.CHANGES SINCE THE LAST REVISION....11

METALS DIGESTION

1. SCOPE AND APPLICATION

1.1. This procedure uses techniques described in method 3050B for acid digestion of sediments, sludges, and soil samples designated for "Total Metals" analysis. One technique is designed for the preparation of samples for analysis by flame AA (Methods 7420-Pb, 7742-Se, and 7062-As) or ICP-OES (methods 6010 and 200.7). Another technique is given for the preparation of samples for analysis by GFAA (see SOP MET-GFAA for methods) or ICP-MS (methods 6020 and 200.8). This procedure is not a *total digestion* technique, but extracts "environmentally available" elements from the sample of interest.

2. METHOD SUMMARY

2.1. One-gram equivalent dry weight sediment, sludge, or soil samples are digested with repeated additions of nitric acid (HNO3) and hydrogen peroxide (H2O2). For GFAA and ICP-MS analysis the resultant digestate is reduced in volume while heating and then diluted to a final volume of 100 mL. For ICP-OES and flame AA analysis, hydrochloric acid (HCl) is added to the initial digestate and the sample is refluxed prior to dilution to a final volume of 100 mL.

3. DEFINITIONS

3.1. **Batch** - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.2. **Preparation Batch** - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.3. **Sample**

3.3.1. Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.3.2. Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.4. **Quality System Matrix** - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.4.1. Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.5. **Laboratory Control Sample (LCS)** - A laboratory blank that has been fortified with target analyte and used to determine that the analysis is in control.

3.6. **Matrix Spike (MS)** - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The percent recovery is calculated. The MS is used to evaluate the effects of the sample matrix on the method used for the analysis. The concentration of the spike should be at three to five times the sample result or at levels specified by a project analysis plan.

3.7. **Duplicate Sample (DUP)** - A laboratory duplicate. The duplicate sample is a separate field sample aliquot that is processed in an identical manner as the sample proper. The relative percent difference between the samples is calculated and used to assess analytical precision.

3.8. **Method Blank (MB)** - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

4. INTERFERENCES

4.1. Refer to the determinative method for a discussion of interferences.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield must be used while pouring concentrated acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Samples may be collected in plastic or glass jars. Non-aqueous samples are refrigerated at 4 ± 2˚C from receipt until analysis.

6.2. The recommended holding time is 6 months from the day of sampling.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements.

7.2. Reagent water: ASTM Type I water (resistivity ≥18 MΩ-cm, conductivity ≤0.056 uS/cm).

7.3. Concentrated Nitric Acid: J.T. Baker "Instra-analyzed", Trace Metals Grade

7.4. Concentrated Hydrochloric Acid: EMD GR ACS

7.5. Hydrogen Peroxide (30%): EMD GR ACS

7.6. Standards

7.6.1. Stock standards may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The vendor assigned expiration date is used.

7.6.2. Metals spiking solutions: Five spiking solutions are needed to prepare the matrix spike sample; SS1, SS2, SS3, SS4, and SS5.

7.6.3. Follow the formulations laid out on the "Metals Spike Form" (see attached Table A). These solutions are prepared in acid rinsed Class A volumetric flasks using purchased custom mixed standards or 1000 ppm single analyte standards. Aliquots are made using acid rinsed Class A volumetric pipettes of the appropriate size.

7.6.4. SS1 (Al, Ag, Ba, Be, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, Sb, V, and Zn): Fill a 1000 mL volumetric flask approximately half full with reagent water, add 50 mL of nitric acid and mix. Next add 100 mL of the custom mixed standard (CAS-CAL-14) purchased from "Inorganic Ventures". In addition add 50 mL of 1000 ppm Antimony(use the Antimony standard that does not contain HCL.) Dilute to volume with reagent water, mix thoroughly and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.6.5. SS2 (GFAA As, Cd, Cu, Pb, Se, Tl): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 2.0 mL each of 1000 ppm Arsenic, Cadmium, Copper, Lead, Selenium, and Thallium. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.6.6. SS3 (As, Se, Tl, and Hg): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL each of 1000 ppm Arsenic, Selenium, and Thallium. Add 6.0mL of 1000ppm Hg. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.6.7. SS4 (B, Mo): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL each of 1000 ppm Boron and Molybdenum. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.

7.6.8. SS5 (K,Na,Mg,Ca): Fill a 200 mL volumetric flask approximately half full with reagent water add 10.0 mL of nitric acid and mix. Next add 20 mL each of 10,000 ppm Potassium, Sodium, Magnesium and Calcium. Dilute to volume with reagent water, mix thoroughly and transfer to a 250 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.

7.7. Metals reference material (ERA Priority PollutnT/CLP Inorganic Soil) for use as the laboratory control sample. The expiration date is assigned by the manufacturer.

7.8. Teflon beads, Teflon boiling chips, or other suitable blank material.

8. APPARATUS AND EQUIPMENT

8.1. 125 mL plastic cup beaker cup, calibrated at 50mL and 100mL

8.2. Borosilicate watch glasses

8.3. Block Digester, calibrated to maintain 95˚C ± 2˚C

8.4. Hot Plates: "Thermolyne Cimerac 3", calibrated to maintain 95˚C ± 2˚C

8.5. Laboratory balance, top-loader capable of reading 0.01g

8.6. Digestion tubes, 125 mL - Environmental Express. An accuracy and precision verification check must be made with each new vendor lot prior to use. Refer to the SOP for *Checking Volumetric Labware ADM-VOLWARE*, for further detailed instructions. Performance data must meet the accuracy and precision requirements specified in Table 1 (*ADM-VOLWARE*) for non-volumetric labware used for measuring initial and/or final digestate volumes.

8.7. USS # 10 sieve.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook. Pertinent information must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, and description of maintenance, date, and name. The log should contain a reference to return to analytical control.

9.2. Maintenance for this procedure is generally limited to glassware cleaning, pipet monitoring, and hot plate calibration. Procedures for glassware washing are described in the SOP for Metals Laboratory Glassware Cleaning (MET-GC). Procedures for pipet monitoring are given in the SOP for Checking Volumetric Labware, (ADM-VOLWARE).

9.3. Each hotplate or block digester is uniquely identified and the temperature is verified with each batch of samples. To perform the verification, a certified thermometer is placed in a container half filled with mineral oil, which is then placed in the center of the hotplate or block digester. The thermometer does not touch the bottom of the container. The temperature is turned to the 95˚C setting and the mineral oil is allowed to come to temperature. The analyst will verify that the hotplate gives a temperature of 95˚C ± 2˚C. If not, the thermostat is adjusted until the thermometer reads and maintains 95˚C ± 2˚C. The thermostat is then marked to clearly

indicate the correct setting to be used during sample digestion (when using Hot Plates.). Each hot Block has an assigned calibrated thermometer. The Temperature and the correction factor of the assigned thermometer is recorded on the digestion bench sheet.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training.

11. PROCEDURE

11.1. Record all digestion and sample information on the applicable benchsheet.

11.2. Mix the sample thoroughly to achieve homogeneity. Sieve if necessary using a USS #10 sieve.

11.3. It can be difficult to obtain a representative sample with wet or damp materials. As per Method 3050B, wet samples may be dried, crushed, and ground to reduce subsample variability, however, drying is not recommended since drying may affect the extraction of the analytes of interest in the sample.

11.4. Weigh approximately 1g of sample into a 125ml plastic beaker cup and record the weight to the nearest 0.01g. For sludge's and sediments that have high moisture content, use more sample. A plastic 10.0 mL disposable pipette is used to measure 10.0 mL of sample. The volume and weight of the pipetted sample is recorded. In cases where the sludge is very thick a 10.0 mL graduated cylinder may be used. The objective is to use about 1g of dry weight sample. For analysis of Lead by Flame AA, use about 2.5g of dry wt. sample and change the final dilution volume to 50ml. This will achieve a lower detection limit needed for most projects. At this point add the appropriate spiking solutions directly onto the designated spike sample prior to addition of reagents.

11.5. Add 5ml reagent water and 5ml concentrated HNO_3. Place in a hot block, cover and reflux (without boiling) at 95ºC for 10 to 15 minutes. Allow the sample to cool. Add 5ml of concentrated HNO_3, cover and reflux for 30 minutes. If brown fumes are generated, indicating oxidation of the sample by HNO_3, repeat the addition of 5ml of HNO_3 and reflux over and over until no brown fumes are given off. Reduce the digestate volume to approximately 5 mL without boiling or digest for two hours maintaining a covering of solution over the bottom of the beaker at all times. If this occurs discard the digestate and begin with a new sample aliquot.

Note: The 95°C hot block temperature must be monitored and documented on a per-batch basis. The actual measured temperature, thermometer correction factor, and corrected temperature must all be recorded.

Note: All Wisconsin samples must digest for 2 hours after generation of brown fumes has ceased.

11.6. Cool the sample and add 3 mL of 30% H_2O_2. Cover and heat to start the peroxide reaction. Care must be taken to ensure that losses do not occur due to excessive effervescence. Heat in the hot block until effervescence subsides. Remove from hot block and cool the beaker.

11.7. Continue to add 30% H_2O_2 in 3ml aliquots with warming until the effervescence is minimal, or until the general sample appearance is unchanged. Do not add more than 10ml of 30% H_2O_2. When the peroxide additions are complete cover the sample with a watch glass and continue heating the acid-peroxide digestate until the volume has been reduced to approximately 5 mL or heat at 95°± 5°C without boiling for 2 hours. Do not let the samples go to dryness, by ensuring the solution covers the bottom of the vessel at all times.

Note: All Wisconsin samples must digest for 2 hours after the final peroxide addition.

If the sample is being prepared for analysis by ICP-OES or Flame AA, add 10 mL of concentrated HCl. If the sample is being prepared for ICP-MS or GFAA analysis no HCl is added. Dilute the sample to 100 mL with reagent water: ASTM Type I water (resistivity $\geq$18 MΩ-cm, conductivity $\leq$0.056 uS/cm) in a 125 mL plastic beaker cup.

Note: For method 7062 and 7742 samples, the 3050B soil digestion is modified as follows: After the final peroxide addition (i.e. before the final reduction stage) add 5.0mL of concentrated hydrochloric acid and reduce the digestate volume to less than 5.0mL, but not to dryness. After cooling, dilute the digestate to 100mL with reagent water.

11.8. Cover and reflux the Flame AA and ICP samples for 15 minutes at 95°C. After cooling, the samples may be diluted to 100ml for ICP analysis, or 50ml for Flame AA analysis.

11.9. Particulates in the digestates that may clog the nebulizer are allowed to settle overnight, or the digestates may be centrifuged.

11.10. To improve the solubility for Antimony, Barium, Lead and Silver, the following modification of the digestion procedure may be used as directed by the client or project chemist.

11.10.1. Weigh (to the nearest 0.01g) 1.00 g of sample into a 125ml plastic cup. For sludges and sediments that have high moisture content, use more sample. The objective is to use about 1g of dry weight sample.

11.10.2. Add 2.5mL HNO_3 and 10mL HCl and cover with a watch glass. Reflux for 15 minutes.

11.10.3. Filter the digestate through Whatman No. 41or equivalent filter paper and collect in a 100mL volumetric flask. Wash the filter paper, while still in the funnel, with no more than 5mL of hot (95°) HCl, and then with 20mL of hot (95°) reagent water. Collect washing in the same volumetric flask.

11.10.4. Remove the filter and residue from the funnel, and place them back in the beaker. Add 5mL HCl, cover and heat at 95° ± 5° until the filter paper dissolves. Remove from the heat and wash the cover and sides with reagent water.

11.10.5. Filter the residue and collect the filtrate in the same 100mL flask. Allow to cool, then dilute to volume.

11.10.6. If precipitation occurs in the flask upon cooling, do not dilute to volume. Instead, add up to 10mL of HCl to dissolve the precipitate. After precipitate is dissolved, dilute to volume with water.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

12.1.1. The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four blank matrix samples are spiked with the LCS spike solution, then prepared and analyzed.

12.2. Monitor Hot Blocks and Hotplates on a per batch basis. Report all deficiencies to the Lab Manager. Corrective action must be taken.

12.3. Digest one laboratory control sample with each batch. Weigh 1.00 g of the current lot of Environmental Resource Associates PriorityPollutnT/CLP Inorganic Soil prepared reference material into a 150 mL beaker and digest as per the procedure.

12.4. Digest one preparation blank (method blank) per digestion batch, or per 20 samples whichever is more frequent. For the method blank, use Teflon beads, Teflon boiling chips, or other suitable solid blank material and follow the digestion procedures.

12.5. Digest one duplicate and one spiked sample with each sample matrix. Prepare one duplicate and spike sample per each digestion batch, or per twenty samples whichever is more frequent. At times, specific samples will be assigned as duplicates of spikes depending on client requirements.

12.6. Soil spikes for ICP and ICP-MS are prepared by adding 2.0 mL of SS1, and 1.0 mL of SS3, SS4 and SS5 directly to the sample aliquot, prior to the addition of any water or acid. Fill out a spiking data sheet and keep it with the digestion data sheets.

12.6.1. For GFAA digestions 2.0 mL of SS2 is added to the sample aliquot designated as the matrix spike sample. The matrix spike sample is then digested as per the procedure.

13. DATA REDUCTION AND REPORTING

13.1. Digestion data sheets including weights and volumes used and reagents/acids are completed and a prep run number or batch lot number is assigned and attached to the data sheet. The lot numbers for the reagents used are added to the digestion data sheet (see Attachments).

13.2. Spiking sheets are included (See Attachments).

13.3. Data Review and Assessment

13.3.1. Refer to the *SOP for Laboratory Data Review Process* for general instructions for data review.

13.3.2. It is the supervisor's responsibility to ensure that digestions data is reviewed to ensure that all quality control requirements have been met and documentation is complete.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept

on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

16.3. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 2.5-12 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS EH&S Manual for details.

17. TRAINING

17.1. Training outline

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3. Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.2. Training is documented following the *SOP ADM-TRAIN*.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. The method uses 2 mL of water and 3 mL of H202 in step 11.6. The lab does not add the 2 mL of water. 3.0 mL aliquots of 30% H202 in lieu of 1.0 mL aliquots are added subsequently.

19. REFERENCES

19.1. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA SW-846, 3rd Edition, Final Update III, Method 3050B, December 1996.

19.2. Table A – METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

20. CHANGES SINCE THE LAST REVISION

20.1. Reformatted SOP to current ALS format and style.
20.2. Updated internal SOP references.
20.3. Few minor changes (correct typos and errors, etc.).
20.4. Section 7.6.6 – revised to include Mercury in SS3 solution.
20.5. Section 8.6 – revised to update tubes to those in use.
20.6. Section 11.5 – Added second note regarding Wisconsin samples.
20.7. Section 11.7 – Inserted first note regarding Wisconsin samples.
20.8. Section 12.6 – revised to list spiking with current solution formulations.
20.9. Section 13.3 – New section.
20.10. Section 14 – updated to current standard language for the section.
20.11. Section 15 – updated to current standard language for the section.
20.12. Section 16 – updated to current standard language for the section.
20.13. Table A – updated

TABLE A
METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

Solution Name	Element	mL of 1000ppm Solution	Final Volume	Solution Conc. mg/L	Enter ml Added
K-MET SS1 *** Add after HNO3 and before cas cal -14 when making the solution	HNO3	50.0	1000ml	-	
	Al	100*	1000ml	200	
	Ag	100*	1000ml	5	
	Ba	100*	1000ml	100	
	Be	100*	1000ml	5	
	Cd	100*	1000ml	5	
	Co	100*	1000ml	50	
	Cr	100*	1000ml	20	
	Cu	100*	1000ml	25	
	Fe	100*	1000ml	100	
	Pb	100*	1000ml	50	
	Mn	100*	1000ml	50	
	Ni	100*	1000ml	50	
	Sb***	50	1000ml	50	
	V	100*	1000ml	50	
	Zn	100*	1000ml	50	
K-MET SS2	HNO3	25.0	500ml	-	
	As	2.0	500ml	4	
	Cd	2.0	500ml	4	
	Pb	2.0	500ml	4	
	Se	2.0	500ml	4	
	Tl	2.0	500ml	4	
	Cu	2.0	500ml	4	
K-MET SS3	HNO3	25.0	500ml	-	
	As	50.0	500ml	100	
	Se	50.0	500ml	100	
	Tl	50.0	500ml	100	
	Hg	6	500ml	12	
K-MET SS4	HNO3	25	500ml	-	
	B	50	500ml	100	
	Mo	50	500ml	100	
K-MET SS5	HNO3	10.0	200ml	-	
	K**	20	200ml	1000	
	Na**	20	200ml	1000	
	Mg**	20	200ml	1000	
	Ca**	20	200ml	1000	

K-MET GFLCSW	HNO3	10.0	1000ml	-	
	As, Pb, Se, Tl	5.0	1000ml	2.5	
	Cd	-	-	1.25	
	Cu	2.5	1000ml	2.5	
K-MET QCP-CICV-1	Ca, Mg, Na, K	no dilution	-	2500	
	Al, Ba	no dilution	-	1000	
	Fe	no dilution	-	500	
	Co, Mn, Ni, V, Zn	no dilution	-	250	
	Cu, Ag	no dilution	-	125	
	Cr	no dilution	-	100	
	Be	no dilution	-	25	
K-MET QCP-CICV-2	Sb	no dilution	-	500	
K-MET QCP-CICV-3	As, Pb, Se, Tl	no dilution	-	500	
	Cd	no dilution	-	250	

* Denotes volume of mixed stock standard.
** Denotes 10,000 ppm individual stock standards.

ALS Standard Operating Procedure

DOCUMENT TITLE:	DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (METHOD 6020)
REFERENCED METHOD:	EPA 6020, 6020A
SOP ID:	MET-6020
REVISION NUMBER:	16
EFFECTIVE DATE:	1/01/2015

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (METHOD 6020)

ALS-KELSO

SOP ID:	MET-6020	Rev. Number:	16	Effective Date:	1/01/2015

Approved By: _____ Date: 12/9/14
Department Manager/Technical Director – Jeff Coronado

Approved By: _____ Date: 12/9/14
QA Manager – Lee Wolf

Approved By: _____ Date: 12/9/14
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date

TABLE OF CONTENTS

1.SCOPE AND APPLICATION....3
2.METHOD SUMMARY....3
3.DEFINITIONS....3
4.INTERFERENCES....5
5.SAFETY....6
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE....6
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS....6
8.APPARATUS AND EQUIPMENT....9
9.PREVENTIVE MAINTENANCE....9
10.RESPONSIBILITIES....10
11.PROCEDURE....10
12.QA/QC REQUIREMENTS....12
13.DATA REDUCTION AND REPORTING....16
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA....17
15.METHOD PERFORMANCE....18
16.POLLUTION PREVENTION AND WASTE MANAGEMENT....18
17.TRAINING....18
18.METHOD MODIFICATIONS....19
19.REFERENCES....19
20.CHANGES SINCE THE LAST REVISION....19

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (METHOD 6020)

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentrations of certain elements in water, soil, tissues, aqueous and non-aqueous wastes, and sediment samples using EPA Method 6020 or 6020A. Table 1 indicates analytes that are typically determined by this procedure and lists the standard Method Reporting Limits (MRLs) for each analyte in water and soil. Project-specific MRLs may apply, and if lower than standard MRLs, it is demonstrated through method detection limit determinations and analysis of MRL standards that the MRL is achievable. Method Detection Limits (MDLs) that have been achieved are listed in Table 1. These may change as new studies are performed.

1.2. The complexity of the technique generally requires outside study of appropriate literature as well as specialized training by a qualified spectroscopist. The scope of this document does not allow for the in-depth descriptions of the relevant spectroscopic principles required for gaining a complete level of competence in this scientific discipline.

2. METHOD SUMMARY

2.1. Prior to analysis, samples must be digested using appropriate sample preparation methods. The digestate is analyzed for the elements of interest using ICP-mass spectrometry (ICP-MS).

2.2. Methods 6020 and 6020A describe the multi-elemental determination of analytes by ICP-MS. The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

3. DEFINITIONS

3.1. **Batch** - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.1.1. Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.1.2. Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The

sequence ends when the set of samples has been analyzed or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2. **Sample**

3.2.1. Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2. Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3. **Quality System Matrix** - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1. Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.

3.3.2. Drinking water - Any aqueous sample that has been designated a potable or potential potable water source.

3.3.3. Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.3.4. Nonaqueous Liquid - Any organic liquid with <15% settleable solids.

3.3.5. Animal tissue - Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.3.6. Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.3.7. Chemical waste - Any sample of a product or by-product of an industrial process that results in a matrix not described in one of the matrices in Sections 3.4.1 through 3.4.6. These can be such matrices as non-aqueous liquids, solvents, oil, etc.

3.3.8. Miscellaneous matrices – Samples of any composition not listed in 3.4.1 – 3.4.7. These can be such matrices as plant material, paper/paperboard, wood, auto fluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.

3.4. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Duplicate samples are spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision. The concentration of the spike should be at the midpoint of the calibration range or at levels specified by a project analysis plan.

3.5. Laboratory Duplicates (DUP) – Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

3.6. Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to extraction and analysis. Percent recoveries are calculated for each surrogate.

3.7. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.8. Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.9. Independent Verification Standard (ICV) - A pre-mixed, purchased, second-source standard analyzed after the calibration curve. This is used to verify the validity of the initial calibration standards

3.10. Continuing Calibration Verification Standard (CCV) - A mid-level standard analyzed at specified intervals. Used to verify that the initial calibration curve is still valid for quantitative purposes.

3.11. Duplicates and Duplicate Matrix Spikes are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed.

3.12. Standard Reference Material (SRM) – A material with specific certification criteria and is issued with a certificate or certificate of analysis that reports the results of its characterizations and provides information regarding the appropriate use(s) of the material. An SRM is prepared and used for three main purposes: (1) to help develop accurate methods of analysis; (2) to calibrate measurement systems used to facilitate exchange of goods, institute quality control, determine performance characteristics, or measure a property at the state-of-the-art limit; and (3) to ensure the long-term adequacy and integrity of measurement quality assurance programs.

4. INTERFERENCES

4.1. Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z). A data system must be used to correct for these interferences. This involves determining the signal for another isotope of the interfering element and subtracting the appropriate signal from the analyte isotope signal. Attention should be given to circumstances where very high ion currents at adjacent masses may contribute to ion signals at the mass of interest. Matrices exhibiting a

significant problem of this type may require resolution improvement, matrix separation, or analysis using another isotope.

4.2. Isobaric molecular and doubly-charged ion interferences in ICP-MS are caused by ions consisting of more than one atom or charge, respectively. Most isobaric interferences that could affect ICP-MS determinations have been identified in the literature. Refer to Method 6020/A for further discussion.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

5.4. High Voltage - The RF generator supplies up to 2000 watts to maintain an ICP. The power is transferred through the load coil located in the torch box. Contact with the load coil while generator is in operation will likely result in death. When performing maintenance on the RF generator, appropriate grounding of all HV capacitors must be performed as per manufacturer.

5.5. UV Light - The plasma is an intense source of UV emission, and must not be viewed with the naked eye. Protective lenses are in place on the instrument. Glasses with special protective lenses are available when direct viewing of the plasma is necessary.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Aqueous samples are typically collected in plastic containers. Aqueous samples are preserved with nitric acid (pH<2), then refrigerated at 4 ± 2°C from receipt until digestion. Soil or solid samples may be collected in plastic or glass jars. Non-aqueous samples are refrigerated at 4 ± 2°C from receipt until digestion.

6.2. Samples are prepared via procedures in SOPs MET-DIG, MET-3020A, or MET-3050 depending on matrix and project specifications.

6.3. Digestates are stored in the appropriate volumetric containers. Following analysis, digestates are stored until all results have been reviewed. Digestates are neutralized prior to disposal through the sewer system, 2 weeks after data is reviewed.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. All standards are prepared from NIST traceable standards. The expiration dates are assigned according to the EPA method and the vendor's assigned expiration dates. For example, working ICS solutions are prepared weekly in accordance with Method 6020, Section 5.6.1.

7.1.1. 1000 ppm Single Element Stock Standard Solutions: Each stock standard is store at room temperature on shelves located in room 113 of the metals lab. The manufacturer, lot number, and expiration date of each stock standard is recorded in a bound logbook also located in room 113. Additionally each stock standard is given a unique, identifying name.

7.1.2. Intermediate Standard Solutions: Intermediate mixed stock solutions are made from the individual stock standards described above. The individual component of each mixed solution is recorded in a bound logbook located in the ICP-MS laboratory and mixed solution is given a unique, identifying name. The expiration date for the intermediate standard is the earlier of any one of its stock components.

7.1.3. Calibration Standards: Calibration standards are made fresh daily from the intermediate standard solutions. Each individual intermediate standard used in the calibration standard is recorded in a bound logbook located in the ICP-MS laboratory, and the calibration standard solution is given a unique, identifying name. The calibration standards unique name is used on the raw data to link the data to the subsequent prepared standards and ultimately the original purchased stock standard.

7.2. Standards Preparation

7.2.1. Expiration of all standard solutions defaults to the earliest expiration date of an individual component unless otherwise specified.

7.2.2. Calibration Standards

The calibration standard is prepared from two intermediate stock solutions. These solutions are prepared in acid rinsed 1000 mL Class A volumetric flasks following the formulations laid out on the attached example standard sheet (see Attachments). The working calibration standard is made daily by aliquoting 2.5 mL of each of the intermediate solutions in to a 100 mL Class A volumetric flask and diluting to volume with 1% HNO3. This standard is also used as the Continuing Calibration Verification (CCV).

7.2.3. Initial Calibration Verification (ICV)

7.2.3.1. The ICV intermediate stock solution is prepared in an acid rinsed 100 mL Class A volumetric flask. The solution is prepared by adding 2.0 mL of Inorganic Ventures QCP-CICV-1, 1.0 mL each of QCP-CICV-2 and QCP-CICV-3, 0.5 mL of 1000 ppm Molybdenum stock solution, 0.5 mL of 1000 ppm Uranium stock solution, and 0.5mL of 1000ppm B, Bi, Sr, Ti solution and diluting to volume with 1% HNO3.

7.2.3.2. The working ICV solution is prepared by aliquoting 0.5 mL of the mixed ICV intermediate solution into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1% HNO3.

NOTE: The ICV solution is not at the midpoint of the linear range which may be as high as 1000 µg/L for some elements. The ICV solution used is a premixed standard purchased from Inorganic Ventures and contains the elements of interest between 2.5 and 100 µg/L. This solution provides calibration confirmation at more representative levels, given that most ICP-MS analyses are quantifying analytes in the low-ppb to sub-ppb range.

7.2.4. Interference Check Solutions (ICSA and ICSAB)

7.2.4.1. The ICSA is prepared in an acid rinsed 50 mL Class B volumetric flask by aliquoting 1.0 mL of Elements ICSAm (CS-CAK02) solution and diluting to volume with 1% HNO3.

7.2.4.2. The ICSAB is prepared in an acid rinsed 50 mL Class B volumetric flask by aliquoting 1.0 mL of Elements ICSAm (CS-CAK02), 0.125 mL of Inorganic Ventures 6020ICS-9B, and 0.250 mL of 10 ppm Molybdenum solutions and diluting to volume with 1% HNO3.

7.2.5. Post-digestion spikes are performed by adding appropriate amounts of the calibration intermediate solutions to aliquots of the sample digestate. The volumes of each standard used vary based on the native concentrations found in the field samples. Refer to the post-digestion spike in Section 12 for details.

7.2.6. Refer to the appropriate digestion SOP for details of LCSW and matrix spike solution composition and preparation.

7.2.7. Tuning / Mass Calibration Solution

7.2.7.1. A 1ppm intermediate solution containing Be, Bi, Ce, Co, In, Li, Pb, Mg, and U is prepared by adding 1.0 mL of each from 1000 ppm stock standards to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric acid. The expiration date for the intermediate solution is the earliest of any one of its stock components.

7.2.7.2. The working solution is prepared in three ways:

- For the Agilent: a 1.0 ppb tune/mass calibration solution is prepared by adding 1.0 mL of intermediate solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric acid.
- For the X-Series (K-ICP-MS-03) instrument a 5.0 ppb tune/mass calibration solution is prepared by adding 5.0 mL of intermediate solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric acid.
- For the NexION (K-ICP-MS-04) instrument a 2.0 ppb tune/mass calibration solution is prepared by adding 2.0 mL of intermediate solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric acid.
- The expiration date for this solution is taken from the intermediate stock above.

7.3. Internal Standards Stock Solution – Prepare solutions by adding appropriate amounts of each 1000 ppm single element stock solution to a acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric. Use this solution for addition to blanks, calibration standards

and samples at a ratio of 0.5 mL of internal standard to 100 mL of solution, or dilute by an appropriate amount using 1% (v/v) nitric acid, if the internal standards are being added by peristaltic pump. The typical solutions are:

- XSeries instrument: 50ppb Li; 25ppb Sc, Ga, Y; 10ppb Rh, In, Lu, Tm, Th.
- Agilent instrument: 2ppm Li, Sc, Y, Ga, Ge, Ce, Tm, In, Lu, Th
- NexION instrument: 30ppb In, Tm, Lu, Th; 60ppb Li, Rh, Au; 75ppb Sc; 100ppb Ga,Y; 500ppb Ge

7.4. Additional Reagents

7.4.1. Reagent water, ASTM Type II

7.4.2. "OmniTrace Ultra" Concentrated Nitric Acid (EM Science # NX0408-2)

7.4.3. Argon (Airgas Industrial Grade – 99.999% pure, bulk delivered)

8. APPARATUS AND EQUIPMENT

8.1. ICP/MS instruments:

8.1.1.

Instrument:	Thermo Electron X-Series
Nebulizer:	Conikal
Spray Chamber:	VG Peltier-cooled
Cones:	Nickel Sampler (1.0 mm orifice)
	Nickel Skimmer (0.75 mm orifice)

8.1.2.

Instrument:	NexION 300D
Nebulizer:	PFA-ST MIcroflow
Spray Chamber:	Cyclonic, Peltier-cooled
Cones:	Nickel Sampler (1.0 mm orifice)
	Nickel Skimmer (0.75 mm orifice)

8.1.3.

Instrument:	Agilent 7700
Nebulizer:	MicroMist
Spray Chamber:	Double Pass quartz spray chamber
Cones:	Nickel Sampler (1.0 mm orifice)
	Nickel Skimmer (0.75 mm orifice)

9. PREVENTIVE MAINTENANCE

9.1. All maintenance is documented in the instrument logbook. ALS/Kelso maintains a service contract with the instrument manufacturer that allows for an unlimited number of service calls and full reimbursement of all parts and labor.

9.2. Most routine maintenance and troubleshooting is performed by ALS staff. Preventive maintenance activities listed below should be performed when needed as determined by instrument performance (i.e. stability, sensitivity, etc.) or by visual inspection. Other maintenance or repairs may, or may not require factory service, depending on the nature of the task.

- cone removal and cleaning
- removal and cleaning of ICP glassware and fittings
- checking and cleaning RF contact strips
- checking air filters and cleaning if necessary
- checking the oil mist filters and cleaning if necessary
- checking the rotary pump oil and adding or changing if necessary
- removal and cleaning of extraction lens
- removal and cleaning of ion lens stack
- replace the electron multiplier as necessary

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in the SOP for Documentation of Training, is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Refer to method 6020 (or 6020A) and the instrument manuals for detailed instruction on implementation of the following daily procedures preceding an analytical run.

11.2. After the instrument has been placed in the "Operate" mode, begin completing the daily instrument log (see Attachments). Refer to the instrument manuals for the optimum settings for each instrument.

11.3. The following parameters are monitored to assure awareness of changes in the instrumentation that serve as signals that optimum performance is not being achieved, or as indicators of the physical condition of certain consumable components (i.e. EMT and cones).

11.3.1. Multiplier Voltages

11.3.2. Gas Flows - Coolant Ar

11.3.3. The nebulizer and auxiliary flows are adjusted later as part of the optimizing procedure.

11.4. Optimization

11.4.1. Gas Flows

11.4.1.1. Allow a period of not less than 30 minutes for the instrument to warm up.

11.4.1.2. Aspirate a mixed tune solution into the plasma and monitor the instrument output signal of In at mass 115 on the ratemeter. Adjust the nebulizer and auxiliary flows to obtain maximum signal. Adjust the tension screw on the peristaltic pump to obtain minimum noise in the analytical signal. Record flow rates and note any large variances.

Note: Significant differences in flow rates will be observed for different torches and cones.

11.4.2. Tuning

11.4.2.1. Ion Lens Setting - While monitoring the output signal of a mixed tune solution at mass 115 on the ratemeter, adjust the ion lenses to obtain maximum sensitivity. Refer to the instrument manual for details on performing the adjustments.

11.4.2.2. Mass Calibration - Aspirate the tune / mass calibration solution described in section 7.2 and perform the mass calibration using the instrument's Mass Calibration program. (Refer to the instrument manual for details pertaining to the mass calibration procedure.) The acceptance criteria for the mass calibration is <0.1 amu from the true value. If the mass calibration fails criteria re-tune the instrument and perform the mass calibration procedure again.

11.4.2.3. Resolution Check - Using the spectra created during the mass calibration procedure; perform the resolution check to assure the resolution is less than 0.9 AMU at 5% peak height. If the resolution does not pass criteria adjust the instrument's resolution settings, run a new scan of the mass calibration solution and recheck.

11.4.2.4. Stability Check - Using the tune / mass calibration solution, perform a short-term stability check as per EPA Method 6020 or 6020A. The relative standard deviations of five scans for each element in the tune solution must be < 5%. If the test does not pass criteria determine the cause (i.e. dirty cones, improper tune, etc.) correct the problem and re-run the test.

11.5. Analytical Run

11.5.1. Calibrate the instrument using a calibration blank (Standard 0), composed of reagent water and 1% nitric acid, and the working calibration standard (8.2.2). The masses typically monitored and those used for quantification are listed in Table 2. These masses are set as defaults in the instrument's analytical procedures. To begin select the correct method. Nebulize Standard 0 (Blank) into the plasma. Allow 1-2 minutes for system to equilibrate prior to establishing baseline. Follow directions on computer screen to perform standardization. Nebulize the working calibration standard into the plasma. The operator must sign and date the first page of standardization.

11.5.2. After the first CCB and before the ICS standards a CRA (MRL / LLICV / LLCCV) standard is analyzed. Method 6020 requires the detection to be > the MDL but < 2x the MRL. For 6020A, the criteria are 70-130% recovery. For DoD projects, the CRA criteria are 80-120%.

Note: For 6020A the LLCCV must also be analyzed at the end on the analytical run sequence.

11.5.3. Perform the analysis in the order listed below. A daily run log of all samples analyzed is maintained.

Initial Calibration Verification (ICV)
Continuing Calibration Verification (CCV)
Initial Calibration Blank (ICB)
Continuing Calibration Blank (CCB)
CRA (MRL / LLICV / LLCCV)
ICSA
ICSAB
Analyze 10 Samples
CCV
CCB
Analyze 10 Samples
CCV
CCB

Repeat sequence as required to complete analytical run, analyzing CCVs/CCBs every 10 analyses and at the end of the run.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery of for each analyte must be 85-115% (for water, and within the LCS limits for soils) and the RSD <20%.

12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank matrices at a level near or below the MRL. Follow the procedures starting in Section 11 to analyze the samples. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification* details of performing the MDL study.

12.2.2. Calculate the average concentration found (x) and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. MDL's must be verified annually or whenever there is a significant change in the background or instrument response.

12.3. For method 6020A, an LLQC sample (a CRA that is carried through the digestion) must be analyzed to verify accuracy at the MRL. The recovery must be 70-130%.

12.4. Instrument Detection Limits (IDLs) and linear ranges studies are performed quarterly. These will be calculated and made available to the ICP-MS operator. Linear range studies determine the Linear Dynamic Range (LDR) of the each instrument by analysis of a high concentration standard with results with ± 10% of the expected value. For non-DoD projects samples may be quantified between the MRL and 90% of the LDR without flagging. The Linear Calibration Range (LCR) is established by the highest calibration standard.

- **Note:** IDLs must be < LOD for DOD projects. DoD project samples with concentrations above the calibration standard must be diluted to bring results within the quantitation range. The LOQ and cal standard establish the quantitation range. The lab may report a sample result above quantitation range if the lab runs and passes a CCV that is > sample result.

12.5. The Initial Calibration Verification (ICV) standard is analyzed immediately after calibration. The results of the ICV must agree within ±10% of the expected value. If the control limits are exceeded, the problem will be identified and the instrument recalibrated.

12.6. A Continuing Calibration Verification (CCV) and Continuing Calibration Blank (CCB) are analyzed after calibration then every 10 samples thereafter with a final CCV/CCB closing the final samples of the analytical run.

12.6.1. The results of the CCV must agree within ±10% of the expected value.

12.6.2. The CCB measured values must be less than the MRL / LOQ for each element for standard applications. Other project-specific criteria may apply (for DoD QSM projects CCB can have no analytes > the LOD).

12.6.3. If the control limits are exceeded, the problem will be identified and corrective action taken. The instrument recalibrated. The previous 10 samples must be reanalyzed.

12.7. The ICSA and ICSAB solutions are analyzed after calibration and before any field samples. The solutions are then reanalyzed every 12 hours. Results of the ICSA are used by the analyst to identify the impact of potential interferences on the quality of the data. Based on these results appropriate action should be taken when interferences are suspected in an field sample including, but not limited to, selecting and alternative isotope for quantification, manual correction of the data, elevating the MRL, selection of an alternative method (e.g. optical ICP, GFAA) or flagging the result as estimated when no other action is possible. Results for the spiked analytes in the ICSAB solution must agree with ± 20% of the expected value.

INTERFERENCE CHECK SAMPLE COMPONENTS AND CONCENTRATIONS

	Solution A Concentrations (mg/L)	Solution B Concentrations (mg/L)
Al	20.0	20.0
Ca	60.0	60.0
Fe	50.0	50.0
Mg	20.0	20.0
Na	50.0	50.0
P	20.0	20.0
K	20.0	20.0
S	20.0	20.0
C	40.0	40.0
Cl	424	424
Mo	0.05	0.05
Ti	0.40	0.40
As	0.0	0.025
Cd	0.0	0.025
Cr	0.0	0.050
Co	0.0	0.050
Cu	0.0	0.050
Mn	0.0	0.050
Ni	0.0	0.050
Se	0.0	0.025
Ag	0.0	0.0125
V	0.0	0.050
Zn	0.0	0.025

NOTE: The concentration of interfering elements in the ICSA and ICSAB solutions are spiked at levels 5 times lower than recommended in Table 1 of Method 6020A. Running the full strength solutions as described in 6020A introduces too much material approximately 0.35 % dissolved solids into the ICP-MS system when trying to conduct low level analysis. Since the ICP-MS instrumentation is able to handle a maximum of 0.2% solids, the 6020A ICSA solution is higher in interfering components than any sample that would run through the instrument. However, the ICS solutions will be analyzed at levels that will provide approximately 0.1% dissolved solids.

12.8. Internal standards are used to correct for physical interferences. Masses used as internal standards include; ^{71}Ga, ^{115}In, ^{6}Li, ^{175}Lu, ^{103}Rh ^{45}Sc, and ^{89}Y. These internal standards are used in combination to cover the appropriate mass ranges. Internal standard correction is applied to the analytical isotopes via interpolation of the responses from nearest internal standard isotopes (Thermo instruments) or direct correlation of analyte to IS (NexION). This function is performed in real-time by the instruments operating system. Internal standards must be run within 50 AMU of the masses that are analyzed. Internal standard recoveries must fall between 30% and 125% when running method 6020, or 70-125% when running method 6020A Revision 1. If not, then the sample must be reanalyzed after a fivefold or greater dilution has been performed.

12.9. A method blank is digested and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the MRL for standard applications, or >½ the MRL for DoD projects or > 1/10 the sample result, corrective action must be taken. The MB can only be rerun once. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis.

12.10. Laboratory Control Samples are analyzed at a frequency of 5% or one per batch, whichever is greater. Refer to the current ALS-Kelso DQO spreadsheets for the LCS limits. For method 6020A, the LCS recovery limits are 80-120%. If statistical in-house limits are used, they must fall within the 80-120% range. Project, QAPP, or client-specific control limits may supersede the limits listed, but laboratory limits should be consistent with specified limits in order to establish that the specified limits can be achieved. If the control limits are exceeded, the associated batch of samples will be re-digested and reanalyzed.

12.11. A digested duplicate and matrix spike are analyzed at a frequency of 5% or one per batch, whichever is greater. Refer to the current ALS-Kelso DQO spreadsheets for the matrix spike limits. The matrix spike recovery and relative percent difference will be calculated while analysis is in progress. Project, QAPP, or client-specific control limits may supersede the limits listed. If the control limits are exceeded, the samples will be re-digested and reanalyzed, unless matrix interference or sample non-homogeneity is established as cause. In these instances, the data and the report will be flagged accordingly.

12.12. A Matrix Spike sample is digested one per batch, or per 20 samples (i.e. 5%). Default spike concentrations are listed in the sample digestion SOPs. Spike concentrations may be adjusted to meet project requirements. The matrix spike recovery will be calculated while the job is in progress. Where specified by project requirements, a matrix spike duplicate may be required. Matrix spike recovery criteria are derived from lab data. For method 6020A, the recovery limits are 75-125%. If statistical in-house limits are used, they must fall within the 75-125% range. In some cases, project-specific QC limits may be required. Unless specified otherwise, for DoD QSM projects the project LCS criteria will be used for evaluation of matrix spikes. If an analyte recovery is outside acceptance limits proceed with the additional quality control tests described in sections 12.13 and 12.14. Based on results of these tests, the physical nature of the sample (e.g. homogeneity), and any specific project requirements, a determination can then be made as to appropriate corrective action (e.g. re-digestion, reporting with a qualifier, alternative methodologies, etc.). If the analyte concentration is >4x the spike level the spike control limit is no longer applicable and no action is required. For specifics on the preparation and composition of matrix spike solutions refer to the appropriate digestion SOP.

Note: For DOD projects a MS/MSD is required with every extraction batch. The %RSD should be < 20%.

12.13. Post Digestion Spike Test: When analysis is conducted via 6020 a post digestion spike must be performed for each matrix and each batch of sample. The prepared sample or its dilution is spiked for each element of interest at a concentration sufficiently high to be observed. Typically 20 µL of 10,000 ppb intermediate stock is added to a 10 mL aliquot of sample. If analyte concentrations are elevated in the sample, spiking at a higher concentration may be required. The post spike should be recovered to within 75-125% of the known value or within the laboratory derived acceptance criteria. When analysis is conducted via 6020A, the post digestion spike test is performed whenever matrix spike or replicate criteria are exceeded. An analyte spike is added to a portion of a prepared sample, or its dilution, and should be recovered to within 80% to 120% of the known value. If this spike fails, then the dilution test

(Sec. 12.14) should be run on this sample. If both the matrix spike and the post digestion spike fail, then matrix effects are confirmed.

12.14. Dilution Test: When analysis is conducted via 6020, a serial dilution test must be performed for each matrix and each batch of sample. For sample concentrations that are sufficiently high (minimally, a factor of greater than 100 times the MDL), the analysis of a fivefold (1+4) dilution must agree within ± 10% of the original determination. When analysis is conducted via 6020A, the dilution test is performed whenever matrix spike or replicate criteria and post digestion spike criteria are exceeded. If the dilution test fails then a chemical or physical effect should be suspected. Corrective action can include additional dilution of the sample, the use of alternate methodologies, etc. or the data can be flagged and reported. The exact course of action will be dependent on the nature of the samples and project requirements and should be discussed with the project manager.

12.15. Instrument blanks should be evaluated for potential carryover and rinse times need to bring the analyte signal to within the CCB criteria discussed above in section 12.6.2. Results from instrument blanks run after standards or control samples should be used to establish levels at which carryover in samples may occur. Samples exhibiting similar effects of carryover should be reanalyzed.

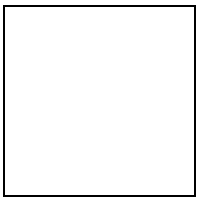
12.16. Refer to the Quality Control section of EPA Methods 6020 and 6020A for additional information describing required QA/QC. Note that the nomenclature of certain QC samples in the method differs from that of the CLP SOW, but the function of those samples is equivalent in both cases.

13. DATA REDUCTION AND REPORTING

13.1. Calculations

Calculate sample results using the data system printouts and digestion information. the digestion and dilution information is entered into the data system. The data system then uses the calculations below to generate a sample result.

Aqueous samples are reported in µg/L:



C*= Concentration of analyte as measured at the instrument in ug/L (in digestate).

Solid samples are reported in mg/Kg:

$$mg/Kg\,(Sample) = C^{*}\ x\ Post\ Digestion\ Dilution\ Factor\ x\ \frac{Digestion\ Vol.(ml)}{Sample\ wt.(g)}\ x\ \frac{1mg}{1000ug}\ x\ \frac{1L}{1000ml}\ x\ \frac{1000g}{1Kg}$$

C*= Concentration of analyte as measured at the instrument in ug/L (in digestate).

NOTE: If results are to be reported on a dry weight basis, determine the dry weight of a separate aliquot of the sample, using the SOP for Total Solids.

13.2. Common isobaric interferences are corrected using equations equivalent to those listed in EPA Methods 6020, 6020A, and 200.8. Monitoring of multiple isotopes for a single element provides a mechanism for identifying isobaric interferences. Refer to the Interferences section of EPA methods for additional descriptions of possible interferences and the mechanisms required for adequately compensating for their effects.

13.3. Data Review and Reporting

13.3.1. The ICP-MS operator reviews the MS data and signs and dates the Data Review Form. A qualified senior staff spectroscopist performs a secondary review of the data and the Data Review Form is signed and dated. The data is then delivered to the report generation area where it is filed in the service request file. Once all of the data for the service request is complete, a CAR is generated.

13.3.2. The data is saved on the local hard drive and is also copied to the appropriate directory on the network. The data directories are located at r:\icp\wip\data. The data is kept on the local directory for 1 month. The network files are periodically backed up on disc or network tape.

13.3.3. For "non-production" work (such as method development or research/development studies) the analyses are performed under the direction of a senior spectroscopist. All associated data is scrutinized by the senior spectroscopist. Original raw data and associated records are archived in the analytical project file.

13.3.4. The final review and approval of all data is performed by qualified spectroscopists.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels

- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.

15.2. The method detection limit (MDL), limit of detection (LOD) and limit of quantitation (LOQ) are established using procedures described in CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.* Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS, Kelso Quality Assurance Manual.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

16.3. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 5-9 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS *EH&S Manual* for details.

17. TRAINING

17.1. Refer to the SOP ADM-TRAIN, *ALS-Kelso Training Procedure* for standard procedures.

17.2. A minimum of two senior level spectroscopists are to be maintained on staff at all times. Senior spectroscopists are defined as individuals with a minimum of ten years combined education and experience in, or related to atomic spectroscopy. Of those ten years, a minimum of two years of ICP-MS experience is required.

17.3. All technical staff is encouraged to attend one technical seminar per year. In addition to the technical seminars, senior spectroscopists are required to complete a one week training session offered by the instrument manufacturer.

17.4. On-the-job-training occurs daily with the senior spectroscopists providing direction to new operators. The physical operation of the equipment is relatively simple. The data reduction

and troubleshooting requires extensive experience that can only be gained by hands-on operation of the instrument and assisted evaluation of raw data.

17.5. Training outline

17.5.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.5.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.5.3. Perform initial precision and recovery (IPR) study as described above for water or soil samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.6. Training and proficiency is documented in accordance with the SOP ADM-TRAIN.

18. METHOD MODIFICATIONS

18.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

19. REFERENCES

19.1. USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III Method 6020, Revision 0, September 1994.

19.2. USEPA, Test Methods for Evaluating Solid Waste, SW-846, Update IV, Method 6020A, Revision 1, February 2007.

19.3. Agilent and Thermo Elemental Instrument Manuals

20. CHANGES SINCE THE LAST REVISION

20.1. Reformatted SOP to current ALS format.
20.2. Minor changes (correct typos and errors, etc.) throughout SOP.
20.3. Section 1 – revised to eliminate redundant language.
20.4. Section 7.2.7.2 – updated to replace Excell with Agilent
20.5. Section 7.3 – revised to list specific internal standards and concentrations.
20.6. Section 8.1 – updated instrument information.
20.7. Section 11.4.2.3 – revised to correct peak height %.
20.8. Sections 12.10 and 12.12 – revised to refer to DQO tables for QC limits
20.9. Section 16 – revised to include default language.
20.10. Section 17 – revised to include default language and be consistent with 200.8 SOP.
20.11. Table 1 – updated.
20.12. Attachments updated.

TABLE 1
TARGET ANALYTES, MDLs, and MRLs

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL mg/kg
6020A	EPA 3050B	Aluminum	Soil	0.6	2
6020A	EPA 3050B	Antimony	Soil	0.02	0.05
6020A	EPA 3050B	Arsenic	Soil	0.2	0.5
6020A	EPA 3050B	Barium	Soil	0.02	0.05
6020A	EPA 3050B	Beryllium	Soil	0.005	0.02
6020A	EPA 3050B	Bismuth	Soil	0.02	0.05
6020A	EPA 3050B	Boron	Soil	0.05	0.5
6020A	EPA 3050B	Cadmium	Soil	0.009	0.02
6020A	EPA 3050B	Chromium	Soil	0.07	0.2
6020A	EPA 3050B	Cobalt	Soil	0.009	0.02
6020A	EPA 3050B	Copper	Soil	0.04	0.1
6020A	EPA 3050B	Lead	Soil	0.02	0.05
6020A	EPA 3050B	Manganese	Soil	0.02	0.05
6020A	EPA 3050B	Molybdenum	Soil	0.02	0.05
6020A	EPA 3050B	Nickel	Soil	0.04	0.2
6020A	EPA 3050B	Selenium	Soil	0.2	1
6020A	EPA 3050B	Silver	Soil	0.005	0.02
6020A	EPA 3050B	Thallium	Soil	0.002	0.02
6020A	EPA 3050B	Tin	Soil	0.02	0.1
6020A	EPA 3050B	Uranium	Soil	0.003	0.02
6020A	EPA 3050B	Vanadium	Soil	0.08	0.2
6020A	EPA 3050B	Zinc	Soil	0.2	0.5

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL ug/L
6020A	MET-DIG (CLP)	Aluminum	Water	0.2	2
6020A	MET-DIG (CLP)	Antimony	Water	0.01	0.05
6020A	MET-DIG (CLP)	Arsenic	Water	0.05	0.5
6020A	MET-DIG (CLP)	Barium	Water	0.006	0.05
6020A	MET-DIG (CLP)	Beryllium	Water	0.008	0.02
6020A	MET-DIG (CLP)	Bismuth	Water	0.005	0.05
6020A	MET-DIG (CLP)	Boron	Water	0.07	0.5
6020A	MET-DIG (CLP)	Cadmium	Water	0.005	0.02
6020A	MET-DIG (CLP)	Chromium	Water	0.02	0.2
6020A	MET-DIG (CLP)	Cobalt	Water	0.006	0.02
6020A	MET-DIG (CLP)	Copper	Water	0.03	0.1
6020A	MET-DIG (CLP)	Iron	Water	0.3	1
6020A	MET-DIG (CLP)	Lead	Water	0.004	0.02
6020A	MET-DIG (CLP)	Manganese	Water	0.006	0.05
6020A	MET-DIG (CLP)	Molybdenum	Water	0.008	0.05
6020A	MET-DIG (CLP)	Nickel	Water	0.04	0.2
6020A	MET-DIG (CLP)	Selenium	Water	0.4	1
6020A	MET-DIG (CLP)	Silver	Water	0.005	0.02
6020A	MET-DIG (CLP)	Thallium	Water	0.005	0.02
6020A	MET-DIG (CLP)	Tin	Water	0.01	0.05
6020A	MET-DIG (CLP)	Uranium	Water	0.003	0.02
6020A	MET-DIG (CLP)	Vanadium	Water	0.05	0.2
6020A	MET-DIG (CLP)	Zinc	Water	0.09	0.5

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL mg/kg
6020A	PSEP TISSUE	Aluminum	Tissue	0.2	2
6020A	PSEP TISSUE	Antimony	Tissue	0.002	0.05
6020A	PSEP TISSUE	Arsenic	Tissue	0.02	0.5
6020A	PSEP TISSUE	Barium	Tissue	0.005	0.05
6020A	PSEP TISSUE	Beryllium	Tissue	0.003	0.02
6020A	PSEP TISSUE	Bismuth	Tissue	0.003	0.05
6020A	PSEP TISSUE	Boron	Tissue	0.2	2
6020A	PSEP TISSUE	Cadmium	Tissue	0.002	0.02
6020A	PSEP TISSUE	Chromium	Tissue	0.02	0.2
6020A	PSEP TISSUE	Cobalt	Tissue	0.003	0.02
6020A	PSEP TISSUE	Copper	Tissue	0.02	0.1
6020A	PSEP TISSUE	Iron	Tissue	0.2	1
6020A	PSEP TISSUE	Lead	Tissue	0.0005	0.02
6020A	PSEP TISSUE	Manganese	Tissue	0.008	0.05
6020A	PSEP TISSUE	Molybdenum	Tissue	0.008	0.05
6020A	PSEP TISSUE	Nickel	Tissue	0.02	0.2
6020A	PSEP TISSUE	Selenium	Tissue	0.2	1
6020A	PSEP TISSUE	Silver	Tissue	0.006	0.02
6020A	PSEP TISSUE	Thallium	Tissue	0.0009	0.02
6020A	PSEP TISSUE	Tin	Tissue	0.003	0.05
6020A	PSEP TISSUE	Uranium	Tissue	0.0008	0.02
6020A	PSEP TISSUE	Vanadium	Tissue	0.007	0.2
6020A	PSEP TISSUE	Zinc	Tissue	0.06	0.5

Table 2
Target Element Masses

Analyte	ISOTOPES ANALYZED	ISOTOPE REPORTED
Aluminum	27	27
Antimony	121,123	123
Arsenic	75	75
Barium	135,137,138	137
Beryllium	9	9
Cadmium	111,112,114	111
Chromium	52,53	52
Cobalt	59	59
Copper	63,65	65
Lead	206,207,208	208
Manganese	55	55
Molybdenum	95,97,98	98
Nickel	60,61,62	60
Selenium	77,78,82	82
Silver	107,109	107
Thallium	203,205	205
Uranium	238	238
Vanadium	51	51
Zinc	66,67,68	66

ATTACHMENT A
Example Standard Sheets

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 2% HNO3

ELEMENT		ALIQUOT OF 1000 ppm Std./1000ml	CONCENTRATION (µg/L)
HNO3		50.0 ml.	5%
Al		1.0 ml.	1000
Sb		1.0 ml.	1000
As		1.0 ml.	1000
Ba		1.0 ml.	1000
Be		1.0 ml.	1000
Cd		1.0 ml.	1000
Cr		1.0 ml.	1000
Co		1.0 ml.	1000
Cu		1.0 ml.	1000
Fe		1.0 ml.	1000
Pb		1.0 ml.	1000
Mn		1.0 ml.	1000
Mo		1.0 ml.	1000
Ni		1.0 ml.	1000
Se		1.0 ml.	1000
Tl		1.0 ml.	1000
V		1.0 ml.	1000
U		1.0 ml.	1000
Zn		1.0 ml.	1000

SOLUTION: ICP-MS, 200.8 SILVER INTERMEDIATE STOCK
MATRIX: 5% HNO3

ELEMENT		ALIQUOT OF 1000 ppm Std./1000ml	CONCENTRATION (µg/L)
HNO3		50.0	5%
Ag		1.0	1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: As Required

SOURCE	ALIQUOT PER 100 ml.	CONCENTRATION (µg/L)
HNO3 (Ultrex)	As Required	As Required
INTERMEDIATE STOCK	2.5	25.0
SILVER INTERMEDIATE STOCK	2.5	25.0

ATTACHMENT B
Isobaric Interference Corrections

Interference Equations:

Equation Name: Default

?SW82 = I82 * 0.7
?%SE77 = ?SE82 * 0.8484163
?%ARCL77 = I77 - ?%SE77
?%ARCL75 = ?%ARCL77 * 3.0650407
?AS75 = I75 - ?%ARCL75
?%CR53 = I52 * 0.1133652
?%CLO53 = I53 - ?%CR53
?%CLO51 = ?%CLO53 * 3.0650407
?V51 = I51 - ?%CLO51
?PB208 = I208 + I207 + I206

DOCUMENT TITLE:	***BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE***
REFERENCED METHOD:	
SOP ID:	***MET-BIOACC***
REV. NUMBER:	***1***
EFFECTIVE DATE:	***07/31/2013***

ALS-Kelso Procedure Change Form

SOP Code: MET-BIOACC Revision: 1 Effective Date: 7/31/13			
SOP Section Number	**Description of Procedure Change**	**Date Procedure Change Implemented**	**Supervisor Initials & Date** Indicating Approval and Training of Staff
10.2.2	Weigh approximatly 1g of sample to the nearest 0.01g	2-3-15	L.J

BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE

MET-BIOACC

ALS-KELSO

SOP ID:	MET-BIOACC	Rev. Number:	1	Effective Date:	07/31/2013

Approved By: _____ Date: 7/16/13
Department Supervisor - Jeff Coronado

Approved By: _____ Date: 7/16/13
QA Manager - Suzanne LeMay

Approved By: _____ Date: 7/16/13
Laboratory Director - Jeff Grindstaff

Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

for

BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the procedure used to determine a bioaccessibility value for Arsenic and/or Lead for soils and solid waste. This procedure describes the extraction procedure and calculations. The determinative analytical procedures are described in detail in separate SOPs.

1. METHOD SUMMARY

A soil or solid waste sample is dried and sieved to achieve a homogeneous sample. An aliquot of this homogenized sample is extracted at constant temperature for one hour then filtered to produce a final "in-vitro" aqueous extract. This extract is then analyzed for Arsenic and/or Lead by various instrumental techniques depending on target method reporting limit (MRL) and detection limit requirements. The result of the in-vitro analysis are used in conjunction with separate total metals results to calculate a bioaccessibility value.

2. DEFINITIONS

2.1. **Duplicate Sample** (DUP) – A laboratory duplicate. The duplicate sample is a separate field sample aliquot that is processed in an identical manner as the sample proper. The relative percent difference between the samples is calculated and used to assess analytical precision.

2.2. **Laboratory Control Sample** – An analyte-free matrix to which a known quantity of analytes are added. The LCS is subjected to the same processing as field samples and is carried through the entire analytical process. The percent recovery of the analyte in the LCS is used to assess analysis performance in terms of accuracy.

2.3. **Method Blank** – The method blank is a blank matrix designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

2.4. **Post-Extraction Matrix Spike** – A known amount of Arsenic and/or Lead added to an aliquot of final extract to demonstrate the analytical method is free from interference in the extraction matrix.

2.5. **Reagent Blank** – Extraction solution analyzed once per batch.

3. INTERFERENCES

3.1. When obtaining subsamples it is important to minimize any chances for sample contamination or cross-contamination between samples. Work should be performed in

an organized and neat manner. Equipment and laboratory tools used with samples should be cleaned between samples to prevent cross-contamination.

3.2. Analysis-specific interferences are described in the applicable analytical SOP.

4. SAFETY

4.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

4.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental Health and Safety Manual and the appropriate MSDS prior to beginning this method.

4.3. Hydrochloric is used in this method. This acid is extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids and safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

5. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

5.1. ALS laboratory staff does not collect samples. Samples are collected by field sampling staff of ALS customers using their sampling plans and procedures.

5.2. Samples may be collected in plastic or glass jars, typically 2 ounce (although larger jars may be used). Samples are refrigerated at 4 ± 2°C from receipt until analysis. Samples should be analyzed within 6 months of sampling.

6. APPARATUS AND EQUIPMENT

6.1. Aluminum drying pans

6.2. Laboratory drying oven

6.3. 60 mL Syringe – Luer-Lok (VWR # BD309653 or equivalent)

6.4. Syringe Filters – Millipore Millex-HV Hydrophilic PVDF 0.45 µm (VWR # SLHV025NK or equivalent)

6.5. pH Meter – Orion model 230A or equivalent

6.6. pH Probe – Thermo Combination pH Probe (part # 9256BN)

6.7. Modified Toxicity Characteristic Leaching Procedure (TCLP) extractor – TCLP extraction unit with tumbler assembly enclosed by oven capable of maintaining 37°C. Modified TCLP extractor located in room 108.

6.8. Water bath, capable of maintaining 37 ± 2°C

6.9. HDPE bottles, 125 mL

6.10. Evergreen disposable tubes, 50 mL. Check tubes for accuracy on a per batch basis by filling a tube to the 50 mL mark and measuring the water's mass. The measured mass must be accurate to ±3%; if not, obtain a new lot of tubes and retest. Pipettors: All-plastic pneumatic fixed-volume and variable pipettors in the range of 20 uL to 1.0 mL.

6.11. Top-loader laboratory balance capable of weighing to the nearest 0.01 g

7. STANDARDS, REAGENTS AND CONSUMABLE MATERIALS

7.1. Document all reagent and acid preparation information in a logbook, including acids and acid mixtures. Label all reagents and acids/mixtures with appropriate identification,, tracking , and expiration date information.

7.2. Reagent water: ASTM Type II deionized (DI) water

7.3. Hydrochloric Acid (12N) – EMD ACS Grade (HX0603-75)

7.4. 2.0 pH Buffer – VWR BDH5010-500mL

7.5. 4.0 pH Buffer – VWR BDH0198-2.0L

7.6. Glycine (Crystalline Granules) – J.T. Baker, Pharmaceutical Grade (0581-01)

7.7. Extraction Solution – To 1.9 L of reagent water add 60.06 g of Glycine. Place the mixture in a water bath at 37°C at allow to come to equilibrium. Standardize the pH meter using 2.0 and 4.0 pH standards which have also been brought to 37°C in the water bath. Add hydrochloric acid until the extraction solution reaches a pH of 1.50 ± 0.05. Bring the solution to a final volume of 2.0 L with reagent water.

7.8. QC Spiking solutions – Since the determinative methodology may vary, refer to the applicable determinative SOP for preparation of spiking solutions.

8. PREVENTIVE MAINTENANCE

Maintenance for this procedure is generally limited to glassware cleaning, pipet monitoring, and tumbler monitoring. Procedures for glassware washing are described in the SOP for Metals Laboratory Glassware Cleaning (MET-GC).

9. RESPONSIBILITIES

9.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

9.2. It is the responsibility of the department supervisor/manager to document analyst training and method proficiency.

10. PROCEDURE

10.1. Sample Preparation

10.1.1. Record all sample preparation and sample information on the applicable bench sheet. This includes acid mixture tracking documentation.

10.1.2. Using a spatula or other utensil, thoroughly mix and homogenize the sample, making sure to mix the entire contents of the jar. Additional steps may be needed to homogenize the sample (break up soil clumps, etc.). The sample should be mixed so there is a uniform color and texture. Since the entire jar is used, do not remove any extraneous material (this will be removed by sieving).

10.1.3. Transfer the entire mixed contents of the sample jar to an aluminum drying pan. Dry the sample in a drying oven at a temperature <40°C. The dried sample is then sieved to <250 µm. All subsequent analysis are performed on the <250 µm fraction.

10.1.4. The <250 µm sample is mixed thoroughly and placed in an appropriate sized glass jar. Subsamples are taken from this homogenized sample with a spatula or other utensil for analysis.

10.2. Leaching Procedure

10.2.1. Pre-heat the modified TCLP extractor to 37 ± 2 °C.

10.2.2. Weigh 1.00 ± 0.05 g of sample and quantitatively transfer to a 125 mL HPDE bottle. Next add 100 ± 0.5 mL of extraction solution (pre-heated to 37°C) to the bottle. Hand-tighten the cap, shake and invert to ensure there is no leakage and that no sample remains caked on the bottom of the bottle.

10.2.3. Open the door allowing access to the extractor oven then quickly place the bottles (field samples and all associated QC samples) on the tumbler and reseal the oven. Allow the temperature to return to equilibrium in the oven (usually 2 to 3 minutes) and begin the extraction.

10.2.4. Rotate the tumbler end over end at 30 ± 2 rpm for 1 hour. Record the start time of the rotation.

10.2.5. When the extraction is complete remove the bottles and arrange them on a bench top. Transfer 25-30 mL of extract to a 60 mL syringe and filter through a 0.45 µm disk filter. Capture the filtrate in 50 mL polypropylene centrifuge tubes and cap tightly. Store the filtered extracts in a refrigerator at 4 ± 2°C until they are analyzed.

10.2.6. The time each sample is filtered, and the extraction stopped, must be recorded. The elapsed time of the extraction cannot exceed 1 hour and 30 minutes. Any samples with extraction times greater than this must be re-extracted.

10.2.7. Measure the pH of the sample remaining in the extraction bottle. Standardize the pH meter using 2.0 and 4.0 pH standards which have also been brought to 37°C in the water bath. Rinse and blot electrode, then immerse into the sample. Press pH and record the pH when stabilized. Remove the electrode from samples after each measurement and rinse 3 times with D.I. water.

10.2.8. If the pH is not within ± 0.5 pH units of the starting pH then the extract must be discarded and reanalyzed using the procedure below.

10.2.8.1. Scenario 1: If the pH has dropped by more than 0.5 pH units repeat the test exactly as before. If the pH has dropped by more that 0.5 pH units again, record the pH and proceed with the analysis of the extract.

10.2.8.2. Scenario 2: If the pH has risen more than 0.5 pH units the extraction is repeated, however the extractor is stopped at 5, 10, 15, and 30 minutes and the pH adjusted down to 1.5 with dropwise additions of HCl. The pH is also adjusted upon final removal from the extractor (i.e. at 60 minutes). Note: Samples with rising pH cannot be extracted concurrently with sample being extracted with the standard procedure.

Note: All pH measurements indicated above are made by first calibrating the pH meter using 2.0 and 4.0 pH standards that have be equilibrated to 37°C in a water bath. The pH probe is acid then DI rinsed prior to making measurements is extracts and is subsequently acid then DI rinsed between samples to prevent any cross contamination.

10.3. Analysis

10.3.1. Extracts are analyzed for Arsenic and/or Lead by Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES), Inductively Coupled Plasma – Mass Spectroscopy (ICP-MS), or Graphite Furnace Atomic Absorption Spectroscopy (GFAAS) following SW-846 methodologies. Details of the instrumental analysis are described in SOPs for the specific analytical procedure and are outside the scope of this document.

11. QA/QC REQUIREMENTS

11.1. Initial Precision and Recovery Validation

The accuracy and precision of the procedure must be validated before analysis of samples begins. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery of for each analyte must be 85-115% and the RSD <20%.

11.2. Method Detection Limits

11.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank matrices at a level near or below the instrument limit of quantitation. Follow the procedures starting in Section 11 to analyze the samples. Refer to

CE-QA011, *Determination of Method Detection Limits and Limits of Detection* for details of performing the MDL study.

11.2.2. Calculate the average concentration found (x) and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. MDL's must be performed annually.

11.3. General ongoing QC Samples required for each sample batch (20 or fewer samples) are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. QC samples for the in vitro extraction must include the following:

11.3.1. Reagent Blank - Extraction solution analyzed once per batch. Ideally no target analytes should be detected in the reagent blank, but any detections must be <½ the MRL.

11.3.2. A method blank (bottle blank) is analyzed once per batch. A 100 mL aliquot of extraction solution is carried through the entire extraction procedure. The concentration found in the method blank must be less than the MRL for non-DoD projects and < ½ the MRL for DoD projects.

11.3.3. A Laboratory Control Sample (LCS) is analyzed once per batch using an aliquot of the extraction solution spiked at 1.0 mg/L for Arsenic and/or 10 mg/L for Lead using traceable 1000 mg/L stock solutions. Recovery for the LCS must fall between 85-115%.

11.3.4. A duplicate sample is performed at a frequency of 1 for every 10 samples. The duplicate analysis is evaluated against a control limit of ± 20% RPD.

11.3.5. A post-extraction matrix spike is analyzed once per batch. A known amount of Arsenic and/or Lead added to an aliquot of final extract to demonstrate the analytical method is free from interference in the extraction matrix. The spike concentration should be 1-5 times the native level found in the extract. The post-extraction matrix spike analysis is evaluated against a control limit of 75-125% recovery.

12. DATA REDUCTION, REVIEW, AND REPORTING

12.1. It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in section 12.

12.2. Calculations

12.2.1. Total Arsenic and/or Lead must also be determined for each sample subjected to this procedure. An additional aliquot of the homogenized <250 µm sample is digested via EPA method 3050B and analyzed by ICP, ICP-MS, or GFAA. Again, the details of the instrumental analysis are described in SOPs for the specific analytical procedure.

12.2.2. The bioaccessibility of Arsenic or Lead is calculated as follows:

$$Bioaccessibility\ value = \frac{(Concentration\ in\ in-vitro\ extract, mg/L)\ (0.1L)}{(Concentration\ in\ solid\ sample, mg/Kg)(0.001Kg)} \times 100$$

12.3. The data packet for the sequence is submitted for review by supervisor or designee. The results are transferred to the appropriate report form located in the ALS network directory R:\ICP\WIP. Once the results are transferred, the report is reviewed.

12.4. Refer to the *SOP for Laboratory Data Review Process* for general instructions for data review.

13. METHOD PERFORMANCE

13.1. This method will be validated through single laboratory studies of accuracy and precision.

13.2. The method detection limit (MDL) is established for the determinative methods using the procedure described in CE-QA011, *Determination of Method Detection Limits and Limits of Detection*.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Non Conformance and Corrective Action (CE-QA008)* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. POLLUTION PREVENTION AND WASTE MANAGEMENT

15.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

15.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

15.3. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 2.5-12 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS EH&S Manual for details.

16. TRAINING

16.1. Refer to ADM-TRAIN, *ALS-Kelso Training Procedure* for standard procedures.

16.2. Training outline

16.2.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

16.2.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

16.2.3. Perform initial precision and recovery (IPR) study by performing 4 replicate LCS analyses. Summaries of the IPR are reviewed and signed by the supervisor and forwarded to the employee's training file.

16.3. Training is documented following ADM-TRAIN, *ALS-Kelso Training Procedure*.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

17. METHOD MODIFICATIONS

17.1. This section is not applicable because this procedure is a laboratory developed method.

18. REFERENCES

18.1. *In Vitro Method for Determination of Lead Bioaccessibility,* Solubility/Bioavailability Research Consortium Standard Operating Procedure, Revision 8.

19. CHANGES SINCE THE LAST REVISION

19.1. Reformatted SOP to ALS branding.
19.2. Replaced “CAS” references with “ALS”.
19.3. Updated SOP references.
19.4. Sec. 17: New section.
19.5. Sec. 19: New section.
19.6. Added benchsheet as an attachment.

ATTACHMENT A
In Vitro Extraction Benchsheet
(1 page)

In Vitro Extraction

Sample ID	Sample Preparation		Extraction								Filtration	
	Weight (g)	Volume (mL)	Start Time	End Time	Elapsed Time (min)	Starting pH	Ending pH	ΔpH	Starting Temp. (°C)	Ending Temp. (°C)	Time	Time Elapsed from Extraction (min)
Acceptance Range	0.95-1.05	95.5-100.5	---	---	55-65	---	---	max = 0.5	35-39	35-39		max = 90

SRM = NIST 2711, Montana Soil Spike Solution = _____

Analyst:_____ Date:_____

Reviewer:_____ Date:_____

In Vitro Extraction

Sample ID	Sample Preparation		Extraction								Filtration	
	Weight (g)	Volume (mL)	Start Time	End Time	Elapsed Time (min)	Starting pH	Ending pH	ΔpH	Starting Temp. (°C)	Ending Temp. (°C)	Time	Time Elapsed from Extraction (min)
Acceptance Range	0.95-1.05	95.5-100.5	---	---	55-65	---	---	max = 0.5	35-39	35-39		max = 90

SRM = NIST 2711, Montana Soil Spike Solution = _____

Analyst:_____ Date:_____

Reviewer:_____ Date:_____

ALS Standard Operating Procedure

DOCUMENT TITLE:	METALS LABORATORY GLASSWARE CLEANING
REFERENCED METHOD:	N/A
SOP ID:	MET-GC
REVISION NUMBER:	5
EFFECTIVE DATE:	08/15/2014

METALS LABORATORY GLASSWARE CLEANING

ALS-KELSO

SOP ID:	MET-GC	Rev. Number:	5	Effective Date:	08/15/2014

Approved By: _____ Date: 8/8/14
Department Manager/Technical Director – Jeff Coronado

Approved By: _____ Date: 8-8-14
QA Manager – Lee Wolf

Approved By: _____ Date: 8/8/14
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

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Signature	Title	Date

TABLE OF CONTENTS

1.SCOPE AND APPLICATION 3
2.METHOD SUMMARY 3
3.DEFINITIONS 3
4.INTERFERENCES 3
5.SAFETY 3
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE 3
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS 4
8.APPARATUS AND EQUIPMENT 4
9.PREVENTIVE MAINTENANCE 4
10.RESPONSIBILITIES 4
11.PROCEDURE 4
12.QA/QC REQUIREMENTS 7
13.DATA REDUCTION, REVIEW, AND REPORTING 7
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA 7
15.METHOD PERFORMANCE 7
16.POLLUTION PREVENTION AND WASTE MANAGEMENT 7
17.TRAINING 8
18.METHOD MODIFICATIONS 8
19.REFERENCES 8
20.CHANGES SINCE THE LAST REVISION 8

METALS LABORATORY GLASSWARE CLEANING

1. SCOPE AND APPLICATION

1.1. This method describes the necessary steps to be taken to obtain target analyte-free labware. Sample digestion/preparation must be performed in meticulously clean labware to aide in the control and elimination of potential metal contaminants.

1.2. This procedure can also be applied to decontamination of field equipment. Refer to Appendix A.

2. METHOD SUMMARY

2.1. Glassware used in metals analysis is washed with soap and water, rinsed with hot water and further rinsed with deionized (DI) water. This step is followed by soaking the glassware in an 8 % Nitric Acid bath for a minimum of two hours and a final rinse with DI water.

3. DEFINITIONS

3.1. Not applicable

4. INTERFERENCES

4.1. Some soaps and detergents could contain target metals analytes. For this reason, the labels should be checked for ingredients that may contain target analytes.

4.2. Acids may contain trace amounts of target analytes. It is important to verify that each lot is free of such target analytes.

5. SAFETY

5.1. Appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. Hydrochloric and/or Nitric Acid are used in this procedure. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Not applicable

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Soap – Citranox , Prepare a 2% solution of Citranox in DI WATER

7.2. Hot tap water and DI water for rinsing.

7.3. Nitric Acid – General Grade – 8-10% solution for glassware soaking

7.4. Hydrochloric Acid

7.5. Acetone - low grade for drying and initial solvent rinse.

8. APPARATUS AND EQUIPMENT

8.1. Sink with hot tap water and DI water plumbed.

8.2. Protective equipment – Fume hood, gloves, lab coat, apron, and eyewear suitable for acid and solvent usage.

8.3. Plastic tubs and sponges – for collecting glassware soaking and cleaning

8.4. Nitric Acid bath for soaking glassware.

8.5. Solvent waste can and storage containers.

9. PREVENTIVE MAINTENANCE

9.1. Laboratory water systems are maintained so as to produce the acceptable water for glassware washing and other related cleaning. Water and specifications are described in the FAC-WATER SOP.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform this function according to this SOP. It is the responsibility of the department supervisor/manager to ensure that the procedure is being implemented correctly.

10.2. It is the responsibility of the department supervisor/manager to document analyst training as described in ADM-TRAIN, *ALS-Kelso Training Procedure*.

11. PROCEDURE

11.1. Laboratory Glassware

11.1.1. Vigorously wash glassware using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the glassware.

11.1.2. Rinse with hot tap water followed by DI water

11.1.3. Soak in dilute nitric acid (8%) for at least two hours.

11.1.4. Remove glassware from nitric acid bath and thoroughly rinse with DI water. Using your gloved hand by rubbing the surface of the glassware, while rinsing with DI water will help remove the acid from the inside and outside surfaces of the glassware.

11.1.5. Perform a final rinse using DI water without rubbing the gloved hand over the glassware.

11.1.6. After the final DI rinse, immediately place glassware face down on a tray holding several layers of paper toweling.

11.2. Graduated Cylinders

11.2.1. Vigorously wash glassware using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the glassware.

11.2.2. Rinse with hot tap water.

11.2.2.1. Use as much water pressure as possible.

11.2.2.2. Fill at least four times

11.2.3. Rinse with D.I. water.

11.3. TCLP/SPLP Extraction Bottles – Metals and Organics

11.3.1. Metals TCLP bottles – wide mouth plastic

11.3.1.1. Vigorously wash glassware using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the bottle.

11.3.1.2. Rinse with hot tap water.

11.3.1.3. Use as much water pressure as possible.

11.3.1.4. Fill at least four times

11.3.1.5. Rinse with 25% HCL

11.3.1.6. Rinse with DI Water

11.3.2. Organics TCLP Bottles – narrow mouth/Teflon

11.3.2.1. Vigorously wash glassware using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the bottle.

11.3.2.2. Rinse with hot tap water.

11.3.2.3. Use as much water pressure as possible.

11.3.2.4. Fill at least four times

11.3.2.5. Rinse with D.I. water.

11.3.2.6. In a fume hood, rinse with Acetone to remove any organic residue. The Acetone should drain into a waste beaker. The waste beaker should be emptied into an appropriate waste container labeled as "Acetone Waste" and stored for proper disposal by the solvent disposal team.

11.4. Closed Vessel Oil Digestion Bombs

11.4.1. Rinse each Teflon® bomb with acetone, discarding the waste from each vessel into a designated acetone waste container.

11.4.2. Vigorously wash glassware using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the digestion bomb.

11.4.3. Rinse with hot tap water.

11.4.4. Use as much water pressure as possible.

11.4.5. Fill at least four times

11.4.6. Add 3.0 mL of general grade nitric acid to each digestion bomb. Tighten cap with the bomb wrench and heat in an oven for 30 minutes. Remove from oven after 30 minutes and tighten the caps of the bomb. Put the digestion bomb back into the oven and continue to heat for at least 2 hours.

11.4.7. Remove the bombs from the oven, cool to room temperature and rinse with DI water a minimum of 6 times.

11.4.8. After the final DI rinse, immediately place Teflon bombs face down on a tray holding several layers of paper toweling.

11.5. Tissue Digestion Bombs

11.5.1. Vigorously wash Teflon bombs using the Citranox detergent solution which has been added to hot water. Use a sponge to remove any materials that adhere to the sides of the digestion bomb.

11.5.2. Rinse with hot tap water.

11.5.2.1. Use as much water pressure as possible.

11.5.2.2. Fill at least four times

11.5.3. Add 3.0 mL of general grade nitric acid to each tissue digestion bomb. Tighten cap with the bomb wrench and heat in an oven for two hours.

11.5.4. Remove the bombs from the oven, cool to room temperature and rinse with DI water at least 6 times.

11.5.5. After the final DI rinse, immediately place Teflon bombs face down on a tray holding several layers of paper toweling.

11.6. Decontamination of field equipment - refer to Appendix A.

12. QA/QC REQUIREMENTS

12.1. Not applicable – see determinative methods.

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Not applicable

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.)
- Sample preservation or handling discrepancies due to laboratory or operations error.

15. METHOD PERFORMANCE

15.1. Not applicable

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

16.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

16.4. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 2.5-12 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS EH&S Manual for details.

17. TRAINING

17.1. Refer to ADM-TRAIN, ALS-Kelso Training Procedure for standard procedures.

17.2. Training is documented following ADM-TRAIN, ALS-Kelso Training Procedure.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. Not applicable.

19. REFERENCES

19.1. Not applicable.

20. CHANGES SINCE THE LAST REVISION

20.1. Updated to current ALS format.
20.2. Minor formatting and text corrections.
20.3. Section 1.2 – added.
20.4. Section 9 – added.
20.5. Section 10.2 – added.
20.6. Section 11.6 – added.
20.7. Section 14 – Standard SOP language added.
20.8. Section 16 – prior pollution prevention and waste management sections combined and added standard language for 16.3 and 16.4.
20.9. Section 17 – revised.
20.10. Appendix A – new.

APPENDIX A
Decontamination of Field Equipment

Decontamination Supplies and Reagents

1. Tubing as specified by client/project.
2. Plastic buckets as specified by client/project.
3. ASTM Type 1 deionized (DI) water.
4. Hydrochloric Acid (BDH, ACS grade), diluted with Type 1 water to 25%.
5. Ceramic knife.
6. 12"x12" Lint free clean room wipes (Amplitude Helix, item # 89030-184).
7. Plastic Zip Lock bags (13"x15 5/8" and 22"x 22").
8. Field Equipment Decontamination (FED) logbook (current version 14-MET-FED-01).

Tubing Preparation for Clean Sampling

The following cleaning procedures are all carried out in the ALS/Kelso Class 1000 clean room (Rm. 314) fitted with Class 100 laminar flow fume hoods.

Bulk tubing is either supplied by the client or purchased by ALS as per the client's specifications.

Procedure:

1. Bulk tubing is measured and cut to the specified length with a ceramic knife. This procedure being conducted on an available clean room counter.
2. 250 mL of 25% HCl is added to one end of the tubing and gravity fed through the length tubing. Acid exiting the opposite end of the tubing is captured in an appropriate waste container for later neutralization and disposal.
3. (Note: If an entire roll of tubing is being cleaned without cutting to lengths 2 L of 25% HCl is passed through the tubing using a peristaltic pump.)
4. Following the acid rinse the same end of tubing is connected to a DI faucet. The tubing is then rinsed with a minimum of 3 L of DI water.
5. After as much water as possible is allowed to gravity drain from the rinsed tubing the discharge end of the tube is connected to vacuum using the 2 L trap assembly. Vacuum is then applied to remove as much residual water from the tubing as possible.

6. The ends of the tubing are next sealed with DI rinsed aluminum foil and Teflon tape. The exterior of the tubing is wiped down with lint free wipes, coiled, then double bagged in appropriate size zip lock bags.

7. The bagged tubing is then labeled with a lot number obtained from the FED logbook.

Bucket Decontamination

Procedure:

1. Rinse interior and exterior of bucket and lid vigorously with tap water using as much pressure as possible.

2. Rinse interior and exterior of bucket and lid with 25% HCl.

3. Rinse interior and exterior of bucket and lid with vigorously with DI water using as much pressure as possible.

Quality Control

1. Equipment (i.e. tubing, buckets, etc.) of the same type, prepared on the same day, using the same reagents is given a unique lot number. The unique lot number is assigned using the FED logbook name and page number (e.g. page eight of the current log book generates a lot number of (13-METFED-01). Only information for one lot is recorded per page in the logbook.

2. In the FED logbook, record the type of equipment, and for tubing the lengths prepared. Also include lot number or unique CAS identification number (i.e. from the Reagent Logbook) for the acid used.

3. Tubing Blank: Using one section of cleaned tubing from each lot, fill a 1 L polymer metals sample container with DI water and preserve with nitric acid (if 1631 Hg is required transfer 150 mL of this aliquot to a fluoropolymer container prior to preservation).

4. Bucket Blanks: Fill one bucket with DI water. Fill a 1 L polymer metals sample container from this bucket and preserve with nitric acid. If needed, also fill a 500 mL fluoropolymer container and preserve with HCl.

5. Analyze the DI sample for the list of metals specified by the project plan by the appropriate analytical procedure (typically ICP/MS and/or P&T/CVAFS). Where project specifications are not available, analyze a comprehensive list of metals utilizing the most sensitive methodology for each. If contamination is detected, identify the source of the contamination, re-clean the associated tubing, and recheck as described above. This must be repeated until satisfactory results are achieved. Once satisfactory results are produced, an analytical report summarizing the results is generated. The tubing in then ready for shipment to the client.

ALS Standard Operating Procedure

DOCUMENT TITLE:	DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)
REFERENCED METHOD:	EPA 200.7/6010C
SOP ID:	MET-ICP
REVISION NUMBER:	25
EFFECTIVE DATE:	01/01/2015

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

ALS-KELSO

SOP ID:	MET-ICP	Rev. Number:	25	Effective Date:	01/01/2015

Approved By: _____ Date: 12/8/14
Department Supervisor/Technical Director – Jeff Coronado

Approved By: _____ Date: 12/8/14
QA Manager – Lee Wolf

Approved By: _____ Date: 12/8/14
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

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TABLE OF CONTENTS

1.SCOPE AND APPLICATION 3
2.METHOD SUMMARY 3
3.DEFINITIONS 3
4.INTERFERENCES 5
5.SAFETY 5
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE 6
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS 6
8.APPARATUS AND EQUIPMENT 8
9.PREVENTIVE MAINTENANCE 8
10.RESPONSIBILITIES 8
11.PROCEDURE 8
12.QA/QC REQUIREMENTS 11
13.DATA REDUCTION, REVIEW, AND REPORTING 14
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA 15
15.METHOD PERFORMANCE 15
16.POLLUTION PREVENTION AND WASTE MANAGEMENT 16
17.TRAINING 16
18.METHOD MODIFICATIONS 16
19.REFERENCES 16
20.CHANGES SINCE THE LAST REVISION 17

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

1. SCOPE AND APPLICATION

1.1. This procedure describes the steps taken for the analysis of soil, sludge surface water and drinking water digestates using EPA methods 6010C, 200.7, and CLP ILM04.0 for a variety of elements. The digested samples and QC standards are all diluted in a similar acid matrix. A procedure is also given for calculation of hardness by Standard Methods 2340B.

1.2. The Method Reporting Limits (MRLs) for common elements are listed in Table 1. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The reported MRL may be adjusted if required for specific project requirements, however, the capability of achieving other reported MRLs must be demonstrated. The Method Detection Limits (MDLs) that have been achieved are listed in Table 1. The MDL and MRL may change as annual studies are performed.

1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP or project which require older versions of EPA methods (i.e. 6010B). QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD)* may supersede the requirements defined in this SOP.

2. METHOD SUMMARY

2.1. A representative aliquot of sample is prepared as described in the applicable digestion SOP. The digestate is analyzed for the elements of interest using ICP spectrometry. The instrument measures characteristic emission spectra by optical spectrometry. The intensity of emission lines are monitored.

2.2. Final results are calculated using the digestion information and the results from the ICP analysis. Data is reported using standard ALS procedures and formats, or following project specific reporting specifications.

2.3. Deviations from the reference method(s): This SOP contains no deviations from the reference methods.

3. DEFINITIONS

3.1. **Batch** - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.1.1. Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.1.2. Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2. **Sample**

3.2.1. Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2. Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3. **Quality System Matrix** - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1. Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.

3.3.2. Drinking water - Any aqueous sample that has been designated a potable or potential potable water source.

3.3.3. Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.3.4. Non-aqueous Liquid - Any organic liquid with <15% settleable solids.

3.3.5. Animal tissue - Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.3.6. Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.3.7. Chemical waste - Any sample of a product or by-product of an industrial process that results in a matrix not described in one of the matrices in Sections 3.3.1 through 3.3.6. These can be such matrices as non-aqueous liquids, solvents, oil, etc.

3.3.8. Miscellaneous matrices – Samples of any composition not listed in 3.3.1 – 3.3.7. These can be such matrices as plant material, paper/paperboard, wood, autofluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.

3.4. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Duplicate samples are spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision. The concentration of the spike should be at the midpoint of the calibration range or at levels specified by a project analysis plan.

3.5. Laboratory Duplicates (DUP) – Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

3.6. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.7. Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.8. Laboratory fortified Blank (LFB) - A laboratory blank that has been fortified with target analyte at the method reporting limit and used to determine if the laboratory can detect contaminants at the method reporting limit.

3.9. Independent Verification Standard (ICV) - A mid-level standard injected into the instrument after the calibration curve and prepared from a different source than the initial calibration standards. This is used to verify the validity of the initial calibration standards

3.10. Continuing Calibration Verification Standard (CCV) - A standard analyzed at specified intervals and used to verify the ongoing validity of the instrument calibration.

3.11. Instrument Blank (CCB) - The instrument blank (also called continuing calibration blank) is a volume of blank reagent of composition identical to the digestates. The purpose of the CCB is to determine the levels of contamination associated with the instrumental analysis.

4. INTERFERENCES

4.1. Interferences from contaminated reagents must be eliminated. The purity of acids must be established by the laboratory as being high enough to eliminate the introduction of contamination above the MRL (or above ½ the RL for DoD work).

4.2. Background emission and stray light can be compensated by background correction.

4.3. Spectral overlaps resulting in interelement contributions can be corrected for by using interelement correction factors. Interelement correction factors are established for each instrument and are maintained by the analyst at the workstation.

5. SAFETY

5.1. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.2. Hydrochloric, Nitric and Hydrofluoric Acids are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. Safety glasses, lab coat and gloves should be worn while working with the solutions.

5.3. High Voltage - The power unit supplies high voltage to the RF generator which is used to form the plasma. The unit should never be opened. Exposure to high voltage can cause injury or death.

5.4. UV Light -The plasma when lit is a very intense light, and must not be viewed with the naked eye. Protective lenses are in place on the instrument. Glasses with special protective lenses are available.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Samples are prepared using methods 3005A, 3010A, 3050, or CLPILM04.0 (ALS SOPs MET-3005A, MET-3010A, MET-3050, and MET-DIG). Samples are received in the ICP lab as completed digestates. Samples are stored in 50 mL plastic centrifuge tubes, 100 mL digestion vessels or in 100 mL volumetric flasks.

6.2. Water samples analyzed by EPA method 200.7 are preserved after arrival at the laboratory. These samples are held for a minimum of 24 hours and the pH verified to be <2 prior to digestion.

6.3. Soil samples are diluted prior to instrumental analysis by a factor of 2. This allows the method to meet the required 1 g of sample to 200 mL dilution during digestion.

6.4. Following analysis, digestates are stored until two weeks after all results have been reviewed and then brought to 3< pH<10 and disposed of through the sewer system.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Standards Preparation

7.1.1. Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements. Manufacturer's expiration dates are used to determine the viability of standards.

7.1.2. Calibration Standards

Calibration standards are prepared from commercially purchased single element 1000 ppm or 10,000 ppm stock standards as well as pre-mixed multi element stock standards. All standards are aliquoted using Class A volumetric pipettes, or calibrated

fixed and adjustable volume autopipetters. All dilutions are made in Class A volumetric glassware.

The standard mixes for each ICP system vary based on the requirements of each instrument. The composition of the ICAP 6500 standards are outlined in Table 2.

7.1.3. Continuing Calibration Verification (CCV) Standards

CCV standards are analyzed at the midpoint of the calibration. These standards are produced by making a two-fold dilution of each calibration standard. The CCV standards are then run in sequence during the analytical run.

7.1.4. Initial Calibration Verification (ICV) Standards

The ICV working standards are produced by direct dilution of two certified mixed stock solutions (QCP-CICV1 and QCP-CICV3 purchased from Inorganic Ventures or another qualified vendor and various single element stock solutions from sources different than the calibration standards. The composition of these standards is outlined in Table 3.

7.1.5. Interference Check Solutions (ICSA & ICSAB)

The ICSA and ICSAB working standards are produced by direct dilution of certified mixed stock solutions (CLPP-ICS-A and CLPP-ICS-B or equivalent.) Antimony is also added to the ICSAB solution from a 1000 ppm single element stock standard. The composition of these standards is outlined in Table 4.

7.1.6. CRI/Low Level Calibration Verification

The CRI, Low Level Initial Calibration Verification (LLICV), and Low Level Continuing Calibration Verification (LLCCV) are produced by diluting 1000 or 10000ppm single stock standards into a 100X intermediate standard and then diluted 1/100 to obtain the MRL level. Note: The level used is that of the normal MRL used for both instruments.

7.1.7. The solutions and materials used for the LCS and matrix spikes are described in the applicable digestion SOP.

7.1.8. Standard Log

The analyte, source, initial volume, final volume, final concentration and expiration date are recorded in a standard logbook kept in the ICP lab. The operator who prepares the standard must date and initial the entry in the standards logbook. The operator also places his initials and the date prepared on the standard container. In addition to working standards used in calibration, all other standards used in the analytical run such as ICVs, MRL standards, and other project or client specific standards shall be documented in the standard logbook.

7.2. High Purity Argon.

7.3. Capillary, rinse and peristaltic pump tubing.

7.4. 17 x 100mm polypropylene test tubes.

8. APPARATUS AND EQUIPMENT

8.1. Inductively Coupled Plasma Atomic Emission Spectrometer

8.1.1. Thermo Scientific ICAP 6500 (AES-03).
8.1.2. Thermo Scientific ICAP 6500 (AES-04).

8.2. Concentric nebulizers.

8.3. Microflow nebulizer for ICAP 6500.

8.4. Torches and injector tips for each ICP.

8.5. Cyclonic spray chambers for each instrument.

8.6. Water coolers for each ICP.

8.7. Argon Humidifiers for the ICAP 6500.

8.8. ESI SC4 DX Autosampler with Fast System for ICAP 6500.

8.9. Peristaltic Pumps for each Spectrometer.

8.10. RF Generators for each ICP (internal on the IRIS and ICAP 6500).

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in section 9. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.

9.2. Torch, nebulizer, and spray chambers are cleaned as required. All instrument filters are vacuumed monthly. Dirty ICP torches and mixing chambers are soaked in aqua regia overnight, rinsed and placed in a clean dry area. The conical nebulizer is back flushed with acid or DI water as needed. The microflow nebulizer is not back flushed. Use the obstruction removal kit.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Training and proficiency is documented in accordance with the SOP *ADM-TRANDOC*.

11. PROCEDURE

11.1. Operating Parameters

11.1.1. For each Thermo Scientific ICAP 6500, the operating parameters are defined in the Method file. Default operating parameters are given in Tools/Options/New Method Parameters. However, each unique set of operating parameters is saved as a new file and the analyst must select and use the correct Method file for the application. Refer to the method files on the workstation for a listing of parameters for each file. The interelement correction factors to be used are established for the ICAP 6500 and are saved on the workstation also. Since these parameters change with method and correction factor updates, and due to the large amount of hardcopy printout for listing these parameters, it is not practical to include the parameters in this SOP.

11.2. Calibration/Standardization

11.2.1. ICAP 6500

11.2.1.1. Plasma is ignited and instrument is allowed to warm up for at least 30 minutes.

11.2.1.2. An internal standard is used for routine analyses on this instrument. Yttrium and Indium are used as internal standards. The internal standard solution is introduced into the analyzed solutions (standards, blanks, QC, samples, etc.) at 0.8 ug/mL for Y, and 1.6 ug/mL for In.

11.2.1.3. Run a peak check standard and adjust peaks as needed.

11.2.1.4. Standardize by running a Blank and a High Standard for each element in the analytical method. Analyst will initial and date the first page of the standardization.

11.2.2. Standardization is completed by analyzing an ICV for each analyte to be determined. For method 200.7 the result must be within ±5% of the true value. For method 6010B/C the result must be within ±10% of the true value. If the ICV fails when running method 6010C, either the calibration standards or the ICV must be prepared fresh and the instrument re-standardized. If the ICV fails when running methods 200.7 and 6010B only re-standardization is necessary.

11.2.3. Method 6010C also requires a LLICV be analyzed at the MRL level. The result must be within ±30% of the true value. The LLICV need not be made up with stock standards different than those of the calibration standards.

11.3. Analytical Run

11.3.1. Following standardization and ICV analysis, the remainder of the run is determined by what analytical method is being performed. These are listed below.

11.3.1.1. CLP ILM04.0: ICB, CCV, CCB, CRI, ICSA, ICSAB, CCV, CCB, routine samples. The CRI, ICSA, and ICSAB will be analyzed every 20 samples.

They will be labeled with an F indicating Final. Each set will be numbered in increasing order, i.e. ICSAF1, ICSAF2.

11.3.1.2. Methods 200.7 and 6010B/C: ICB, LLICV, CCV, CCB, CRI, ICSA, ICSAB, routine samples.

11.3.2. Evaluate the initial QC using the following criteria:

11.3.2.1. For methods 200.7 and 6010B/C, the following criteria apply:

- The ICB and CCB results are evaluated using method specified requirements. The following guidelines should also be used to determine acceptability:
- For 200.7, the result should be less than 3 times the standard deviation of the mean background signal.
- For method 6010B, the result should be less than the Method Detection Limit (MDL). In cases where the associated sample results are being reported to the Method Reporting Limit (MRL) the result may be greater than the MDL if the result does not adversely impact data quality.
- For method 6010C, the result should be less than the Lower Limit of Quantitation (LOQ).
- Where project specifications allow, the result may be over the MDL if the result does not adversely impact data quality.
- The CCV immediately following standardization must verify within ± 10% of the true values with a relative standard deviation of <5% from 2 replicate integrations for methods 6010B/C. For 200.7, the first CCV must verify within ± 5% with a RSD of <3% from 4 replicates. Calculate %RSD as follows:

$$\%RSD = \frac{StdDev_{CCV}}{Average_{CCV}} x\,100$$

where: StdDevccv = Standard deviation of the replicate integrations
Averageccv = Average of the replicate CCV integrations

- The LLICV or CRI is a low level standard with concentrations at the RL. For DoD projects, the LLICV standard concentrations will be equal to the project RLs. For method 6010C the CRI results should be within 30% of the true value. For 200.7 and 6010B the LLICV/CRI results should be greater than the MDL and less than 2X the MRL. For method 6010C, the LLICV results should be ± 30% of the true value.

- The ICSA is run to check the validity of the Interelement Correction Factors (IECs).

Note: DoD QSM requires this to be run at the beginning of each analytical run.

- The ICSAB must be within 20% of the expected value for the CLPP-ICS-B elements and Sb.

11.3.2.2. The ICV, LLICV, ICB, CCV, CCB, CRI, and ICSAB must meet the criteria listed. Reanalyze any elements that fail.

11.3.2.3. For CLP, refer to SOW ILM04.0 for acceptance criteria.

11.3.3. Continuing Calibration Verification

11.3.3.1. CCVs are analyzed after every 10 samples and at the end of the analytical run. They must verify within ±10% of the expected value with a RSD of <10%.

11.3.3.2. CCBs are analyzed after every 10 samples and at the end of the analytical run. CCBs are evaluated as in section 11.3.2.1.

11.3.3.3. Method 6010C requires a LLCCV be analyzed at the end of each analysis batch. The LLCCV is at the MRL level and must verify within ±30% of the true value. Reanalyze any elements to be reported at low levels that are bracketed by the LLCCV if the standard fails.

11.3.4. If the CCV or CCB solutions fail, reanalyze any elements to be reported.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery for each analyte must meet LCS criteria and the RSD< 30%.

12.2. Method Detection Limits

12.2.1. A Method Detection Limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates at a level near or below the MRL. Follow the procedures in Section 11 to analyze the samples. Refer to the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*.

12.2.2. Calculate the average concentration found (x) and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct

T value for the number of replicates. MDLs must be performed whenever there is a significant change in the background or instrument response.

12.2.3. A Limit of Detection (LOD) check must be performed after establishing the MDL and at least annually (quarterly if DoD) afterward. A blank is spiked with analytes at 2-4X the MDL and carried through the preparation and analytical procedure. The LOD is verified when the signal/noise ratio is > 3 for all analytes.

12.3. Limit of Quantitation Check(LOQ)/Lower Limit of Quantitation Check(LLQC)

For Method 6010C and drinking waters by method 200.7 a Lower Limit of Quantitation Check (LOQ/LLOQ) sample must be analyzed after establishing the MRL and at least annually (quarterly if DoD) afterward to demonstrate the desired detection capability. The LOQ/LLOQ sample is spiked at 1-2X the MRL and must be carried through the entire preparation and analytical procedure. Limits of quantitation are verified when all analytes are detected within 30% of their true value.

12.4. Linear Dynamic Range

The upper limit of the LDR must be established for each wavelength utilized. It must be determined from a linear calibration prepared in the normal manner using the established analytical operating procedure for the instrument. The LDR should be determined by analyzing at least three succeeding higher standard concentrations of the analyte until the observed analyte concentration is no more than 10% above or below the stated concentration of the standard. Determined LDRs must be documented and kept on file. The LDR which may be used for the analysis of samples should be judged by the analyst from the resulting data. Sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and reanalyzed. The LDRs are verified semi-annually or whenever, in the judgment of the analyst, a change in analytical performance caused by either a change in instrument hardware or operating conditions would dictate they be redetermined.

12.5. Instrument Detection Limit

On a quarterly basis, the instrument detection limits for all analytes are determined as per procedures outlined in ILM04.0 (Section E, paragraph 10, 12 resp.). IDLs are determined using blanks and this data is kept on file.

12.6. Interelement Correction Factors

Semi-annually, instrument interferences are calculated as per ILM04.0 (Section E, paragraph 11) and Method 6010B/C. During the course of routine work, other interferences may be found. They are verified by the operator during the analytical run and data is manually corrected. Copies of this data are kept on file. Data can be manually corrected or automatically corrected using iTEVA software.

12.7. Internal Standard

Internal standard values are tracked by the instrument software. Values should remain within 60-125% of the value found in the calibration blank. If a sample is found to have and internal standard outside this value, the sample will be diluted to bring the internal standard into range.

12.8. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches*. Additional QC Samples may be required in project specific quality assurance plans (QAPP). For example projects managed under the DoD ELAP must follow requirements defined in the DoD *Quality Systems Manual for Environmental Laboratories*. General QA requirements for DoD QSM are defined in the laboratory SOP, Department *of Defense Projects – Laboratory Practices and Project Management (ADM-DOD).* General QC Samples are:

12.8.1. Each sample preparation batch must have a method blank associated with it. The method blank result should be < MRL. If the method blank is found to be contaminated, it may be reported if the concentration in the associated samples is at least 20 times the amount found in the method blank for methods 200.7 and 6010B, otherwise redigest the batch. For Method 6010C, the method blank may be reported if the concentration in the associated samples is at least 10 times the amount found in the method blank.A contaminated method blank (MB) may also be reported if all of the associated samples are non-detect (ND).

Note: DoD QSM requires contamination in the MB be <1/2 the RL or < 1/10 any sample amount.

12.8.2. A Laboratory Control Sample (LCS) is digested one per batch, or per 20 samples. For soil samples, the recovery must fall within the ranges specified for the reference material. For CLP, use the prescribed limits for the SOW in use. If the LCS fails the acceptance criteria, redigest the batch of samples. For specifics on the preparation and composition of LCS samples refer to the appropriate digestion SOP.

12.8.3. A Duplicate sample is digested one per batch, or per 20 samples (i.e. 5%) for 6010B/C analysis, or per 10 samples (i.e. 10%) for 200.7 analyses. If the RPD is outside acceptance limits, either redigest the sample batch or flag the data appropriately, depending on the physical nature of the samples (e.g. non-homogenous).

12.8.4. A Laboratory fortified Blank (LFB) at the MRL is digested and analyzed with every batch of drinking water samples (method 200.7). The default acceptance criteria of 50-150% are to be used until sufficient data points are acquired to calculate in-house control limits.

12.8.5. A Matrix Spike sample is digested one per batch, or per 20 samples (i.e. 5%) for 6010B/C analysis, or per 10 samples (i.e. 10%) for 200.7 analyses. Where specified by project requirements, a matrix spike duplicate may be required. If the recovery is outside acceptance limits, either redigest the sample batch or flag the data appropriately, depending on the physical nature of the samples (e.g. non-homogenous). If the sample concentration is >4x the spike level, no action is required and data is flagged accordingly. For specifics on the preparation and composition of matrix spike solutions refer to the appropriate digestion SOP.

12.8.6. Acceptance criteria

12.8.6.1. Current ALS control limits and acceptance criteria for ongoing QC analyses are listed in the current ALS-Kelso DQO tables. Criteria are subject to change as statistical data are generated. The default method criteria may be used if

statistically generated criteria are broader or insufficient points are available for accurate statistical limits.

12.8.6.2. For all QC analyses, project-specific or program-specific (e.g. DOD) acceptance criteria may supersede ALS criteria. For analyses under the CLP SOW use the prescribed limits for the SOW in use.

12.8.7. Matrix Interference

12.8.7.1. When an analyst suspects that there may be any matrix interferences present, a post digestion spike may be performed. The recovery should be ± 20%.

12.8.7.2. If the post spike fails, a 1:5 serial dilution test shall be performed. The dilution should be within ± 10% of the original result.

12.8.7.3. A 1:5 serial dilution shall be performed for all Tier III or IV deliverables.

Note: DoD QSM recovery acceptance limits are 75-125%.

12.8.7.4. Post spikes for 6010C shall be performed for Tier III and Tier 1V.

12.9. Additional QC measures include control charting and compiling of QC data for generation of control limits.

12.10. CLP analyses are performed as per the QA/QC guidelines in the most current CLP SOW.

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Calculate sample results using the data system printouts and digestion information. The digestion and dilution information is entered into the data system. The data system then uses the calculations below to generate a sample result. The wavelengths used to quantify each metal are summarized in Table 5 for the IRIS and Table 6 for the ICAP6500.

Aqueous samples are reported in ug/L:

$$\mu g/L\,(Sample) = C^{*}\ x\ Digestion\,Dilution\,Factor\ x\ Post\ Digestion\,Dilution\,Factor \times 1000\ \mu g/mg$$

Solid samples are reported in mg/Kg:

$$mg/Kg\ \ (Sample) = C^{*}\ x\ Post\ Digestion\,Dilution\,Factor\ x\ \frac{Digestion\,Vol.(ml)}{Sample\,wt.(g)}\ x\ \frac{1L}{1000ml}\ x\ \frac{1000g}{1Kg}$$

C*= Concentration of analyte as measured at the instrument in mg/L.

13.2. If total hardness is to be reported, use Calcium and Magnesium results to calculate as follows. For reporting calcium hardness, use only the calcium portion of the equation.

$$Hardness, mg\ equivalent\ CaCO_3/L = 2.497\left[Ca, mg/L\right] + 4.118\left[Mg, mg/L\right]$$

13.3. A daily run log of all samples analyzed is maintained. All CLP data should be printed and stored after operator has checked for evenness of burns. A copy of this document will go with each package of Tier III or higher data run that day.

13.4. Data Review and Reporting

13.4.1. It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in section 12. The data is then placed in a work order file until complete. When the work order is complete, a report is generated. A final review is performed and the data is delivered to the project management department.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

16.3. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 3-10 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS EH&S Manual for details.

17. TRAINING

17.1. Training outline

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. Assist in the procedure under the guidance of an experienced analyst for approximately two weeks. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3. Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAP Initial Demonstration of Capability.

17.2. Training is documented following the *ALS Kelso, Training Procedure* (ADM-TRAIN) and the Corporate *Training Policy (*CE-QA003*).*

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

19. REFERENCES

19.1. USEPA, Contract Laboratory Program, SOW #ILM04.0

19.2. Thermo Jarrell Ash ICAP61 Manual

19.3. USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010B, Revision 2, December 1996.

19.4. USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010C, Revision 3, February 2007.

19.5. USEPA, Methods for Determination of Metals in Environmental Samples, Supplement I, EPA/600/R-94/111, Method 200.7, Revision 4.4, May 1994.

19.6. *Hardness by Calculation, Method 2340B,* Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.

20. CHANGES SINCE THE LAST REVISION

20.1. Updated to current ALS format.
20.2. Revised internal document references from CAS to ALS
20.3. Minor typographical and format corrections.
20.4. Section 3– updated several definitions to standard definitions for SOPs.
20.5. Section 7.1.4 – corrected standard composition to reflect current practice.
20.6. Section 9.2 – revised to reflect current practice.
20.7. Section 11.3.2.1 – LL ICV criteria revised to reflect current practice.
20.8. Section 12.2.3 – LOD spike level corrected.
20.9. Section 12.4 – revised to reflect current practice (LDR semi-annual).
20.10. Sections 12.8.2. – 12.8.5 revised to remove outdated/redundant QC criteria and added new section 12.8.6.
20.11. Section 14 – updated to standard language.
20.12. Section 17 – updated to standard language.
20.13. Tables reference errors corrected and tables updated.

TABLE 1

Target Elements, Method Reporting Limits, and Method Detection Limits

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
0.7	EPA 3050B	Aluminum	Soil	0.5	2
200.7	EPA 3050B	Antimony	Soil	2	4
200.7	EPA 3050B	Arsenic	Soil	2	4
200.7	EPA 3050B	Barium	Soil	0.3	0.8
200.7	EPA 3050B	Beryllium	Soil	0.08	0.2
200.7	EPA 3050B	Bismuth	Soil	3	8
200.7	EPA 3050B	Boron	Soil	0.7	4
200.7	EPA 3050B	Cadmium	Soil	0.09	0.2
200.7	EPA 3050B	Calcium	Soil	1	4
200.7	EPA 3050B	Chromium	Soil	0.3	0.8
200.7	EPA 3050B	Cobalt	Soil	0.2	0.4
200.7	EPA 3050B	Copper	Soil	0.4	0.8
200.7	EPA 3050B	Iron	Soil	2	4
200.7	EPA 3050B	Lead	Soil	0.7	2
200.7	EPA 3050B	Lithium	Soil	0.6	4
200.7	EPA 3050B	Magnesium	Soil	0.2	2
200.7	EPA 3050B	Manganese	Soil	0.04	0.2
200.7	EPA 3050B	Molybdenum	Soil	0.2	0.8
200.7	EPA 3050B	Nickel	Soil	0.2	0.8
200.7	EPA 3050B	Phosphorus	Soil	3	8
200.7	EPA 3050B	Potassium	Soil	10	40
200.7	EPA 3050B	Selenium	Soil	2	4
200.7	EPA 3050B	Silver	Soil	0.3	0.8
200.7	EPA 3050B	Sodium	Soil	5	40
200.7	EPA 3050B	Strontium	Soil	0.05	0.2
200.7	EPA 3050B	Sulfur	Soil	4	8
200.7	EPA 3050B	Thallium	Soil	0.8	2
200.7	EPA 3050B	Tin	Soil	0.6	4
200.7	EPA 3050B	Titanium	Soil	0.2	0.4
200.7	EPA 3050B	Vanadium	Soil	0.3	0.8
200.7	EPA 3050B	Zinc	Soil	0.2	1

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
200.7	MET-DIG (CLP)	Aluminum	Water	4	10
200.7	MET-DIG (CLP)	Antimony	Water	6	20
200.7	MET-DIG (CLP)	Arsenic	Water	5	10
200.7	MET-DIG (CLP)	Barium	Water	0.6	4
200.7	MET-DIG (CLP)	Beryllium	Water	0.5	1
200.7	MET-DIG (CLP)	Bismuth	Water	6	40
200.7	MET-DIG (CLP)	Boron	Water	4	20
200.7	MET-DIG (CLP)	Cadmium	Water	0.5	1
200.7	MET-DIG (CLP)	Calcium	Water	0.9	20
200.7	MET-DIG (CLP)	Chromium	Water	0.9	4
200.7	MET-DIG (CLP)	Cobalt	Water	1	2
200.7	MET-DIG (CLP)	Copper	Water	2	4
200.7	MET-DIG (CLP)	Iron	Water	3	20
200.7	MET-DIG (CLP)	Lead	Water	5	10
200.7	MET-DIG (CLP)	Lithium	Water	4	20
200.7	MET-DIG (CLP)	Magnesium	Water	0.3	5
200.7	MET-DIG (CLP)	Manganese	Water	0.3	1
200.7	MET-DIG (CLP)	Molybdenum	Water	0.9	4
200.7	MET-DIG (CLP)	Nickel	Water	0.6	4
200.7	MET-DIG (CLP)	Phosphorus	Water	6	40
200.7	MET-DIG (CLP)	Potassium	Water	60	200
200.7	MET-DIG (CLP)	Selenium	Water	9	20
200.7	MET-DIG (CLP)	Silicon	Water	20	200
200.7	MET-DIG (CLP)	Silver	Water	2	4
200.7	MET-DIG (CLP)	Sodium	Water	20	200
200.7	MET-DIG (CLP)	Strontium	Water	0.2	1
200.7	MET-DIG (CLP)	Sulfur	Water	20	40
200.7	MET-DIG (CLP)	Thallium	Water	4	10
200.7	MET-DIG (CLP)	Tin	Water	3	20
200.7	MET-DIG (CLP)	Titanium	Water	0.8	2
200.7	MET-DIG (CLP)	Vanadium	Water	1	4
200.7	MET-DIG (CLP)	Zinc	Water	0.6	4

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
6010C	EPA 3050B	Aluminum	Soil	0.5	2
6010C	EPA 3050B	Antimony	Soil	2	4
6010C	EPA 3050B	Arsenic	Soil	2	4
6010C	EPA 3050B	Barium	Soil	0.3	0.8
6010C	EPA 3050B	Beryllium	Soil	0.08	0.2
6010C	EPA 3050B	Bismuth	Soil	3	8
6010C	EPA 3050B	Boron	Soil	0.7	4
6010C	EPA 3050B	Cadmium	Soil	0.09	0.2
6010C	EPA 3050B	Calcium	Soil	1	4
6010C	EPA 3050B	Chromium	Soil	0.3	0.8
6010C	EPA 3050B	Cobalt	Soil	0.2	0.4
6010C	EPA 3050B	Copper	Soil	0.4	0.8
6010C	EPA 3050B	Iron	Soil	2	4
6010C	EPA 3050B	Lead	Soil	0.7	2
6010C	EPA 3050B	Lithium	Soil	0.6	4
6010C	EPA 3050B	Magnesium	Soil	0.2	2
6010C	EPA 3050B	Manganese	Soil	0.04	0.2
6010C	EPA 3050B	Molybdenum	Soil	0.2	0.8
6010C	EPA 3050B	Nickel	Soil	0.2	0.8
6010C	EPA 3050B	Phosphorus	Soil	3	8
6010C	EPA 3050B	Potassium	Soil	10	40
6010C	EPA 3050B	Selenium	Soil	2	4
6010C	EPA 3050B	Silver	Soil	0.3	0.8
6010C	EPA 3050B	Sodium	Soil	5	40
6010C	EPA 3050B	Strontium	Soil	0.05	0.2
6010C	EPA 3050B	Sulfur	Soil	4	8
6010C	EPA 3050B	Thallium	Soil	0.8	2
6010C	EPA 3050B	Tin	Soil	0.6	4
6010C	EPA 3050B	Titanium	Soil	0.2	0.4
6010C	EPA 3050B	Vanadium	Soil	0.3	0.8
6010C	EPA 3050B	Zinc	Soil	0.2	1
6010C/AVS-SEM	EPA 821/R-91-100	Antimony	Soil	0.0008	0.003
6010C/AVS-SEM	EPA 821/R-91-100	Arsenic	Soil	0.002	0.005
6010C/AVS-SEM	EPA 821/R-91-100	Cadmium	Soil	0.00007	0.0002
6010C/AVS-SEM	EPA 821/R-91-100	Chromium	Soil	0.0004	0.002
6010C/AVS-SEM	EPA 821/R-91-100	Copper	Soil	0.0005	0.002
6010C/AVS-SEM	EPA 821/R-91-100	Lead	Soil	0.0005	0.001
6010C/AVS-SEM	EPA 821/R-91-100	Nickel	Soil	0.0003	0.001
6010C/AVS-SEM	EPA 821/R-91-100	Silver	Soil	0.0003	0.001
6010C/AVS-SEM	EPA 821/R-91-100	Zinc	Soil	0.0003	0.003

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
6010C	MET-DIG (CLP)	Aluminum	Water	4	10
6010C	MET-DIG (CLP)	Antimony	Water	6	20
6010C	MET-DIG (CLP)	Arsenic	Water	5	10
6010C	MET-DIG (CLP)	Barium	Water	0.6	4
6010C	MET-DIG (CLP)	Beryllium	Water	0.5	1
6010C	MET-DIG (CLP)	Bismuth	Water	6	40
6010C	MET-DIG (CLP)	Boron	Water	4	20
6010C	MET-DIG (CLP)	Cadmium	Water	0.5	1
6010C	MET-DIG (CLP)	Calcium	Water	0.9	20
6010C	MET-DIG (CLP)	Chromium	Water	0.9	4
6010C	MET-DIG (CLP)	Cobalt	Water	1	2
6010C	MET-DIG (CLP)	Copper	Water	2	4
6010C	MET-DIG (CLP)	Iron	Water	3	20
6010C	MET-DIG (CLP)	Lead	Water	5	10
6010C	MET-DIG (CLP)	Lithium	Water	4	20
6010C	MET-DIG (CLP)	Magnesium	Water	0.3	5
6010C	MET-DIG (CLP)	Manganese	Water	0.3	1
6010C	MET-DIG (CLP)	Molybdenum	Water	0.9	4
6010C	MET-DIG (CLP)	Nickel	Water	0.6	4
6010C	MET-DIG (CLP)	Phosphorus	Water	6	40
6010C	MET-DIG (CLP)	Potassium	Water	60	200
6010C	MET-DIG (CLP)	Selenium	Water	9	20
6010C	MET-DIG (CLP)	Silicon	Water	20	200
6010C	MET-DIG (CLP)	Silver	Water	2	4
6010C	MET-DIG (CLP)	Sodium	Water	20	200
6010C	MET-DIG (CLP)	Strontium	Water	0.2	1
6010C	MET-DIG (CLP)	Sulfur	Water	20	40
6010C	MET-DIG (CLP)	Thallium	Water	4	10
6010C	MET-DIG (CLP)	Tin	Water	3	20
6010C	MET-DIG (CLP)	Titanium	Water	0.8	2
6010C	MET-DIG (CLP)	Vanadium	Water	1	4
6010C	MET-DIG (CLP)	Zinc	Water	0.6	4

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
6010C	PSEP TISSUE	Aluminum	Tissue	0.3	1
6010C	PSEP TISSUE	Antimony	Tissue	0.5	2
6010C	PSEP TISSUE	Arsenic	Tissue	0.5	1
6010C	PSEP TISSUE	Barium	Tissue	0.07	0.4
6010C	PSEP TISSUE	Beryllium	Tissue	0.05	0.1
6010C	PSEP TISSUE	Boron	Tissue	0.8	2
6010C	PSEP TISSUE	Cadmium	Tissue	0.04	0.1
6010C	PSEP TISSUE	Calcium	Tissue	2	4
6010C	PSEP TISSUE	Chromium	Tissue	0.08	0.4
6010C	PSEP TISSUE	Cobalt	Tissue	0.07	0.2
6010C	PSEP TISSUE	Copper	Tissue	0.2	0.4
6010C	PSEP TISSUE	Iron	Tissue	1	2
6010C	PSEP TISSUE	Lead	Tissue	0.3	1
6010C	PSEP TISSUE	Lithium	Tissue	0.3	2
6010C	PSEP TISSUE	Magnesium	Tissue	0.6	2
6010C	PSEP TISSUE	Manganese	Tissue	0.03	0.1
6010C	PSEP TISSUE	Molybdenum	Tissue	0.2	0.4
6010C	PSEP TISSUE	Nickel	Tissue	0.2	0.4
6010C	PSEP TISSUE	Phosphorus	Tissue	2	4
6010C	PSEP TISSUE	Potassium	Tissue	9	20
6010C	PSEP TISSUE	Selenium	Tissue	0.9	2
6010C	PSEP TISSUE	Silicon	Tissue	4	20
6010C	PSEP TISSUE	Silver	Tissue	0.2	0.4
6010C	PSEP TISSUE	Sodium	Tissue	2	20
6010C	PSEP TISSUE	Strontium	Tissue	0.04	0.1
6010C	PSEP TISSUE	Thallium	Tissue	0.4	1
6010C	PSEP TISSUE	Tin	Tissue	0.3	2
6010C	PSEP TISSUE	Titanium	Tissue	0.08	0.2
6010C	PSEP TISSUE	Vanadium	Tissue	0.2	0.4
6010C	PSEP TISSUE	Zinc	Tissue	0.2	0.4

TABLE 1 – continued

METHOD	PREP METHOD	ANALYTE	MATRIX	MDL	MRL
6010C	1311/3010A	Antimony	TCLP	0.03	0.1
6010C	1311/3010A	Arsenic	TCLP	0.025	0.05
6010C	1311/3010A	Barium	TCLP	0.5	1
6010C	1311/3010A	Beryllium	TCLP	0.001	0.005
6010C	1311/3010A	Cadmium	TCLP	0.001	0.05
6010C	1311/3010A	Chromium	TCLP	0.01	0.05
6010C	1311/3010A	Cobalt	TCLP	0.0035	0.01
6010C	1311/3010A	Copper	TCLP	0.01	0.1
6010C	1311/3010A	Lead	TCLP	0.02	0.05
6010C	1311/3010A	Manganese	TCLP	0.0025	0.005
6010C	1311/3010A	Nickel	TCLP	0.0035	0.1
6010C	1311/3010A	Selenium	TCLP	0.025	0.1
6010C	1311/3010A	Silver	TCLP	0.004	0.05
6010C	1311/3010A	Thallium	TCLP	0.1	0.25
6010C	1311/3010A	Zinc	TCLP	0.1	1

TABLE 2					
Standard A for ICAP 6500 ICP-OES					
		Source		Final	Final
Analyte	Source	Concentration	Aliquot	Volume	Concentration
		(ppm)	(mL)	(mL)	(ppm)
Antimony	(1)	100	5	1000	0.5
Beryllium	(1)	100	5	1000	0.5
Boron	(1)	100	5	1000	0.5
Cadmium	(1)	100	5	1000	0.5
Calcium	Ca stock	1000	0.5	1000	1.0*
Chromium	(1)	100	5	1000	0.5
Cobalt	(1)	100	5	1000	0.5
Copper	(1)	100	5	1000	0.5
Iron	(1)	100	5	1000	0.5
Lead	(1)	100	5	1000	0.5
Magnesium	(1)	100	5	1000	0.5
Manganese	(1)	100	5	1000	0.5
Molybdenum	(1)	100	5	1000	0.5
Nickel	(1)	100	5	1000	0.5
Selenium	(1)	100	5	1000	0.5
Silver	(1)	100	5	1000	0.5
Tin	Elemental Stock	1000	0.5	1000	0.5
Thallium	(1)	100	5	1000	0.5
Titanium	(1)	100	5	1000	0.5
Vanadium	(1)	100	5	1000	0.5
Zinc	(1)	100	5	1000	0.5
Hydrochloric Acid	-	-	50	1000	5%
Nitric Acid	-	-	10	1000	1%
(1) Mixed Standard, QCS-26 * 0.5mL 1000ppm Ca added to 5mL QCS-26(100ppm Ca), 1000mL Final Volume					

TABLE 3
ICP ICV Standards

ICV1 Solution

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (ppm)
Aluminum	QCP-CICV-1	1000	2.5	500	5.0
Antimony	QCP-CICV-1	1000	1.25	500	2.5
Arsenic	QCP-CICV-3	500	2.5	500	2.5
Barium	QCP-CICV-1	1000	2.5	500	5.0
Beryllium	QCP-CICV-1	25	2.5	500	0.125
Cadmium	QCP-CICV-3	250	2.5	500	1.25
Calcium	QCP-CICV-1	2500	2.5	500	12.5
Chromium	QCP-CICV-1	100	2.5	500	0.5
Cobalt	QCP-CICV-1	250	2.5	500	1.25
Copper	QCP-CICV-1	125	2.5	500	0.625
Iron	QCP-CICV-1	500	2.5	500	2.5
Lead	QCP-CICV-3	500	2.5	500	2.5
Magnesium	QCP-CICV-1	2500	2.5	500	12.5
Manganese	QCP-CICV-1	250	2.5	500	1.25
Molybdenum	Elemental Stock	1000	1.0	500	2.0
Nickel	QCP-CICV-1	250	2.5	500	1.25
Potassium	QCP-CICV-1	2500	2.5	500	12.5
Selenium	QCP-CICV-3	500	2.5	500	2.5
Silver	QCP-CICV-1	125	2.5	500	0.625
Sodium	QCP-CICV-1	2500	2.5	500	12.5
Thallium	QCP-CICV-3	500	2.5	500	2.5
Titanium	Elemental Stock	1000	1.0	500	2.0
Vanadium	QCP-CICV-1	250	2.5	500	1.25
Zinc	QCP-CICV-1	250	2.5	500	1.25
Hydrochloric Acid	-	-	25	500	5%
Nitric Acid	-	-	5	500	1%

TABLE 4
ICP Interference Check Solutions

ICSA Solution

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (ppm)
Aluminum	CLPP-ICS-A	5000	50	500	500
Calcium	CLPP-ICS-A	5000	50	500	500
Iron	CLPP-ICS-A	2000	50	500	200
Magnesium	CLPP-ICS-A	5000	50	500	500
Hydrochloric Acid	-	-	25	500	5%
Nitric Acid	-	-	5	500	1%

ICSAB Solution

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (ppm)
Aluminum	CLPP-ICS-A	5000	50	500	500
Antimony	Elemental Stock	1000	0.5	500	1
Barium	CLPP-ICS-B	50	5	500	0.5
Beryllium	CLPP-ICS-B	50	5	500	0.5
Cadmium	CLPP-ICS-B	100	5	500	1
Calcium	CLPP-ICS-A	5000	50	500	500
Chromium	CLPP-ICS-B	50	5	500	0.5
Cobalt	CLPP-ICS-B	50	5	500	0.5
Copper	CLPP-ICS-B	50	5	500	0.5
Iron	CLPP-ICS-A	2000	50	500	200
Lead	CLPP-ICS-B	100	5	500	1
Magnesium	CLPP-ICS-A	5000	50	500	500
Manganese	CLPP-ICS-B	50	5	500	0.5
Nickel	CLPP-ICS-B	100	5	500	1
Silver	CLPP-ICS-B	100	5	500	1
Vanadium	CLPP-ICS-B	50	5	500	0.5
Zinc	CLPP-ICS-B	100	5	500	1
HCl	-	-	25	500	0.05
HNO3	-	-	5	500	0.01

TABLE 5
IRIS Analytical Wavelengths

Analyte	Wavelength	
Aluminum	237.3	
Antimony	206.8	
Arsenic	189.0	
Barium	233.5	
Beryllium	313.0	
Boron	249.7	
Cadmium	226.5	
Calcium	317.9	
Calcium	211.2	High Line
Chromium	267.7	
Cobalt	228.6	
Copper	324.7	
Iron	259.9	
Iron	271.4	High Line
Lead	220.3	
Lithium	670.7	
Magnesium	279.5	
Magnesium	202.5	High Line
Manganese	257.6	
Manganese	293.9	High Line
Molybdenum	202.0	
Nickel	231.6	
Phosphorus	214.9	
Potassium	766.4	
Selenium	196.0	
Silicon	251.6	
Silver	328.0	
Sodium	589.5	
Strontium	407.7	
Thallium	190.8	
Tin	189.9	
Titanium	323.4	
Vanadium	310.2	
Zinc	206.2	

TABLE 6
ICAP 6500 Analytical Wavelengths

Analyte	Wavelength	
Aluminum	167.0	Low Line
Aluminum	394.4	
Antimony	206.8	
Antimony	217.5	Alternate
Arsenic	189.0	
Barium	455.4	
Beryllium	234.8	
Boron	249.6	
Cadmium	226.5	
Cadmium	214.4	Alternate
Calcium	315.8	
Calcium	393.3	Low Line
Chromium	267.7	
Cobalt	230.7	
Cobalt	228.6	Alternate
Copper	327.3	
Copper	224.7	Alternate
Iron	259.9	
Lead	220.3	
Lithium	670.7	
Magnesium	279.0	High Line
Magnesium	279.5	Low Line
Magnesium	285.2	
Manganese	257.6	
Manganese	260.5	High Line
Molybdenum	202.0	
Nickel	221.6	
Nickel	231.6	Alternate
Phosphorus	214.9	
Phosphorus	178.2	Alternate
Potassium	766.4	
Selenium	196.0	
Silicon	251.6	
Silver	328.0	
Sodium	588.9	Alternate
Sodium	589.5	

TABLE 6
ICAP 6500 Analytical Wavelengths, continued

Analyte	Wavelength	
Strontium	407.7	
Thallium	190.8	
Tin	189.9	
Titanium	336.1	
Vanadium	292.4	
Zinc	206.2	
Zinc	213.8	Alternate

ALS Standard Operating Procedure

DOCUMENT TITLE:	METALS DIGESTION OF AQUEOUS SAMPLES
REFERENCED METHOD:	EPA 200.7, 200.8, 200.9, 3005A AND CLP
SOP ID:	MET-DIG
REVISION NUMBER:	16
EFFECTIVE DATE:	11/30/2015

METALS DIGESTION OF AQUEOUS SAMPLES

ALS-KELSO

SOP ID:	MET-DIG	Rev. Number:	16	Effective Date:	11/30/2015

Approved By: _____ Date: 11/11/15
Department Supervisor/Technical Director – Jeff Coronado

Approved By: _____ Date: 11/12/15
QA Manager – Carl Degner

Approved By: _____ Date: 11/11/15
Laboratory Director – Jeff Grindstaff

Issue Date: _____	Doc Control ID#: _____	Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

TABLE OF CONTENTS

1.SCOPE AND APPLICATION....3
2.METHOD SUMMARY....3
3.DEFINITIONS....3
4.INTERFERENCES....4
5.SAFETY....4
6.SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE....5
7.STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS....5
8.APPARATUS AND EQUIPMENT....8
9.PREVENTIVE MAINTENANCE....8
10.RESPONSIBILITIES....8
11.PROCEDURE....9
12.QA/QC REQUIREMENTS....11
13.DATA REDUCTION AND REPORTING....12
14.CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA....12
15.METHOD PERFORMANCE....12
16.POLLUTION PREVENTION AND WASTE MANAGEMENT....13
17.TRAINING....13
18.METHOD MODIFICATIONS....14
19.REFERENCES....14
20.CHANGES SINCE THE LAST REVISION....14

METALS DIGESTION OF AQUEOUS SAMPLES

1. SCOPE AND APPLICATION

1.1. This procedure is used to prepare aqueous samples for determination of metals using ICP, ICP/MS, and GFAA methodologies. This procedure is the ALS default water digestion procedure and is based on methods described in EPA CLP ILM04.0, EPA 200.8, EPA 200.7, EPA 200.9, and EPA SW-846 3005A.

1.2. This procedure is applicable to all "CLP" scope of elements plus boron and molybdenum.

1.3. This procedure is used for the determination of dissolved as well as total recoverable metals.

1.4. This procedure is applicable to drinking water and non-potable water sample matrices.

2. METHOD SUMMARY

2.1. A representative aliquot of aqueous sample is digested in nitric, hydrochloric acid, hydrogen peroxide or a mix of acids/reagents. After cooling, the sample is made up to volume prior to analysis.

2.2. This digestion procedure is carried out in a Class-10,000 clean room and "Clean" procedures are utilized throughout.

3. DEFINITIONS

3.1. Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.2. Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, meeting the criteria in Section 3.3 and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.3. Sample

3.3.1. Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.3.2. Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.4. Quality System Matrix - The matrix of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.4.1. Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.

3.4.2. Drinking water - Any aqueous sample that has been designated a potable or potential potable water source.

3.4.3. Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.5. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.6. Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.7. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Samples are split into duplicates, spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision. The concentration of the spike should be at 3- 5 times the method reporting limit or at levels specified by a project analysis plan.

3.8. Laboratory Duplicates (DUP) – Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

4. INTERFERENCES

4.1. Refer to the determinative method for a discussion of interferences.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS

Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

5.4. Hydrogen peroxide is an irritant of the eyes, mucous membranes, and skin. Inhalation of high concentrations of the vapor or mist may cause extreme irritation of the nose and throat. Lab coat, gloves and safety eyewear must be worn while working with this reagent.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Aqueous samples are preserved with nitric acid (pH<2), then refrigerated at 4± 2˚C from receipt until analysis. If properly acid preserved, the sample can be held up to 6 months before analysis.

6.2. Samples acidified at the laboratory must be held for 24 hours, then the pH verified as < 2 prior to digestion.

6.3. Metals holding time is six months from sample collection until analysis.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements.

7.1.1. Reagent water: ASTM Type I water (resistivity $\geq$18 MΩ-cm, conductivity $\leq$0.056 uS/cm).

7.1.2. Concentrated Nitric Acid: J.T. Baker “Instra-analyzed”, Trace Metals Grade - should be demonstrated to be free of impurities

7.1.3. Ultrex concentrated nitric acid - should be demonstrated to be free of impurities

7.1.4. Ultrex concentrated hydrochloric acid - should be demonstrated to be free of impurities

7.1.5. Hydrogen peroxide (30%) - H_2O_2. should be demonstrated to be free of impurities.

7.2. Standards

7.2.1. Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The vendor-assigned expiration date is used.

7.2.2. Metals spiking solutions: 12 solutions are needed to prepare the matrix spiking standards: SS1, SS2, SS3, SS4, SS5, GGLCSW, QCP-CICV-1, QCP-CICV-3, 1/100 QCP-CCV-1,5ug/mL Sb, 1/100 QCP-CICV-3 and Mo/U 10ppm.

7.2.2.1. QCP-CICV-1 and QCP-CICV-3 are purchased as prepared standards.

7.2.3. Follow the formulations laid out on the "Metals Spiking Solutions Concentrations Form" and "ICPMS LCSW and spiking Solutions Form" (See Tables A and B). These solutions are prepared in acid rinsed Class A volumetric flasks using purchased custom mixed standards and 1000ppm and 10,000 ppm, single analyte standards. Aliquots are made using acid rinsed Class A volumetric pipettes of the appropriate size.

7.2.3.1. SS1 (Al, Ag, Ba, Be, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, Sb, V and Zn. Fill a 1000mL Volumetric flask approximately half full with reagent water. Add 50 mL of nitric acid and mix. Next add 50 mL of 1000ppm Sb. In addition add 100 mL of the custom mixed standard (CAS-CAL-14) purchased from Inorganic Ventures. Dilute to volume with reagent water and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.2. SS2 (As,Cd, Se, Pb, Tl and Cu): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 2.0 mL each of 1000 ppm Arsenic, Cadmium, Lead, Selenium, Thallium and Copper. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.3. SS3 (As, Se, Tl and Hg) Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL of each of 1000 ppm Arsenic and Selenium. In addition add 10 mL of 1000 ppm Thallium and 6 mL of 1000 ppm Hg.

7.2.3.4. SS4 (B, Mo): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL each of 1000 ppm Boron and

Molybdenum. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.5. SS5 (Fill a 200 mL volumetric flask approximately half full with reagent water. Next add 10.0 mL of nitric acid. Next add 20.0 mL of 10,000 ppm individual standards K, Na, Mg and Ca. Dilute to volume with reagent water, mix thoroughly and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.6. K-met 1/100 QCP-CICV-1: Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 5.0 mL of QCP-CICV-1 and 5 mL of Ultrex nitric acid. Dilute with reagent water mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.7. K-met 1/100 QCP-CICV-3: Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 5.0 mL of QCP-CICV-3 and 5 mL of Ultrex nitric acid. Dilute with reagent water mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

7.2.3.8. K-met 5ug/mL Sb Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 1% Ultrex HN03 acid. Add 2.50mL of 1000ppm Sb dilute with reagent water mix thoroughly and transfer to a 500 mL HDPE bottle for storage.

7.2.3.9. K-met Mo/U 10ppm Fill a 200 mL volumetric flask approximately half full with reagent water. Next add 1% Ultrex HN03 acid Add 2.00mL of 1000ppm Mo and 1000ppm U dilute with reagent water mix thoroughly and transfer to a 500 mL HDPE bottle for storage.

7.2.3.10. K-MET-GFLCSW (As,Pb,Se,Tl,Cd,Cu): Fill a 1000 mL volumetric flask approximately half full with reagent water, add 10.0 mL nitric acid. Next add 5.0 mL of 1000ppm individual standards As,Pb,Se, Tl and Cd. In addition add 2.5 mL of 1000 ppm Cu. Dilute to volume with reagent water, mix thoroughly and transfer to a 1000 mL Teflon bottle for storage. The solution

expiration date is determined by the earliest expiration date of any single component in the solution.

8. APPARATUS AND EQUIPMENT

8.1. Class 10,000 clean room equipped with Class 100 High Efficiency Particulate Air (HEPA) filter equipped laminar flow hoods.

8.2. Hot Blocks

8.3. Powder free PVC gloves

8.4. 100ml Plastic beaker cups

8.5. Plastic caps for 50 mL centrifuge tubes.

8.6. Evergreen disposable tubes and caps, 50 mL. Check tubes for accuracy on a per Lot basis by filling a tube to the 50 mL mark and measuring the water's mass in ten different tubes. Fill ten different tubes to the 25 mL mark and measure the water's mass. The measured mass must be accurate to plus or minus 3%, if not obtain a new lot of tubes and re-test. Refer to the SOP for *Checking Volumetric Labware* (ADM-VOLWARE) for detailed instructions on performing the accuracy test.

8.7. Hot Plates.

8.8. Glass watch glasses, ribbed watch glasses.

8.9. Glass Beakers.

9. PREVENTIVE MAINTENANCE

9.1. Facility and Equipment Preparation

9.1.1. Laboratory equipment (i.e. centrifuge tubes, filtration apparatus, etc.) which comes in contact with the sample or digestate during the analysis must be thoroughly pre-cleaned with 1:4 HCl, and rinsed with DI water. All laboratory equipment used for trace metals analysis shall be stored in the clean room, and shall not be used for any other purpose.

9.1.2. All clean room work areas, including bench tops and laminar flow hoods, should be frequently washed and wiped dry with lint free; class-100 wipes to remove contamination.

9.2. Hot Block temperatures are monitored on sample batch basis.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and

interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Sample Digestion

11.1.1. Set up the sample batch in LIMs and print the *Preparation Information Sheet*. All digestion and sample information on this benchsheet.

11.1.2. Centrifuge tubes used for ICP-OES or ICP-MS analysis require pre-cleaning. This is done by adding 5-10 mL of 25% HCl to the centrifuge tube, shaking to completely 'wash' the centrifuge tube and its cap. Dispose of the rinse acid into an acid waste container. Rinse the centrifuge tube and cap 3 times with DI water, then air dry.

11.1.3. Shake the sample and measure a 25 ml aliquot into a 50 ml centrifuge tube. Use DI water for the MB and LCS.

11.1.4. Add the appropriate spiking solutions directly into the designated MS and LCS samples prior to addition of reagents. The amount and mix of spiking solutions are determined during the initial batch set up in LIMs. Typically this is 0.1 ml - 0.5 mL appropriate spiking solution. Fill out a spiking data sheet and keep it with the digestion data sheets.

11.1.4.1. Pipette tips used for ICP-MS analysis require pre-cleaning. This done by rinsing 3 times with diluted Ultrex HN03 and 3 times with DI water. Dispose of the rinse into an acid waste container.

11.1.5. The amount of type of reagents added for digestion will vary depending upon the method used for the final determination. The follow table list the amount and type of reagent to add:

Method	HNO_3	Ultrex HNO_3	HCL	Ultrex HCL	30% H_2O_2
200.7 & 6010	0.25 mL	-	1.25 mL		-
200.8		0.25 mL	-	-	
6020		0.25 mL	-	-	
200.9	0.25 mL				1.0 mL
7010	0.25 mL				1.0 mL

11.1.5.1. If the sample is being prepared for analysis by ICP, add 0.25ml of concentrated HNO_3, and 1.25 mL of concentrated HCL. Cap centrifuge tube with open reflux caps.

11.1.5.2. If the sample is being prepared for analysis by Graphite Furnace, add 0.25 mL of HNO_3 and 1.0 ml of 30% H_2O_2. Cap centrifuge tube with open reflux caps.

11.1.5.3. If sample is being prepared for analysis by ICP-MS aliquot 25 mL into an acid rinsed centrifuge tube and add 0.25 mL of Ultrex concentrated nitric acid. Cap centrifuge tube with centrifuge tube caps.

11.1.6. Place the centrifuge tube containing the sample in the "Block Digester", located in the Clean Room laminar flow hood, and heat at 95˚C for two hours, or until the volume has been reduced to between 15 and 25 mL.

11.1.7. Allow the sample to cool and dilute to the 25 mL mark with ASTM Type I - DI water.

11.1.8. Insoluble material is allowed to settle overnight, or the digestate may be centrifuged.

11.1.9. The digestates are ready for analysis.

11.2. Procedure for Arizona Samples

11.2.1. For the determination of total recoverable analytes in aqueous samples, transfer a 100 mL (±1 mL) aliquot from a well-mixed, acid preserved sample to an acid/DI rinsed 150 mL borosilicate beaker.

11.2.2. Add 1 mL concentrated nitric acid and 0.5 mL concentrated hydrochloric acid to the beaker containing the measured volume of sample. Place the beaker on a 95 degree Hot Plate, located in a clean room laminar flow hood, for solution evaporation.

11.2.3. Reduce the volume of the sample aliquot to about 20 mL by gentle heating. DO NOT BOIL. This step takes about two hours for a 100 mL aliquot with the rate of evaporation rapidly increasing as the sample volume approaches 20 mL.

11.2.4. Cover the beaker with a glass watch glass to reduce additional evaporation and gently reflux the sample for 30 minutes. (Slight boiling may occur, but vigorous boiling must be avoided to prevent loss of the HCl-H2O azeotrope).

11.2.5. Allow the sample to cool then dilute with reagent water to a final volume of 50 mL in a centrifuge tube. Seal the tube with an acid/DI rinsed cap and mix.

11.2.6. Allow any undissolved material to settle overnight, or centrifuge a portion of the prepared sample until clear. (If after centrifuging or standing overnight

the sample contains suspended solids that would clog the nebulizer, a portion of the sample may be filtered for their removal prior to analysis. However, care should be exercised to avoid potential contamination from filtration).

11.2.7. Prior to analysis, adjust the chloride concentration by diluting the sample 2.0 fold. (If the dissolved solids in this solution are >0.2%, additional dilution may be required to prevent clogging of the extraction and/or skimmer cones.) The sample is now ready for analysis. Because the effects of various matrices on the stability of diluted samples cannot be characterized, all analyses should be performed as soon as possible after the completed preparation.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

12.1.1. The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed using the applicable method.

12.2. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP, Department *of Defense Projects – Laboratory Practices and Project Management (ADM-DOD; ADM-DOD5).* General QC Samples are:

12.2.1. Method Blank

12.2.1.1. A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.

12.2.2. Lab Control Sample (LCS)

12.2.2.1. Digest one laboratory control sample with each sample batch. Use the appropriate dilution of Inorganic Ventures ICV solutions for the liquid laboratory control sample (LCSW.)

12.2.3. Matrix Spike and Sample Duplicates

12.2.3.1. Digest one duplicate and one spiked sample with each sample matrix. For 6010, 6020, and 7010, prepare one duplicate and spiked sample on a five percent frequency per twenty samples. For 200.7, 200.8 and 200.9 prepare a duplicate and spiked sample on a ten percent frequency per twenty samples, or per SDG group, whichever is more frequent. Specific samples may be assigned as duplicates or spikes depending on client requirements.

13. DATA REDUCTION AND REPORTING

13.1. Digestion data sheets including sample weights and volumes used are completed and a batch lot number is assigned and attached to the data sheet. The Manufacturer's lot numbers for the reagents used are added to the digestion data sheet as well as the spiking solutions and amount.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run-logs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision.
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
- Sample holding time missed due to laboratory error or operations.
- Deviations from SOPs or project requirements.
- Laboratory analysis errors impacting sample or QC results.
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.).
- Sample preservation or handling discrepancies due to laboratory or operations error.

15. METHOD PERFORMANCE

15.1. Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as in the determinative procedure. The method detection limit(s) and

method reporting limit(s) are established for the determinative procedure. See CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.*

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

16.3. This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized to a pH of 2.5-12 prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS EH&S Manual for details.

17. TRAINING

17.1. Training outline

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3. Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.2. Training is documented following the SOP for Documentation of Training.

17.2.1. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. Section 11: The lab uses 25 mL of sample. All acids added to the samples are adjusted accordingly to the 25 mL final volume.

19. REFERENCES

19.1. EPA Contract Laboratory Program, ILM04.0

19.2. DETERMINATION OF TRACE ELEMENTS IN WATERS AND WASTES BY INDUCTIVELY COUPLED PLASMA - MASS SPECTROMETRY, Method 200.8, Revision 5.4, 1994

19.3. DETERMINATION OF TRACE ELEMENTS BY STABILIZED TEMPERATURE GRAPHITE FURNACE ATOMIC ABSORPTION, Method 200.9, Rev 2.2, 1994

19.4. DETERMINATION OF METALS AND TRACE ELEMENTS IN WATER AND WASTES BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY, Method 200.7, Rev 4.4, 1994

19.5. Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, EPA SW-846, Method 3005A, July 1992.

20. CHANGES SINCE THE LAST REVISION

20.1. Section 7: Updated standard preparation procedures throughout the section.
20.2. Updates made in the procedures throughout Section 11.
20.3. Section 11: Updates made to Reagents Table.
20.4. Updated Tables A and B.

Table A

METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

Solution Name	Element	mLs of 1000ppm Solution	Final Volume	Solution Conc. mg/L	Enter mls Added
K-MET SS1 *** Add after HNO3 and before cas cal -14 when making the solution	HNO3	50.0	1000ml	-	
	Al	100*	1000ml	200	
	Ag	100*	1000ml	5	
	Ba	100*	1000ml	100	
	Be	100*	1000ml	5	
	Cd	100*	1000ml	5	
	Co	100*	1000ml	50	
	Cr	100*	1000ml	20	
	Cu	100*	1000ml	25	
	Fe	100*	1000ml	100	
	Pb	100*	1000ml	50	
	Mn	100*	1000ml	50	
	Ni	100*	1000ml	50	
	Sb***	50	1000ml	50	
	V	100*	1000ml	50	
	Zn	100*	1000ml	50	
K-MET SS2	HNO3	25.0	500ml	-	
	As	2.0	500ml	4	
	Cd	2.0	500ml	4	
	Pb	2.0	500ml	4	
	Se	2.0	500ml	4	
	Tl	2.0	500ml	4	
	Cu	2.0	500ml	4	
K-MET SS3	HNO3	25.0	500ml	-	
	As	50.0	500ml	100	
	Se	50.0	500ml	100	
	Tl	10.0	500ml	20	
	Hg	6	500	12	
K-MET SS4	HNO3	25	500ml	-	
	B	50	500ml	100	
	Mo	50	500ml	100	
K-MET SS5	HNO3	10.0	200ml	-	
	K**	20	200ml	1000	
	Na**	20	200ml	1000	
	Mg**	20	200ml	1000	
	Ca**	20	200ml	1000	

Table A Continued

K-MET GFLCSW	HNO3	10.0	1000ml	-	
	As, Pb, Se, Tl	5.0	1000ml	2.5	
	Cd	-	-	1.25	
	Cu	2.5	1000ml	2.5	
K-MET QCP-CICV-1	Ca, Mg, Na, K	no dilution	-	2500	
	Al, Ba	no dilution	-	1000	
	Fe	no dilution	-	500	
	Co, Mn, Ni, V, Zn	no dilution	-	250	
	Cu, Ag	no dilution	-	125	
	Cr	no dilution	-	100	
	Be	no dilution	-	25	
K-MET QCP-CICV-3	As, Pb, Se, Tl	no dilution	-	500	
	Cd	no dilution	-	250	

* Denotes volume of mixed stock standard.
** Denotes 10,000 ppm individual stock standards.

Standard	mls of standard	ppm	Logbook #	Exp. Date

Table B
ICPMS LCSW AND SPIKING SOLUTIONS

5.00mL to 500mL Dilution of Inorganics Ventures QCP-CICV-1		
	k-met 1/100 QCP-CCV-1	
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Al	10000	100
Ba	10000	100
Co	2500	25
Mn	2500	25
Ni	2500	25
V	2500	25
Zn	2500	25
Cu	1250	12.5
Ag	1250	12.5
Cr	1000	10
Be	250	2.5
2.50mL to 500mL Dilution of 1000ppm Sb		
	k-met 5ug/mL Sb	
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Sb	5000	50
5.00mL to 500mL Dilution of Inorganics Ventures QCP-CICV-3		
	k-met 1/100 QCP-CICV-3	
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
As	5000	50
Pb	5000	50
Se	5000	50
Tl	5000	50
Cd	2500	25
2.00mL to 200mL Dilution of 1,000 ppm Mo and 1,000 ppm U		
	k-met Mo/U 10ppm	
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Mo	10000	20
U	10000	20

ATTACHMENT F

LABORATORY QUALITY ASSURANCE MANUAL

QUALITY ASSURANCE MANUAL

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QUALITY ASSURANCE MANUAL

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TABLE OF CONTENTS

1) Introduction and Scope 4
2) Organization 4
3) Management 5
4) Document Control 11
5) Review of Requests, Tenders and Contracts 11
6) Subcontracting of Tests 11
7) Purchasing Services and Supplies 12
8) Service to the Client 12
9) Complaints 13
10) Facilities and Equipment 13
11) Sample Management 14
12) Analytical Procedures 20
13) Measurement Traceability and Calibration 23
14) Assuring the Quality of Results 27
15) Control of Non-Conforming Environmental Testing Work 33
16) Corrective Action, Preventive Action, and Improvement 33
17) Control of Records 35
18) Audits 35
19) Management Review 37
20) Personnel 37
21) Reporting of Results 41
22) Summary of Changes and Document History 47
23) References for Quality System Standards, External Documents, Manuals, and Test Procedures 47
APPENDIX A – Glossary 49
APPENDIX B – Organization Charts, Key Personnel, and Report Signatories 54
APPENDIX C – ALS Environmental Confidentiality Agreement 69
APPENDIX D – Laboratory Floor Plan 74
APPENDIX E – Analytical Equipment 75
APPENDIX F – Containers, Preservation and Holding Times 82
APPENDIX G – Standard Operating Procedures 90
APPENDIX H – Data Qualifiers 100
APPENDIX I – Controlled and Normative Documents 102
APPENDIX J – Laboratory Accreditations 103

Current Data Quality Objectives (DQOs) may be requested from the laboratory for specified methods or projects.

QA MANUAL CROSS REFERENCE TABLE

ALS QA Manual	ISO 17025:2005 Section	TNI Standard 2009 Volume 1, Module 2 Section
2	4.1	4.1
3	4.2	4.2
4	4.3	4.3
5	4.4	4.4
6	4.5	4.5
7	4.6	4.6
8	4.7	4.7
9	4.8	4.8
15	4.9	4.9
16	4.10	4.10
16	4.11	4.11
16	4.12	4.12
17	4.13	4.13
18	4.14	4.14
19	4.15	4.15
2, 12, 13, 14	5.1	5.1
20	5.2	5.2
10	5.3	5.3
12, 13, 14	5.4	5.4
10	5.5	5.5
13	5.6	5.6
11	5.7	5.7
11, 12, 13	5.8	5.8
14	5.9	5.9
21	5.10	5.10

1) Introduction and Scope

ALS Environmental, Kelso is a professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, air, and other material.

We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory. Laboratory management is committed to ensuring the effectiveness of its quality systems and to ensure that all tests are carried out in accordance to customer requirements. Key elements of this commitment are set forth in SOP CE-GEN001, *Laboratory Ethics and Data Integrity* and in this Quality Assurance Manual. ALS - Kelso is committed to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

Quality Management Systems are established, implemented and maintained by management. Policies and procedures are established in order to meet requirements of accreditation bodies and applicable programs, such as the Department of Defense (DOD) Environmental Laboratory Accreditation Program, as well as client's quality objectives. Systems are designed so that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. Quality Systems are applicable to all fields of testing in which the laboratory in involved.

Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. The laboratory maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

This QAM is applicable to the facility listed on the title page. The information in this manual has been organized according to requirements found in the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009), the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, USEPA, 2001; and General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025:2005. A glossary of pertinent terms and acronyms is included in Appendix A.

2) Organization

The ALS Environmental, Kelso staff, consisting of approximately 110 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks. All employees share the responsibility for maintaining and improving the quality of our analytical services.

ALS – Kelso is legally identifiable as ALS Group USA, Corp., dba ALS Environmental. ALS Group USA, Corp. is a component of ALS Limited, a publicly held Australian company. The ALS global website may be referred to for corporate ownership information (www.alsglobal.com/Our-Company). The laboratory is divided into operational and managerial units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting QA and QC practices meeting laboratory needs. Organizational charts of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B. This laboratory organization is designed so that potential conflict of interest is avoided, and such

that an adequate amount of supervisory personnel are in place to provide oversight and supervision of day to day operations.

3) Management

The purpose of the QA program at ALS Environmental, Kelso is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended, and is expressed in the mission statement:

> "The mission of ALS Environmental, Kelso is to provide high quality, cost-effective, and timely professional testing services to our customers. We recognize that our success as a company is based on our ability to maintain customer satisfaction. To do this requires constant attention to customer needs, maintenance of state-of-the-art testing capabilities and successful management of our most important asset - our people - in a way that encourages professional growth, personal development and company commitment."

3.1 Quality Management Systems

In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager with corporate oversight by the Manager of Quality Assurance, USA. These systems are based upon ISO 17025:2005 standards, upon which fundamental programs (NELAC 2003, 2009 and DoD QSM) are based. Implementation and documentation against these standards are communicated in corporate policy statements, this QAM, and SOPs. Actual procedures, actions and documentation are defined in both administrative and technical SOPs. Quality systems include:

- Accreditation and certification program compliance
- Standard Operating Procedures
- Sample management and Chain of Custody procedures
- Document control
- Demonstration of Capability
- Analytical traceability
- Ethics training and data integrity processes
- Corrective action procedures
- Statistical control charting
- Management reviews

The effectiveness of the quality system is assessed in several ways, including:

- Internal and external audits
- Periodic reports to management
- Analysis of customer feedback
- Proficiency testing

The responsibilities of key positions within the laboratory are described below. Table 3-1 lists the ALS - Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. In the event that work is stopped in response to quality problems, as described below, only the Laboratory Director or Quality Assurance Manager has the authority to resume work.

Laboratory Director – The role of the Laboratory Director is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and financial performance. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.

Quality Assurance Manager (QAM) – The Quality Assurance Manager has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities in the laboratory, ensuring that personnel understand the quality system, ensuring communication takes place in the laboratory regarding implementation of the quality system, ensuring adequate staff training, and monitoring overall quality system compliance. The QAM continually evaluates potential improvements in the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews are used to support quality system implementation. The QAM is responsible for ensuring compliance with all applicable regulatory compliance quality standards (i.e. NELAP/TNI, ISO, DoD QSM, etc.). The QAM works with laboratory staff to establish effective quality control and assessment processes and has the authority to stop work in response to quality problems. The QAM is responsible for maintaining the laboratory's certifications and approvals, for maintaining the QA Manual and performing an annual review of it, reviewing and approving SOPs and ensuring the annual review of technical SOPs, maintaining QA records (metrological records, archived logbooks, PT results, etc.), document control, conducting proficiency testing studies, approving nonconformity and corrective action reports, and performing internal QA audits.

The QAM reports directly to the Laboratory Director and reports indirectly to the ALS Manager of Quality Assurance, USA. It is important to note that when evaluating data, the QAM does so in an objective manner and free of outside, or managerial, influence.

The Manager of Quality Assurance, USA is responsible for the overall QA program at all the ALS Environmental Group laboratories. The Manager of Quality Assurance, USA is responsible for oversight of QAM's regulatory compliance efforts (NELAP, ISO, DOD, etc.) and may perform internal audits to evaluate compliance. The Manager of Quality Assurance, USA approves company-wide SOPs and provides assistance to the laboratory QA staff and laboratory managers as necessary.

Deputy Laboratory Director and QA Manager – In the case of absence of the Laboratory Director or QAM, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Metals Department Manager (for the Laboratory Director) and the Laboratory Director (for the QAM).

Environmental Health and Safety (EH&S) Officer – The EH&S officer is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring

of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to the ALS North America EH&S Manager.

Client Services Manager (CSM) – The CSM is responsible for the Client Services Department defined for the laboratory. This includes management and oversight of Project Managers, electronic deliverables, and support functions. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. The Client Services Manager has the responsibility and authority to stop work in response to accreditation/certification or quality problems, or in response to similar subcontractor quality problems.

Department Managers and Supervisors – Each manager or supervisor has the responsibility to ensure that QA and QC functions are carried out as specified when executing the analyses and related tasks and to ensure the production of high quality data. Managers and bench-level supervisors monitor the day-to-day operations to ensure that productivity and data quality objectives are met. A department manager has the authority to stop work in response to quality problems in their area. Managers and supervisors are responsible for ensuring that analysts perform testing according to applied methods, SOPs, and QC guidelines particular to the laboratory department.

Sample Management Office (SMO) – The Sample Management Office plays a key role in the laboratory QA program by handling all activities associated with receiving, storage, and disposal of samples, and maintaining documentation for all samples received. SMO staff is also responsible for the proper disposal of samples after analysis. The Support Services Manager oversees SMO and bottle preparation functions.

Information Technology (IT) – IT staff is responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) support, and data back-up, archival and integrity operations.

3.2 Ethics, Professional Conduct and Data Integrity

One of the most important aspects of the success of ALS - Kelso is the emphasis placed on the integrity of the data provided and the services rendered. This success is reliant on both the professional conduct of all employees within ALS - Kelso as well as established laboratory practices. All personnel involved with environmental testing and calibration activities must familiarize themselves with the quality documentation and implement the policies and procedures in their work.

All employees are required to sign and adhere to the requirements set forth in the *ALS Code of Conduct Policy* and agree to the *Confidentiality Agreement (*Appendix C).

3.2.1 Professional Conduct

To promote quality ALS - Kelso requires certain standards of conduct and ethical performance among employees. The following examples of documented ALS policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.

- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.

3.2.2 Confidentiality

It is the responsibility of all laboratory employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well-being of our company and of our clients is dependent upon protecting and maintaining confidential and/or proprietary company and client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential.

Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights.

3.2.3 Prevention and Detection of Improper, Unethical or Illegal Actions

It is the intention of ALS - Kelso to proactively prevent and/or detect any improper, unethical or illegal action conducted within the laboratory. This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel in their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.

In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements for internal QA audits are described in SOP CE-QA001, Internal Audits. All aspects of this program are documented and retained on file according to the company policy on record retention.

The ALS Employee Handbook also contains information on the ALS ethics and data integrity program, including mechanisms for reporting and seeking advice on ethical decisions.

3.2.4 Laboratory Data Integrity, Ethics, and Computer Security Training

Each employee receives data integrity and ethics training on an annual basis. The topics covered and training participation are documented. It is the responsibility of the QAM to ensure that the training is conducted as described. Additionally, new employees are given a QA and data integrity/ethics orientation within the first month of hire, followed by the routine annual training.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, record

keeping, and reporting data integrity issues. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedures. Training topics also cover examples of improper actions, legal and liability implications (company and personal), causes, prevention, awareness, and reporting options. Computer security is also included, covering ALS computing security awareness, passwords and access, and related topics.

Trainees are required to understand that any infraction of the laboratory data integrity procedures will result in an investigation that could lead to serious consequences including immediate termination, or civil/criminal prosecution.

3.2.5 Management and Employee Commitment

ALS - Kelso makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the ALS Employee Handbook. This includes:

- ALS Open Door Policy (ALS Employee Handbook) – Employees are encouraged to bring any work related problems or concerns to the attention of local management or their Human Resources representative. However, depending on the extent or sensitivity of the concern, employees are encouraged to directly contact any member of upper management.
- Faircall – An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.
- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are established, and within the ALS Environmental laboratory network additional capacity is typically available for subcontracting, if necessary.
- Gifts and Favors (ALS Employee Handbook) – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

Table 3-1
Summary of Technical Experience and Qualifications – Key Personnel

Personnel	Years of Experience	Project Role
Jeff Grindstaff, B.S.	26	Laboratory Director
Carl Degner, M.S.	31	Quality Assurance Manager
Gregory Salata, Ph.D.	28	Client Services Manager
Jeff Coronado, B.S.	25	Metals Department Manager
Harvey Jacky, B.S.	26	General Chemistry Department Manager
Loren Portwood, B.S.	26	Semi-Volatile Organics Department Manager
Jon James, B.A.	24	HPLC, GC/MS Organics Department Manager
Les Kennedy, B.A.	24	Support Services Manager
Eileen Arnold, B.A.	33	Environmental Health and Safety Officer
Mike Sullivan, B.S.	15	Information Technology
Jeff Christian, B.S.	36	Director of Operations, Western USA

4) Document Control

Procedures for control and maintenance of documents are described in SOP CE-GEN005, *Document Control*. The requirements of the SOP apply to all laboratory logbooks (standards, maintenance, run logbooks, etc.), certificates of analysis, SOPs, QAMs, quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled ALS Environmental documents.

Each controlled copy of a controlled document is released after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QAM, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file. Logbook entries are standardized following SOP CE-QA007, *Making Entries onto Analytical Records*. The logbook entries are reviewed and approved at a regular interval (quarterly).

A records system is used which ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in SOP ADM-ARCH, *Data Archiving*.

External documents relative to the management system are managed by the QAM. To prevent the use of invalid and/or outdated external documents, the laboratory maintains a master list of current documents and their availability. The list is reviewed before making the documents available. External documents are not issued to personnel.

5) Review of Requests, Tenders and Contracts

Requests for new work are reviewed prior to signing any contracts or otherwise agreeing to perform the work. The specific methods to be used are agreed upon between the laboratory and the client. A capability review is performed to determine if the laboratory has or needs to obtain certification to perform the work, to determine if the laboratory has the resources (personnel, equipment, materials, capacity, skills, expertise) to perform the work, and if the laboratory is able to meet the client's required reporting and QC limits. The results of this review are communicated to the client and any potential conflict, deficiency, lack of appropriate accreditation status, or concerns of the ability to complete the client's work are resolved. Any differences between the request or tender and the contract shall be resolved before any work commences. The client should be notified at this time if work is expected to be subcontracted. Each contract shall be acceptable both to the laboratory and the client. Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work. If a contract needs to be amended after work has commenced, the contract review process is repeated and any amendments are communicated to all affected personnel. Changes in accreditation status affecting ongoing projects must be reported to the client.

6) Subcontracting of Tests

Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories. Subcontracting to another ALS Environmental Group laboratory is preferred over external-laboratory subcontracting. Further, subcontracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in SOP CE-QA004, *Qualification of Subcontract Laboratories*. The Quality Assurance staff is responsible for maintaining a list of qualified subcontract laboratories.

7) Purchasing Services and Supplies

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. CE-QA012, Quality of Reagents and Standards and ADM-RLT, Reagent and Standards Login and Tracking provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in SOP CE-GEN007, *Procurement and Control of Laboratory Services and Supplies*.

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. The laboratory checks new lots of reagents for unacceptable levels of contamination prior to use in sample preservation, sample preparation, and sample analysis by following SOP ADM-RLT, *Reagent and Standards Login and Tracking*.

8) Service to the Client

ALS - Kelso utilizes a number of processes to ensure that adequate resources exist to meet service demands. Senior staff meetings, tracking of outstanding proposals, and a current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. Status/production meetings are conducted regularly with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, or project requirements.

The Project Manager is a scientist assigned to each client to act as a technical liaison between the client and the laboratory. The Project Manager is responsible for ensuring that the analyses performed by the laboratory meet all project and contract requirements. This entails coordinating with the laboratory staff to ensure that client-specific needs are understood and that the services provided are properly executed and satisfy the requirements of the client.

Laboratory management also monitors a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients. This includes on-time performance, customer complaints, training reports and non-conformity reports. A frequent assessment is made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

All Requests for Proposal (RFP) documents are reviewed by the Project Manager and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that potentially cannot be met are noted and communicated to the client, as well as requesting the client to provide any applicable project specific Quality Assurance Project Plans (QAPPs).

When a client requests a modification to an SOP, policy, or standard specification the Project Manager will discuss the proposed deviation with the Client Services Manager, Laboratory Director, and department manager to obtain approval for the deviation. The QAM may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A Project-Specific Communication Form, Form V, or similar, may be used to document such deviations.

The laboratory affords clients cooperation to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that the laboratory ensures confidentiality to other clients. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services. The SOP CE-GEN010, *Handling Customer Feedback* is in place for these events.

9) Complaints

In addition to project communication and internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The procedure is described in CE-GEN010, Handling Customer Feedback. The person who initially receives feedback in the form of a complaint (typically the Project Manager) is responsible for documenting the complaint. If the Project Manager is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QAM for final resolution. The complaint and resolution are documented.

10) Facilities and Equipment

The ALS Environmental Kelso laboratory features over 45,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Also, ALS - Kelso minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving/Purchasing
- Sample Management Office, including controlled-access sample storage areas
- Inorganic/Metals Sample Preparation Laboratories (2)
- Inorganic/Metals “clean room” sample preparation laboratory
- ICP-AES Laboratory
- ICP-MS Laboratory
- Low-level Mercury Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography and High Performance Liquid Chromatography Laboratories
- Gas Chromatography/Mass Spectrometry Laboratories (2)
- Semi-volatile Organics Drinking Water Laboratory
- Volatile Organics Laboratory
    - Separate sample preparation laboratory
    - Access by semi-volatile sample preparation staff only after removing lab coat and solvent-contaminated gloves, etc.
- Microbiology Laboratory
- Laboratory Deionized Water Systems (2)
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival, Data Review and support functions areas

In addition, the designated areas for sample receiving, refrigerated sample storage and dedicated sample container preparation and shipping areas provide for the efficient and safe handling of a variety of sample types. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Refer to Appendix D for a Laboratory Floor Plan and Appendix E for a list of major equipment, illustrating the laboratory's overall capabilities and depth.

11) Sample Management

11.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. ALS - Kelso recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW 846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

The laboratory uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IV for hazardous waste samples; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; EPA 40CFR parts 136 and 141 and associated Method Update Rules; and Standard Methods for the Examination of Water and Wastewater for water and wastewater samples (see Section 23 for complete references). The container, preservation and holding time information for these references is summarized in Appendix F for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for CLP procedures. Where allowed by project sampling and analysis protocols (such as Puget Sound Protocols) the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20˚C.

ALS - Kelso provides clients with sample containers with applicable preservatives. Containers are purchased as pre-cleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for sample containers are available upon request. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of pre-cleaned, rinsed, and air-dried shipping coolers with foam liners, specially prepared and labeled sample containers individually wrapped in protective material (VOC vials are placed in a specially made foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container. Figure 11-1 shows the chain-of-custody form routinely used at ALS - Kelso and included with sample kits. Dry ice or gel ice is the only temperature preservative used. For large sample container shipments the containers may be shipped in their original boxes. Such shipments will consist of labeled and preserved sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) for return to ALS, unless otherwise instructed by the client.

ALS - Kelso also provides courier service that makes regularly scheduled trips on the I-5 corridor between the Greater Portland, Oregon area and the Great Seattle/Tacoma area, and nearby communities and facilities.

Returning shipping coolers are cleaned and decontaminated. If any such cooler exhibits an odor or other abnormality after receipt and cleaning, a more vigorous decontamination process is employed. Containers which cannot be decontaminated are discarded. ALS - Kelso keeps client-specific shipping requirements on file and utilizes major transportation carriers to necessary to meet sample shipping requirements (same-day, overnight, etc.).

When ALS - Kelso ships samples to other laboratories for analysis, similar sample integrity processes are used to ensure preservation and proper sample handling, and to avoid any possible breakage, cross-contamination of samples, or identification problems. Alternatively, the receiving laboratory's procedures may be specified. Chain of custody is maintained during the process.

11.2 Sample Receipt and Handling

Standard procedures are established for the receiving of samples into the laboratory and are found in SOP SMO-GEN, *Sample Receiving*. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received.

Once samples are received or delivered to the laboratory the sample management office uses a Cooler Receipt and Preservation Check Form (CRF - Figure 11-2) is used to assess the shipping cooler and its contents as received by the laboratory. Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence, location and signature;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);
- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- The minimum amount of sample material is provided for the analysis.
- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Manager and client have reached a

satisfactory resolution, the login process may continue and analysis may begin. During the login process each sample container is given a unique laboratory code and a Service Request form is generated which contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the applicable Project Manager for accuracy and completeness.

Samples are stored as per method requirements until analysis, unless otherwise specified, using various refrigerators, freezers, or designated secure areas. ALS - Kelso has multiple walk-in and refrigerator cold storage units which house the majority of samples, including dedicated refrigerated storage of VOC samples. The VOC storage units are monitored using storage blanks as described in SOP VOC-BLAN, *VOA Storage Blanks*. ALS - Kelso also has multiple sub-zero freezers capable of storing samples at -10 to -30˚C primarily used for tissue and sediment samples. The temperature of each sample storage unit is monitored real time with an electronic temperature monitoring system.

ALS - Kelso adheres to the method-prescribed or project-specified holding times for all analyses. Analysts monitor holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. To document holding time compliance, the date and time analyzed is printed or written on the analytical raw data. Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples are retained at ambient temperature for 30 days, soil samples are retained at ambient temperature for 60 days, and tissue samples are retained frozen for 3 months. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. Sample extracts are retained as specified in analytical SOPs. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the ALS Environmental Health and Safety Manual and in accordance with applicable laws. Documentation is maintained for each sample from initial receipt through final disposal to ensure that an accurate history of the sample from “cradle to grave” is available.

11.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present.

Facility security and access is important in maintaining the integrity of samples received at ALS - Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded/card entry, except for the reception area and sample receiving doors, which are staffed during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area with locked doors with a coded entry. The facility is equipped with an alarm system and the laboratory employs a private security firm to provide nighttime and weekend security.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage is required to document this custody transfer (via custodian or directly). The system uniquely identifies sample containers and provides an electronic record of the sample custody. Procedures are also defined for sample extracts, digestates, and leachates. The procedures are described in the SOP SMO-SCOC, *Sample Tracking and Internal Chain of Custody*.

11.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. LIMS codes are chosen to identify the analysis method used for analysis. The Project Manager ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the Service Request. For SW-846 methods, some projects may require the most recent promulgated version, and some projects may require the most recent published version. The Project Manager will ensure that the correct method version is used. Functionality incorporated in the LIMS is used to communicate and specify project-specific requirements and demographics, including the use of attachments to LIMS delivery group (SDG or SR) such as specification forms, analyte lists, deliverable requirements, and other pertinent information.

Figure 11-1

ALS Environmental Standard Chain of Custody Form

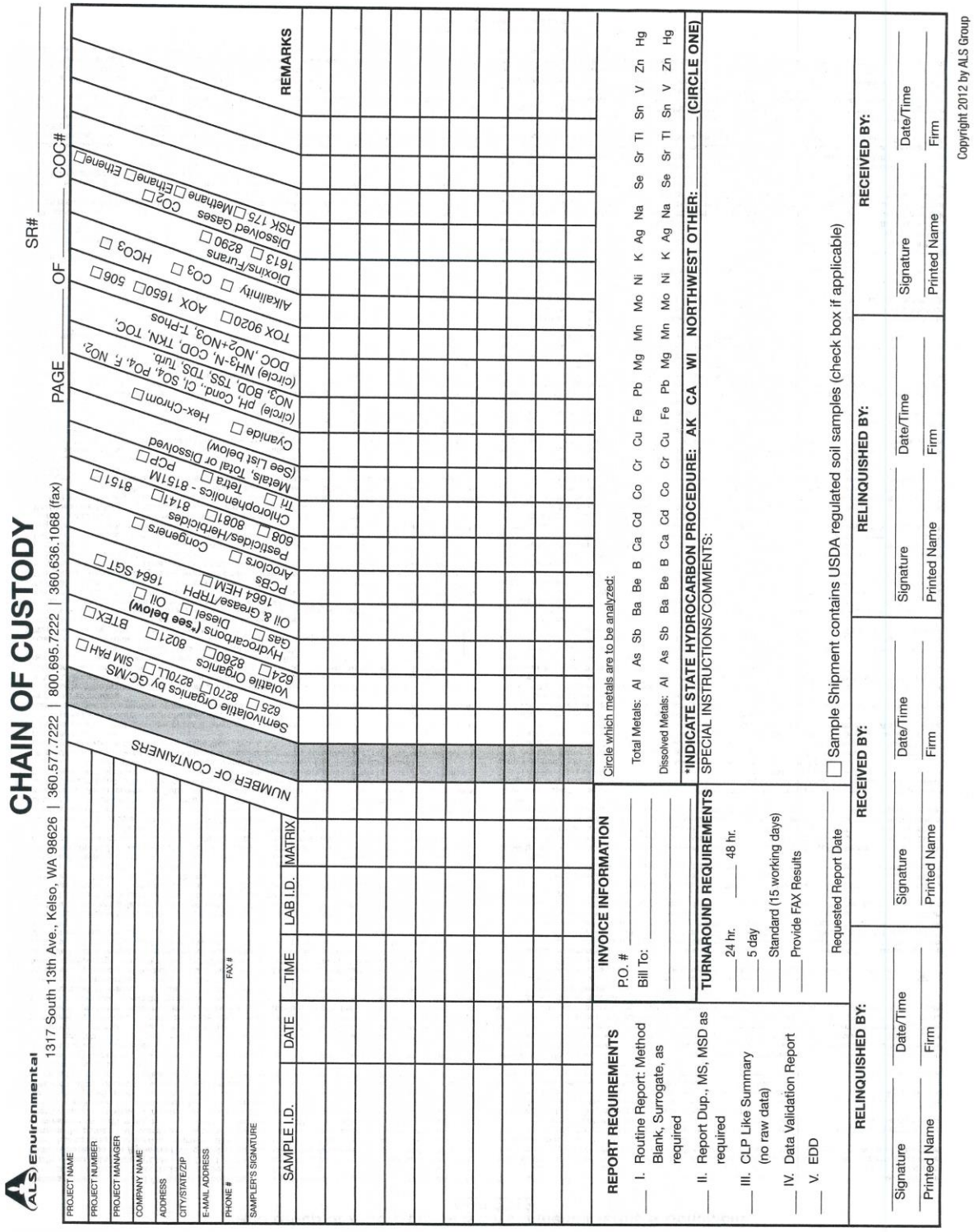

Figure 11-2

ALS Environmental Cooler Receipt and Preservation Form

PC_____

Cooler Receipt and Preservation Form

Client _____ Service Request *K15*_____

Received:_____ Opened:_____ By:_____ Unloaded:_____ By:_____

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where?_____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

*Notes, Discrepancies, & Resolutions:*_____

_____

_____

_____

Page_____of_____

Cooler Receipt and Preservation Form

Client _____ Service Request *K15*_____

Thermometer ID	Corr. Factor	@20 min, Raw Blank	@20 min, Corr. Blank	@40 min. Raw Blank	@40 min. Corr. Blank	@60 min. Raw Blank	@60 min Corr. Blank

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies & Resolutions:

_____

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Page_____of_____

12) Analytical Procedures

ALS - Kelso employs methods and analytical procedures from a variety of external sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, EPA 40CFR parts 136 and 141 and associated Method Update Rules and Supplements; Standard Methods for the Examination of Water and Wastewater for water and wastewater samples, and American Society for Testing and Materials (ASTM). Complete citations for these references can be found in Section 23. Other published procedures, such as state-specific methods, program-specific methods (such as Puget Sound Protocols), or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection/reporting limit, the expected concentration of the analyte(s) being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by ALS - Kelso is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix J.

12.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

ALS Environmental, Kelso maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements as described in CE-GEN009, *Preparation of Standard Operating Procedures*. Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the Quality Assurance Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QAM maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently approved version of an SOP is being used. The procedures for document control are described in CE-GEN005, *Document Control*. In addition to SOPs, each laboratory department maintains the current methods used to perform analyses accessible to all laboratory staff. Laboratory notebook entries are standardized using the procedure in SOP CE-QA007, *Making Entries onto Analytical Records*. Laboratory notebook entries are reviewed and approved by the appropriate supervisor at a regular interval. A list of current SOPs is given in Appendix G.

12.2 Deviation from Standard Operating Procedures

When a client requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the Project Manager handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The Project Manager is responsible for documenting the approved or allowed deviation from the SOP by placing a description of the deviation attached with the project documents and also providing an instructional comment with the Service Request.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the Laboratory Director, or other level of authority. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

12.3 Modified Procedures

ALS - Kelso strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a “Modified” method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating

procedures are available to analysts and are also available to our clients for review. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

12.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS - Kelso has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.

2) All (field) samples in a batch are of the same matrix.

3) The QC samples to be processed with the (field) samples include:

- Method Blank (a.k.a. Laboratory Reagent Blank)
- Laboratory Control Sample
- Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*
- Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

* A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.

4) A single lot of reagents is used to process the batch of samples.

5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.

6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours between the start of processing of the first and last sample of the batch.

7) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours.

8) Field samples are assigned to batches commencing at the time that sample processing begins.

9) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).

10) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.

11) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.

12) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take

precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

12.5 Specialized Procedures

ALS - Kelso not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are trace-level Mercury and Methyl mercury analyses, reductive precipitation metals analysis, leaching procedures, incremental sampling protocols, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs); including those for emerging contaminants of concern.

12.6 Sample Cleanup

The laboratory commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods (3620, 3630, 3640, 3660, and 3665) for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

13) Measurement Traceability and Calibration

All equipment and instruments used at ALS - Kelso are operated, maintained and calibrated according to the manufacturer's recommendations and criteria set forth in the analytical methods. All analytical measurements generated are performed using materials that are traceable to a reference material, unless unavailable. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment are described below. Calibration verification is performed according to the analytical methods and SOPs, and criteria are listed in the SOPs. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials and reference equipment.

Laboratory support equipment (thermometers, balances, and weights) are routinely verified on an annual basis by a vendor accredited to ISO/IEC 17025:2005, or more frequently if program-specified. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. Vendors used for metrology support are required to verify compliance to International Standards by supplying the laboratory with a copy of their scope of accreditation.

Equipment shown by verification to be malfunctioning or defective is taken out of service until it is repaired. When an instrument is taken out of service, an Out of Service sign is placed by the laboratory on the instrument. The equipment is placed back in service only after verifying, by calibration, that the equipment performs satisfactorily.

13.1 Temperature Control Devices

Temperatures are monitored and recorded each day for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators/freezers. Temperatures are recorded in either laboratory logbook or through Check Point® Wireless Monitoring System. During weekends and holidays a min/max thermometer may be used.

Laboratory records contain the recorded temperature, identification and location of equipment, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the SOP ADM-SEMC, *Support Equipment Monitoring and Calibration*.

Where the operating temperature is specified as a test condition (such as ovens, incubators, evaporators) the temperature is recorded on the raw data. All thermometers are identified according to serial number, and the calibration is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer is recertified by a vendor accredited to ISO/IEC 17025:2005 on an annual basis.

13.2 Analytical Balances

The calibration of each analytical balance is checked by the user each day of use with three Class S or S-1 weights, which assess the accuracy of the balance at low, mid-level and high levels bracketing the working range. Records are kept which contain the recorded measurements, identification of the balance, acceptance criteria, and the initials of user who performed the check. The procedure for performing these measurements and use of acceptance criteria is described in the SOP ADM-SEMC. The weights are recertified using NIST traceable standards by an accredited metrology organization on an annual basis. As needed, the balances are recalibrated using the manufacturers recommended operating procedures. Analytical balances are serviced on a semi-annual basis by an accredited metrology organization.

13.3 Water Purification Systems

ALS - Kelso uses two independent water purification systems is designed to produce deionized water meeting method specifications. One system consists of a series of pumps, filters, and resin beds designed to yield deionized water meeting the specifications of ASTM Type II water, and Standard Methods for the Examination of Water and Wastewater (SM1080, 20th Ed.) High Quality water. Activated carbon filters are also in series with the demineralizers to produce "organic-free" water. A second system consists of pumps, filters, and treatment components designed to yield deionized water meeting the specifications of ASTM Type I water, and Standard Methods for the Examination of Water and Wastewater (SM1080, 20th Ed.) High Quality water. The status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily. The meter accuracy is verified annually. Deionizers are rotated and replaced on a regular schedule. Microbiology water is checked on a daily basis at a point downstream of the purification system at a tap in the laboratory.

13.4 Standards and Reference Materials

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors where possible have fulfilled the requirements for 9001 certification and/or are ISO 17025 accredited. ALS - Kelso relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The

date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the SOP for *Reagent Login and Tracking* (SOP ADM-RTL). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material.

13.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and against standards whose concentrations fall within the instruments linear range. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010B, 6010C, CLP SOW, etc.).

13.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated for using a blank and a single standard. Prior to calibration, a short-term stability check is performed on the system. Following calibration, an independent check standard is analyzed, and a continuing calibration verification standard (CCV) is analyzed with every ten samples.

13.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Initial calibration points cannot be “dropped” from the resulting calibration curve.

13.8 GC/MS Systems

All GC/MS instruments are calibrated at multiple concentration levels for the analytes of interest (unless specified otherwise) using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP. For internal standard and isotope dilution procedures, the internal standard response and/or labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked the method-specified compounds. Mass spectra for the tuning compounds must meet method/SOP criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

13.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

LC/MS Systems:

Calibration and tuning procedures are included in analytical SOPs written specifically for these tests. In general, multiple concentration levels for the analytes of interest are used to generate calibration curves. All reference materials used for this function are vendor-certified standards. Calibration and tuning verification is performed at SOP-defined intervals. Any other system performance checks are described in the applicable SOP. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

13.10 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric and turbidimetric analyses involve generating a 5 point calibration curve including a blank. Initial calibration points cannot be "dropped" from the resulting calibration curve. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples. Typical UV-Visible spectrophotometric methods at ALS Environmental, Kelso include total phenolics, phosphates, surfactants and tannin-lignin.

13.11 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of six standards and a blank are used to calibrate the instrument for cyanide analysis. A blank and (minimum of) five standards are used to calibrate the instrument for all other automated chemistries. Initial calibration points cannot be "dropped" from the resulting calibration curve. Standard ALS Environmental, Kelso acceptance limits are used to evaluate the calibration curve prior to sample analysis.

13.12 Discrete Auto-Analyzer (automated absorbance analysis)

A minimum of five standards and a blank are used to calibrate the instrument. Initial calibration points cannot be "dropped" from the resulting calibration curve. Method specific acceptance limits are used to evaluate the calibration curve prior to sample analysis.

13.13 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a calibration curve with the method-specified number of points (or more). Initial calibration points cannot be "dropped" from the resulting calibration curve. A correlation coefficient of > 0.995 for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, nitrite, chloride, fluoride, sulfate and drinking water inorganic disinfection byproducts. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method.

13.14 Turbidimeter

Calibration of the turbidimeter requires analysis of three Nephelometric Turbidity Unit (NTU) formazin standards. Quality Control samples that are routinely analyzed include blanks, Environmental Resource Associates QC samples (or equivalent) and duplicates.

13.15 Ion-selective electrode

The method-prescribed numbers of standards are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

13.16 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following SOP ADM-VOLWARE, *Checking Volumetric Labware*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

13.17 Other Instruments

Calibration for the total organic carbon (TOC), total organic halogen (TOX), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

14) Assuring the Quality of Results

A primary focus of ALS - Kelso's QA Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis on field samples, acceptable method performance is established by performing demonstration of capability analyses. Performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. ALS - Kelso has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the test methodology or are statistically derived based on the laboratory's historical data. Quality Control objectives are defined below.

14.1 Quality Control Objectives

14.1.1 Demonstration of Capability - A demonstration of capability (DOC) is made prior to using any new test method or when a technician is new to the method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control sample material may be obtained from an outside source or may be prepared in the laboratory. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results may be used to meet this requirement, provided acceptance criteria is met.

14.1.2 Accuracy - A measure of the closeness of an individual measurement (or an average of multiple measurements) to a true or expected value and expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis or caused by an artifact of the measurement system (e.g., contamination). Ongoing accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory control sample, standard reference materials, or standard

solutions. In addition, matrix-spiked samples are also measured and recovery indicates the accuracy or bias in the actual sample matrix.

ALS - Kelso utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

14.1.3 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

14.1.4 Control Limits - The control limits for accuracy and precision originate from two different sources. For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values based on similar methods. Control limits are reviewed each year and may be updated if new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the QAM. The new control limits replace the previous limits and data is assessed using the new values. Current *Data Quality Objectives*, including acceptance limits for accuracy and precision are available from the laboratory. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses. Procedures for establishing control limits are found in SOP CE-QA009, *Control Limits*.

14.1.5 Representativeness - The degree to which the field sample, being properly preserved, free of contamination, and properly analyzed, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. ALS - Kelso has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. These include the SOP for *Subsampling and Compositing of Samples* (GEN-SUBS) and the SOP for *Tissue Sample Preparation* (MET-TISP). Further, analytical SOPs specify sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

14.1.6 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc.). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using ALS Environmental, Kelso or project-specified data qualifiers.

14.2 Method Detection Limits, Method Reporting Limits, Limits of Detection, and Limits of Quantitation

Method Detection Limits (MDL) for methods performed at ALS - Kelso are determined during initial method set up and when significant changes are made. If an MDL study is not performed annually, the established MDL is verified by performing a Limit of Detection (LOD) verification on every instrument used in the analysis. The MDLs are determined by following the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*, which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using LOD verification samples.

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. Limit of Quantitation- LOQ). LOQ are analyzed at the frequency specified in the SOP CE-QA011, and at specified concentrations (not lower than the lowest calibration standard). Current MDL/LOD and MRL/LOQ values are available from the laboratory.

14.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below. Unique test-specific requirements may also exist and are found in the laboratory SOP.

14.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (water, soil, etc.) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

14.3.2 Calibration Blank

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

14.3.3 Continuing Calibration Blank

Continuing calibration blanks (CCBs) are solutions of analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

14.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

14.3.5 Initial (or Independent) Calibration Verification Standard (ICV)

The ICV standard is prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). The ICV is analyzed after calibration but prior to sample analysis in order to verify the validity and accuracy of the standards used in calibration. Once it is determined that there is no defect or error in the calibration standard(s), the standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). ICVs are also analyzed in accordance with method-specific requirements.

14.3.6 Continuing Calibration Verification Standard

Continuing calibration verification (CCV) standards are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

14.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP/MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

14.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and analytical behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

$$\text{Recovery (\%)} = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The known concentration of analyte added.

14.3.9 Laboratory Control Samples (a.k.a Laboratory Fortified Blank – LFB)

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

$$\text{Recovery (\%)} = (M/T) \times 100$$

Where: M = The measured analyte concentration,
T = The known analyte concentration added.

14.3.10 Laboratory Fortified Blank – MRL Level

A laboratory blank fortified at the MRL used to verify that the method reporting limit can be achieved. This LFB is carried through the entire extraction and analytical procedure. A MRL LFB is required with every batch of drinking water samples.

14.3.11 Matrix Spikes (MS)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

$$\text{Recovery (\%)} = (S - A)/T \times 100$$

Where: S = The measured analyte concentration in the spiked sample,
A = The measured analyte concentration in the parent sample,
T = The known analyte concentration added to the spiked sample.

14.3.12 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample

(MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

Relative Percent Difference (RPD) = (S1 - S2) x 100 ÷ S_{ave}

Where:

S1 and S2 = The analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and,

S_{ave} = The average of analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

14.3.13 Interference Check Samples (ICS)

An ICS is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

14.3.14 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

14.3.15 Control Charting

The generation of control charts is routinely performed at ALS. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in SOP CE-QA009, *Control Limits*.

14.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS - Kelso undergoes a rigorous

cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at ALS; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

14.3.17 Uncertainty

Measurement uncertainty is associated with most of the results obtained in laboratory testing. It may be meaningful to estimate the extent of the uncertainty associated with each result generated by the laboratory. It is also useful to recognize that this measurement uncertainty is likely to be much less than that associated with sample collection activities. The uncertainty associated with the analytical measurement processes can be estimated from quality control data. When requested, the laboratory provides uncertainty information as described in the SOP CE-QA010, *Estimate of Uncertainty of Analytical Measurements*. The estimation of uncertainty relates only to measurements conducted in the laboratory.

14.4 When data quality objectives or quality control measures are not met, due to the sample matrix or anomalies, incompatibility of the methodology and sample type, statistical outliers, random error, or other factors, it may be necessary to apply data qualifiers to reported data. A list of standard data qualifiers is given in Appendix H.

15) Control of Non-Conforming Environmental Testing Work

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Nonconforming events such as errors, deficiencies, deviations from SOP, proficiency (PT) failure or results that fall outside of established QC limits are documented using the NCAR database. The procedure and responsibilities for addressing nonconforming work is defined in SOP CE-QA008, *Nonconformance and Corrective Action*. Nonconformances are reported to the client using various means (voice, email, narrative, etc.). When a nonconformance occurs that casts doubt on the validity of the test results or additional client instructions are needed, the Project Manager notifies the client the same business day that the nonconformance is confirmed and reported. The QAM reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The QAM periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate Project Manager is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

Results from non-conforming environmental testing work generally require the need for qualified data on analytical reports. A list of standard data qualifiers is given in Appendix H. Additionally, the report narrative will provide an explanation of the nonconformance and potential impact on results.

16) Corrective Action, Preventive Action, and Improvement

If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives, prompts corrective action. Corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and

operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the QAM may examine and pursue alternative solutions. In addition, the appropriate Project Manager is notified in order to ascertain if the client needs to be notified.

Part of the corrective action process involves determining the root cause. Identifying the root cause of a nonconformance can be difficult, but important for implementing effective corrective action. Root cause principles are used to determine assignable causes, which leads to corrective action taken to prevent recurrence. Various preventive action processes are used for eliminating a potential problem or averting a problem before it occurs. This is explained in CE-QA008, *Nonconformance and Corrective Action*.

Preventive action is focused on using existing information or experiences to anticipate potential problems and eliminating the likely causes of them. Preventive action is a pro-active process and tied to results from corrective action as well as opportunities for improvement. ALS – Kelso used preventive action processes to avoid errors and implement improvements. The SOP CE-GEN004, *Preventive Action*, describes procedures used. Examples of preventive action are given in the SOP. The laboratory also uses ideas from staff, client feedback, and other input mechanisms to identify potential improvements. The monthly lab-wide meeting regularly includes reports on improvements made or underway.

16.1 Preventive maintenance

Preventive maintenance is a crucial element of the QA program. Equipment and instruments at ALS - Kelso are regularly maintained by qualified laboratory staff or under commercial service contracts. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at ALS Environmental, Kelso contain extensive information about the instruments used at the laboratory, including:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at ALS. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. This inventory or "parts list" also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;

- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the Appendix E for a list of equipment and whether primarily maintained by laboratory of service providers.

17) Control of Records

ALS - Kelso maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the SOP for *Data Archiving* (ADM-ARCH).

17.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

18) Audits

Quality audits are an essential part of the Quality Assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

18.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of ALS/Kelso are conducted regularly by various regulatory

agencies and clients. Appendix J lists the certification and accreditation programs in which ALS/Kelso participates. Programs and certifications are added as required.

Internal system audits of ALS/Kelso are conducted regularly under the direction of the Quality Assurance Manager. The internal audit procedures are described in SOP CE-QA001, *Internal Audits*. The internal audits are performed as follows:

- System audit – this is an annual audit of the implementation of the quality system in the laboratory.
- Process audit – this is an audit of all operational areas in the laboratory to evaluate compliance with operational and technical procedures. Focus is on sample handling, preparation and analysis and technically sound practices. Three primary concepts are 1) is the procedure in use the same as that described in the SOP, 2) the use of sound analytical techniques and practices, and 3) sample handling/preparation. Topics as calibration, sample/analytical batching, standards traceability, QC criteria, instrument operation and maintenance, data interpretation, and reporting results are included. Hardcopy data and/or report audits may be included.

  Process audits may be one larger audit event or a series of audits such that all areas of the laboratory are audited over a one year period. Audits conducted over the four calendar quarters will follow the schedules listed in an audit plan.
- Electronic data audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, use of appropriate files, and other components of the analysis. Each applicable instrument is periodically audited using audit software and randomly selected data files.

All audit findings and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

18.2 Performance Audits

ALS - Kelso participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. General procedures for these analyses are described in SOP CE-QA006, *Proficiency Sample Testing Analysis*. ALS - Kelso routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil/UST PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- State-specific Underground Storage Tank PT studies, 1 per year, or as specified for accreditation.
- Other studies as required for certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples and are processed the same as field samples (following the PT provider instructions). The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are received by the QAM and distributed to Laboratory Director and department managers for review. For any results outside acceptance criteria, the analysis data is reviewed to identify a root cause for the deficiency, and corrective action is taken and documented through nonconformance (NCAR) procedures.

19) Management Review

An annual Review of the laboratory's quality system and testing activities is conducted by the laboratory's management team to ensure the continuing suitability and effectiveness of the quality system and testing activities and to introduce any necessary changes or improvements. The review ensures that the quality system of the laboratory continues to conform to the requirements of the ISO 17025:2005 and various accrediting authorities, including NELAP/TNI.

General procedures for the Review are described in SOP CE-QA005, *Laboratory Management Review*. When conducting the review a standard list of items and categories is evaluated. The quality policies and their relation to testing activities are reviewed and any changes that are necessary are identified. The review also notes significant changes that have taken place or need to take place in the quality system; and the organization, facilities, equipment, procedures, and activities of the laboratory.

The Review is documented by the laboratory QA Manager. Action items, including preventive actions and improvements, should be identified. Results should feed into the laboratory's planning process planning.

20) Personnel

20.1 Personnel Training

Job descriptions, including technical position descriptions, are used for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS - Kelso when the company policies are presented and discussed. Safety and Quality System requirements are integral parts of initial and ongoing training processes at the laboratory. Safety training begins with the reading of the ALS Environmental Health and Safety Manual. Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer.

Quality Systems training begins with QA orientation for new employees which includes and reading the Quality Assurance Manual and ethics/data integrity introductory training. Additional training on laboratory quality systems as they relate to job functions is incorporated into training plans. Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s).

ALS - Kelso also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the company. Ongoing training occurs for all employees through a variety of mechanisms. The corporate, company-

wide training and development program, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

All technical training is documented and records are maintained in the QA department. Training requirements and its documentation are described in SOP ADM-TRAIN, *ALS-Kelso Training Procedure*. A training plan is developed whenever an employee starts a new procedure to new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of capability. Where the analyst performs the entire procedure, a generic training plan may be used.

20.2 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the SOP for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).
- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.
- Where spiking is not possible but QC standards are used ("non-spiked" LCS), analysis of 4 consecutive LCS analyses with acceptable accuracy and precision.
- Where one of the three above is not possible, special requirements are as follows:
    - Total Settleable Solids: Successful single-blind PT sample analysis and duplicate results with RPD<10%.
    - Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
    - Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 20-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

20.3 Continuing Demonstration of Proficiency

A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind sample analyses using the test method, or a similar test method using the same technology. I.e. PT sample or QC sample blind to the analyst.
- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.

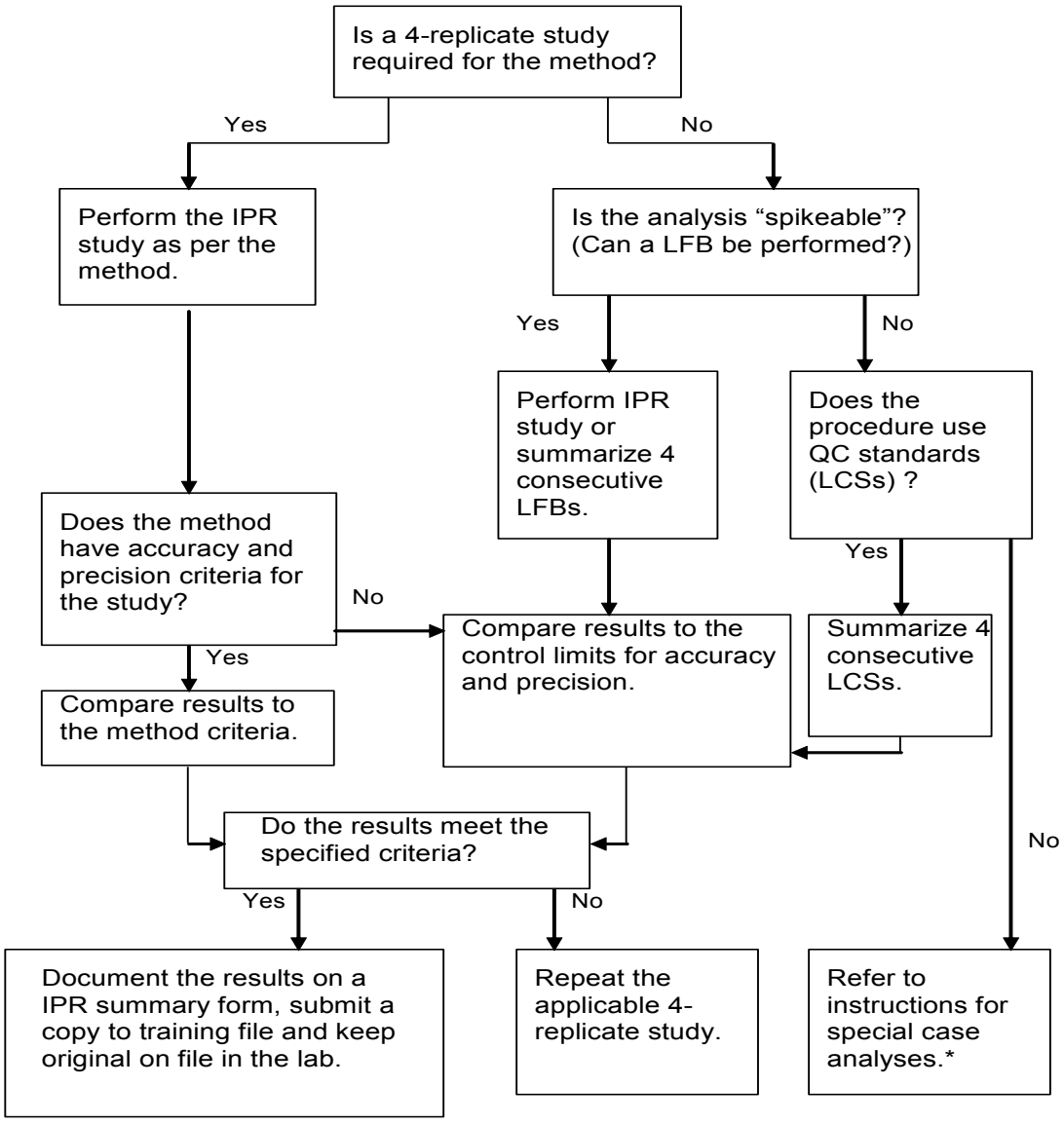
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.
- If the above cannot be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.
- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

20.4 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and internal resumes. The QA department maintains a record of the various technical skills and training acquired while employed by ALS. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in SOP ADM-TRAIN, *ALS-Kelso Training Procedure*.

Figure 20-1

Demonstration of Proficiency Flowchart



21) Reporting of Results

ALS - Kelso reports the analytical data produced in its laboratories to the client via the Analytical Report. This report includes a transmittal letter, a case narrative, client project information, sample receipt and chain of custody information, specific test results, quality control data (as requested), and any other project-specific support documentation. The following procedures describe the procedures used for data reduction, validation and reporting.

21.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the raw data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the SOP CE-QA007, *Making Entries onto Analytical Records*.

The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form or is electronically transferred into the report. Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the data and report hardcopy is forwarded to the supervisor or second qualified analyst who reviews the data. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Nonconformance and Corrective Action Report (NCAR) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed. Data review procedures are described in the SOP for *Laboratory Data Review Process* (ADM-DREV).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the “before” and “after” integrations and including them in the raw data records. The policies and procedures are described in SOP CE-QA002, *Manual Integration Policy* and SOP ADM-MI, *Manual Integration of Chromatographic Peaks*.

21.1.1 Validation of Results

The validity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Initial Calibration – Following the analysis of calibration standards according to the applicable SOP the data is fit to an applicable and allowed calibration model (correlation coefficient, linear, average response factor, quadratic, etc.) and the resulting calibration is compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.
- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.
- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.
- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including alternative analysis.

- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP for Confirmation Procedure for GC and HPLC Analysis (SOC-CONF). If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including additional cleanup.
- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.
- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.
- Laboratory Control Sample Results – The LCS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers. For analysis where a large number of analytes are in the LCS, it becomes more likely that some analytes (marginal exceedences) will be outside the control limits. The

procedure described in the 2003 NELAC standards, Appendix D.1.1.2.1 are used to determine if the LCS is effective in validating the analytical system and the associated samples.

- Matrix Spike Results – The MS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results are reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

21.1.2 Qualitative Data Evaluation

All sample results and QC results are reviewed to ensure correct identification of target analytes, when not inherent to the test method. Details particular to each analysis are given in the analytical SOP.

Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
  - The analyte must fall within the retention time window specified in the applicable SOP. The retention time window is established prior to analysis and documented.
  - For analyses all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis. Details for confirmation analysis are described in the SOP SOC-CONF, *Confirmation Procedures for GC and HPLC Analyses*. Confirmation Data Confirmation data will be provided as specified in the method.
  - When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS and LC/MS Methods - Two criteria are used to verify identification:
  - Elution of the analyte is at the same relative retention time (as defined by the method) as demonstrated in the standard.
  - The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.
  - When Tentatively Identified Compounds are to be reported for GC/MS, the spectrum for non-target peaks is compared to the current GC/MS reference library.

21.2 Data Reporting

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data for each analysis, accompanied by signature approval. When the entire data set has been found to be acceptable, a final copy of the report is generated and approved by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package for the analysis is then placed into the service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate Project Manager.

When all analyses and departmental reports are completed the Project Manager reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A report narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc. Prior to release of the report to the client, the Project Manager reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is scanned and archived by service request number.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The SOP for *Data Reporting and Report Generation* (ADM-RG) addresses the flagging and qualification of data. The ALS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the Project Manager to explain problems with a specific analysis or sample, etc.

When requested by the client or relevant to the validity of reported results, the estimation of measurement uncertainty will be provided to a client or regulatory agency. How the uncertainty will be reported may be dictated by the client's reporting specifications. Procedures for determining and reporting uncertainty are given in SOP CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

For subcontracted analyses, the Project Manager verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Manager accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the client.

21.3 Deliverables

In order to meet individual project needs, ALS - Kelso provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 21-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) deliverables for DoD QSM projects and state-specific drinking water formats.

When requested, ALS - Kelso provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS - Kelso is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 21-1
Descriptions of ALS Environmental - Kelso Standard Data Deliverables*
Tier I. Routine Analytical Report includes the following:
• Transmittal letter
• Chain of custody documents and sample/cooler receipt documentation
• Sample analytical results
• Method blank results
• Surrogate recovery results and acceptance criteria for applicable organic methods
• Dates of sample preparation and analysis for all tests
• Case narrative - optional
Tier II. In addition to the Tier I Deliverables, this Analytical Report includes the following:
• Laboratory Control Sample results with calculated recovery and associated acceptance criteria
• Matrix spike results with calculated recovery and associated acceptance criteria
• Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
• Case narrative - optional
Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:
• Case narrative - required
• Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits
• Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS are included.
Tier IV. Full Data Validation Package.
• All raw data associated with the sample analysis, including but not limited to: • Preparation and analysis bench sheets and instrument printouts, • For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive results, and the results and spectra of TIC compounds when requested.
• QC data
• Calibration data (initial, verification, continuing, etc.),
• Calibration blanks or instrument blanks (as appropriate to method).

* If a project QAPP or program reporting protocol applies the report will be presented as required for the project.

22) Summary of Changes and Document History

Revision Number	Effective Date	Document Editor	Description of Changes
24.1	9/1/2015	L. Wolf	Update QA Manager to Carl Degner, and related revision of key personnel and organization charts. Updated SOP list. Minor error corrections to existing content.

23) References for Quality System Standards, External Documents, Manuals, and Test Procedures

The analytical methods used at ALS Environmental, Kelso generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at ALS Environmental, Kelso are taken from the following references:

- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- TNI Standard – Environmental Laboratory Sector, Volume 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis,* EL-V1-2009.
- Quality Standards. American National Standard *General requirements for the competence of testing and calibration laboratories,* ANSI/ISO/IEC 17025:2005(E)
- *DoD Quality Systems Manual for Environmental Laboratories,* Versions 4.2 and 5.0
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-B-97-001 (January 2005).
- *Procedure Manual for the Environmental Laboratory Accreditation Program,* Washington Department of Ecology, 10-03-048, September 2010.
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.

- Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998) and SM On-Line. See Introduction in Part 1000.
- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and EPA Method Update Rule 2007 and 2012.
- 40 CFR Part 141, National Primary Drinking Water Regulations and EPA Method Update Rule 2007.
- Analytical Methods for Petroleum Hydrocarbons, ECY 97-602, Washington State Department of Ecology, June 1997.
- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products (Alaska, Arizona, California, Oregon, Washington, Wisconsin, etc.).
- Annual Book of ASTM Standards, Part 31, Water.
- U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA-540/R-94/012 (February 1993).
- U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA-540/R-94/013 (February 1994).
- Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, for USEPA and USACE (March 1986), with revisions through April 1997.
- WDOE 83-13, Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations (March 1982) and as Revised (July 1983 and April 1991).
- Identification and Listing of Hazardous Waste, California Code of Regulations, Title 22, Division 4.5, Chapter 11.
- Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater, EPA 821-R-93-017 (October 1993).
- Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters, EPA 821-B-98-016 (July 1998).
- National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI).

Internal program-level QA documents are listed in Appendix I.

APPENDIX A – Glossary

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accreditation Body: The territorial, state or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.

Accreditation Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.

Analysis Date: The calendar date of analysis associated with the analytical result reported for an accreditation or experimental field of proficiency testing.

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation).

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

Bias: The systematic distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

Calibration Standard: A substance or reference material used for calibration.

Certified Reference Material (CRM): Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability to a national metrology institute.

Chain of Custody: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT): Analytes for which a laboratory is required to successfully analyze a PT sample in order to obtain or maintain accreditation, collectively defined as: matrix, technology/method, analyte.

Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.

Holding Time: The specified maximum time that can elapse between two specified sampling and/or analytical activities.

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish evaluate accuracy and bias for associated sample analyses.

Legal Chain of Custody Protocols: Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

Limit of Detection (LOD): A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect.

Limit of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

Matrix: The substrate of a test sample.

Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Measurement System: A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).

Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

National Institute of Standards and Technology (NIST): A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States National Metrology Institute (NMI).

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

Primary Accreditation Body (Primary AB): The TNI-NELAP accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.

Procedure: A specified way to carry out an activity or process. Procedures can be documented or not.

Proficiency Testing (PT): A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.

Proficiency Testing Provider (PTP): A person or organization accredited by the TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT program.

Proficiency Testing Sample (PT Sample): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

Proficiency Testing Study (PT Study): A single complete sequence of circulation of proficiency testing samples to all participants in a proficiency test program.

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control: The overall system of technical activities that continually measures the performance of a process, item, or service against defined standards to verify that they meet the stated requirements. Also, the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system.

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC) activities.

Quality System Matrix: These matrix definitions be used for purposes of batch and quality control requirements:

Air and Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples are grouped according to type of tissue (i.e. marine vs. plant).

Chemical Waste: A product or by-product of an industrial process that results in a matrix not otherwise defined.

Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.

Non-Aqueous Liquid: Any organic liquid, product, or solvent not miscible in water and with <15% settleable solids.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source.

Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.

Raw Data: The documentation generated during sampling and analysis that records the original work steps, observations, and measurements, whether performed by an analyst or instrument. This documentation includes, but is not limited to field notes, electronic data, analysis bench sheets, run/injection logs, printouts, chromatograms, instrument outputs, and handwritten records for calibration, sample preparation, and sample analysis for field samples and QC samples.

Reference Material: Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or at a given location.

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Secondary Accreditation Body (Primary AB): A TNI-NELAP accreditation body responsible that accredits the laboratory based on the Primary AB accreditation and procedures.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Standard Operating Procedure (SOP): A written document that details the process for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the procedures for performing certain routine or repetitive tasks.

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Verification: Confirmation by examination and objective evidence that specified requirements have been met.

Acronyms

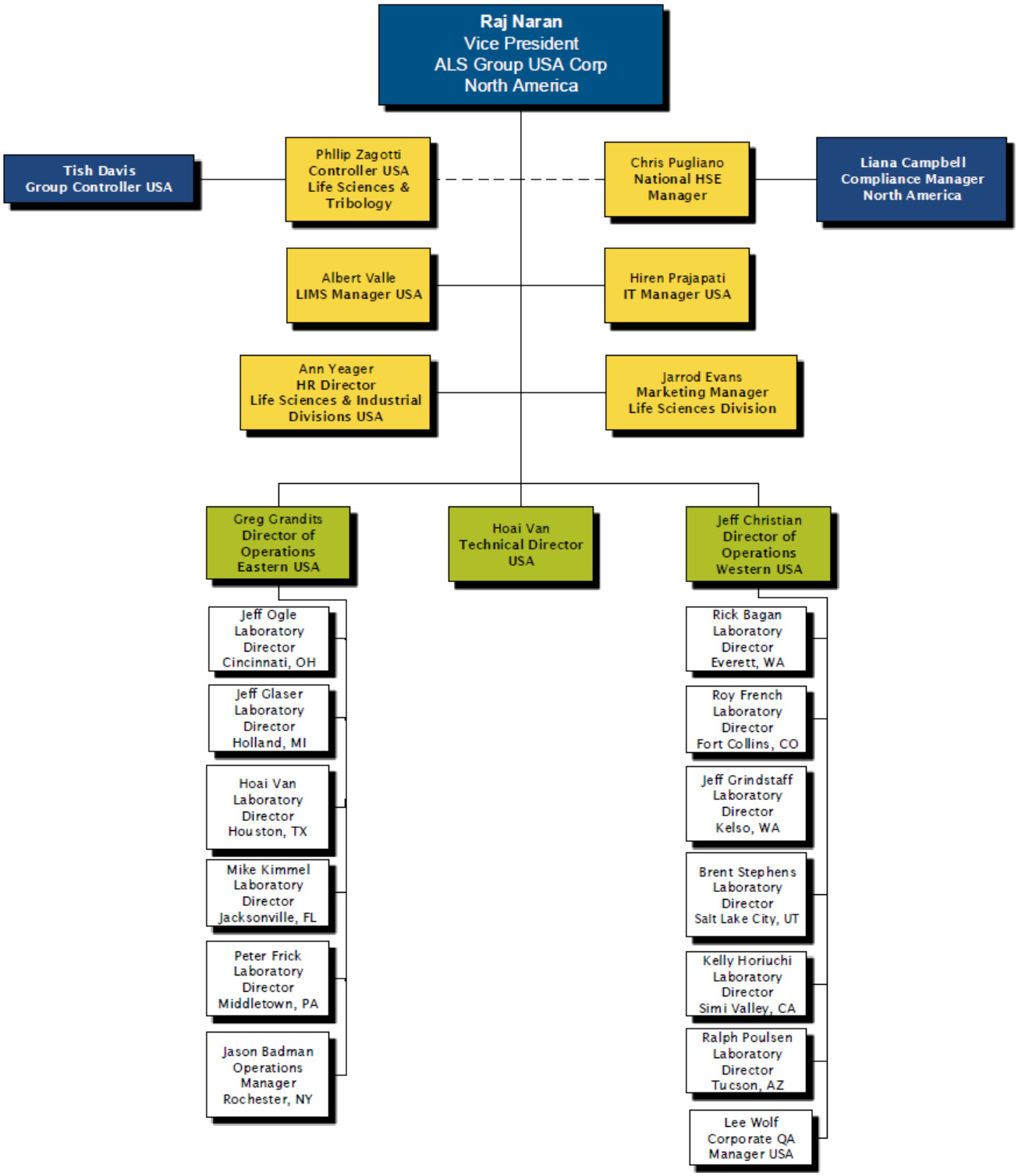
ASTM - American Society for Testing and Materials
A2LA - American Association for Laboratory Accreditation
CARB - California Air Resources Board
CAS - Number Chemical Abstract Service registry Number
CFC - Chlorofluorocarbon
CFU - Colony-Forming Unit
DEC - Department of Environmental Conservation
DEQ - Department of Environmental Quality
DHS - Department of Health Services
DOE - Department of Ecology
DOH - Department of Health
EPA - U. S. Environmental Protection Agency
ELAP - Environmental Laboratory Accreditation Program
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
LOD - Limit of Detection
LOQ - Limit of Quantitation
LUFT - Leaking Underground Fuel Tank
M - Modified
MCL - Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL - Method Detection Limit
MPN - Most Probable Number
MRL - Method Reporting Limit
NA - Not Applicable
NC - Not Calculated
NCASI - National Council of the Paper Industry for Air and Stream Improvement
ND Not Detected
NIOSH - National Institute for Occupational Safety and Health
PQL - Practical Quantitation Limit
RCRA - Resource Conservation and Recovery Act
SIM - Selected Ion Monitoring
TNI – The NELAC Institute
TPH - Total Petroleum Hydrocarbons

APPENDIX B – Organization Charts, Key Personnel, and Report Signatories

ALS Environmental

USA

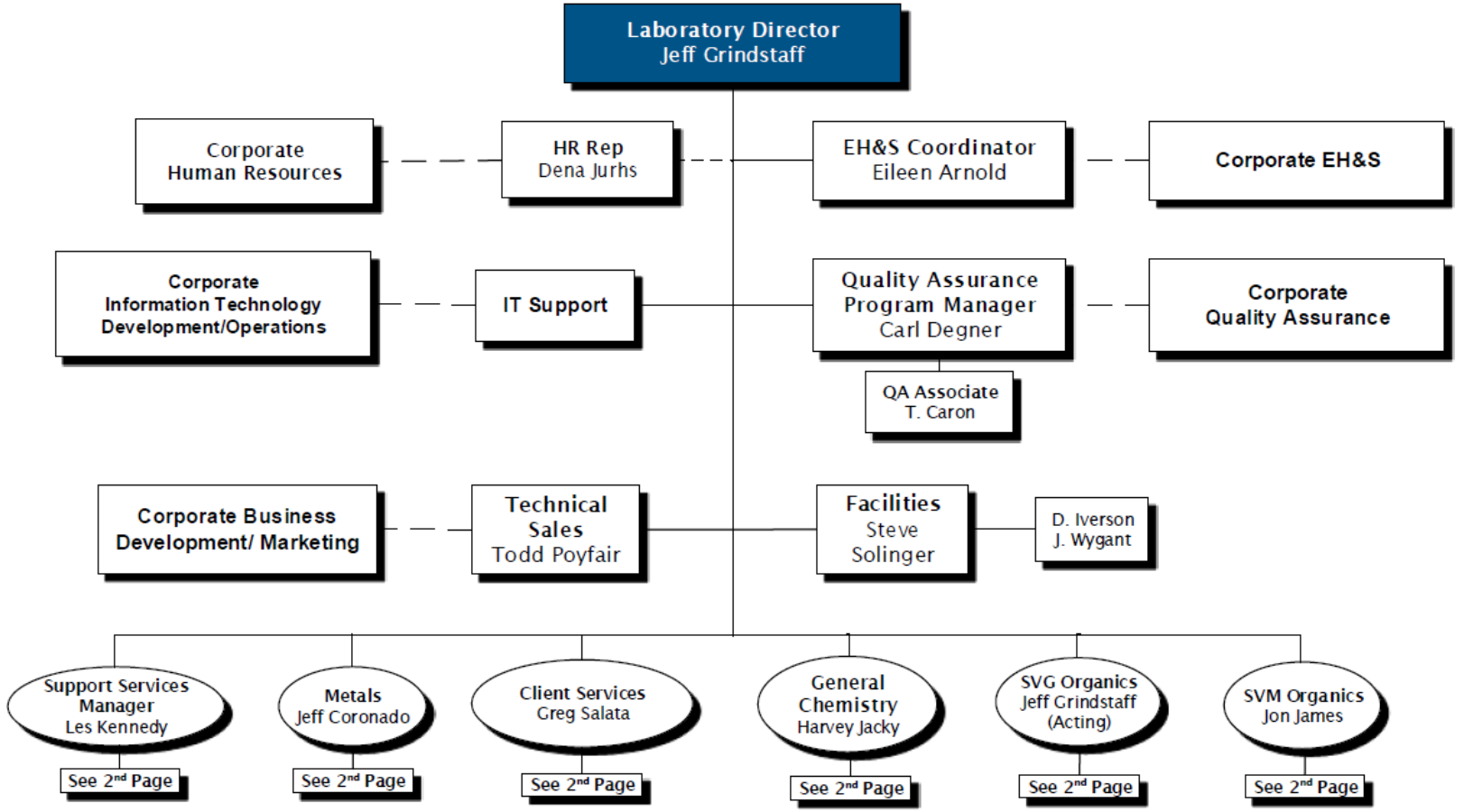
August 28, 2015



Kelso, Washington Laboratory

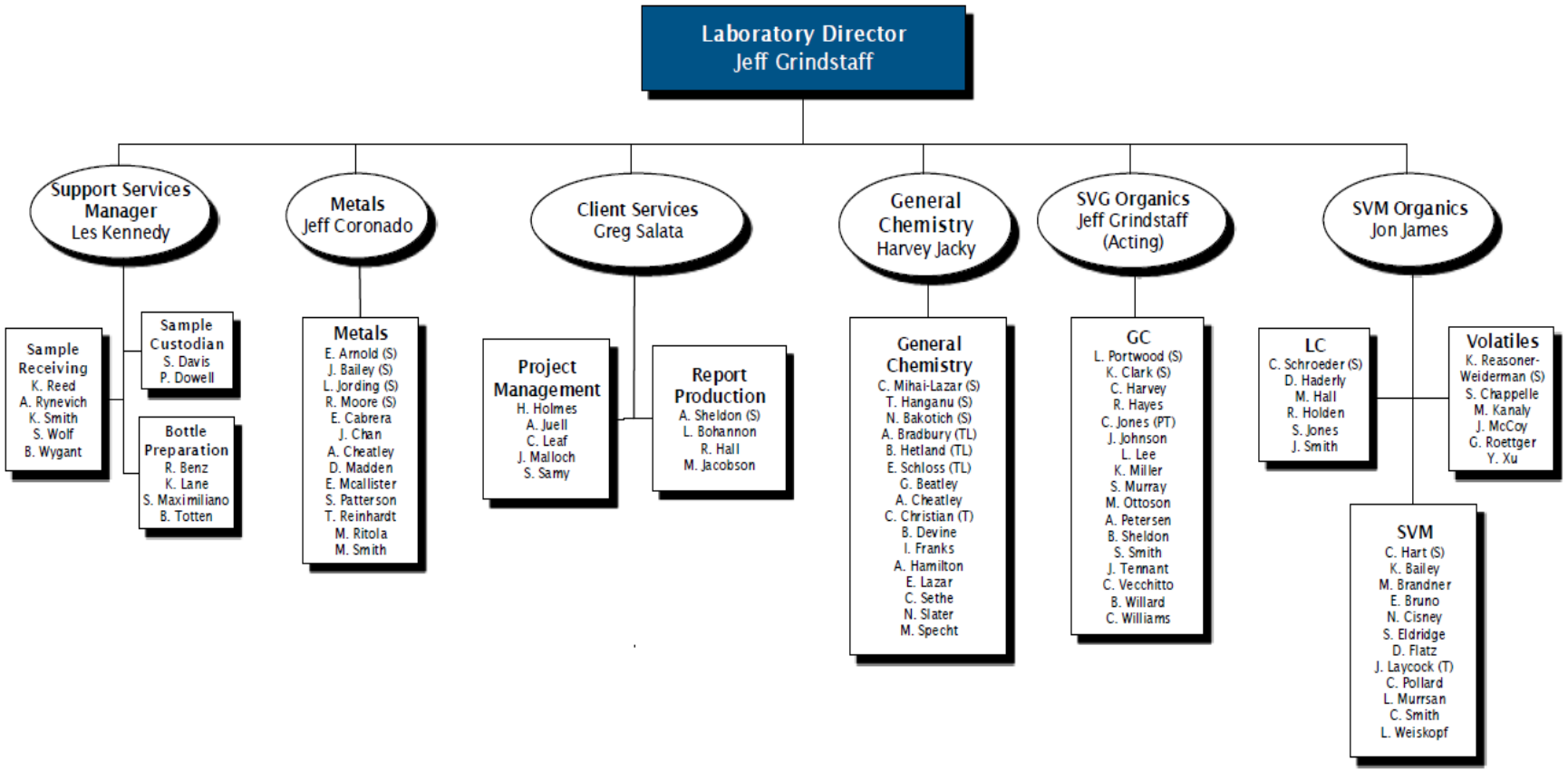
August 28, 2015

ALS Environmental



Kelso, Washington Laboratory

August 28, 2015
Operations



Jeffrey A. Grindstaff

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ALS Environmental

Education

Allan Hancock College.
Santa Maria, CA
AA, Liberal Arts, 1986

California Polytechnic State University
San Luis Obispo, CA
BS, Chemistry, 1989

Hewlett-Packard Analytical Education Center
Interpretation of Mass Spectra I, 1992

Hewlett-Packard Analytical Education Center
Mass Selective Detector Maintenance 1993

Richard Rogers Group
Leadership Training, 1996

PTI International
Sampling and Testing of Raw Materials, 2004

Affiliations

American Chemical Society, 1989

Publications

Mr. Grindstaff has a number of publications and presentations. For a complete list, contact ALS.

Laboratory Director

2011 - Present

Responsible for all phases of laboratory operations at the Kelso, (WA) facility, including project planning, budgeting and quality assurance. Primary duties include the direct management of the Kelso laboratory

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Laboratory Director, '10-'11

Responsibilities the same as above.

Columbia Analytical Services, Inc.
Kelso, WA
Technical Manager III, Pharmaceutical GC/MS, VOC and SVOC Laboratories, '97-'10

Primary responsibilities include leadership of the Pharmaceutical GC/MS, VOC and SVOC staff, management of method development, training, data review, tracking department workload, scheduling analyses. Responsible for ensuring data quality and timeliness. Also responsible for project management and coordination for pharmaceutical clients.

Columbia Analytical Services, Inc.
Kelso, WA
Manager, GC/MS VOA Laboratory, '94-'97

Responsible for supervision of GC/MS VOA staff development, method development, training, data review, tracking department workload, scheduling analyses, and general maintenance and troubleshooting of GC/MS systems.

Columbia Analytical Services, Inc.
Kelso, WA
Scientist III, GC/MS VOA Laboratory, '91-'94

Responsible included scheduling workload, data review, instrument maintenance and troubleshooting and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts. Additional supervisory duties included report generation and data review for GC analyses. Responsibilities also included project management and client service.

Enseco-CRL
Ventura, CA
Chemist, '90-'91

Established GC/MS department including inventory maintenance, preparation of state certification data packages, method development, SOPs, and extended data programs. Performed daily maintenance and troubleshooting of GC and GC/MS instrumentation. Scheduled and performed routine and non-routine VOA analyses.

Coast to Coast Analytical Services.
San Luis Obispo, CA
GC/MS Chemist VOA Laboratory, '05-'07

Responsible for Standard Preparation for VOA analyses, instrument calibration, tuning and maintenance. Also implemented and further developed EPA methods for quantitative analysis of pesticides and priority pollutants

Gregory G. Salata, Ph.D.

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ALS Environmental

Education

University of California-San Diego,
Revelle College,
La Jolla, CA
BA, Chemistry, 1987

Texas A&M University,
College Station, TX
MS, Oceanography, 1993

Texas A&M University,
College Station, TX
Ph.D., Oceanography, 1999

Affiliations

Society of Environmental Toxicology and Chemistry (SETAC)

Publication

Dr. Salata has a number of publications and published abstracts. For a complete list, contact ALS|Kelso.

Client Services Manager

2013 – Present

Management of the Client Services Departments: Project Management, Electronic Data Deliverables and Report Generation, and Sample Management. Oversee the client services for approximately $15 million in revenue annually. Personally responsible for approximately $4 million of direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received by the laboratory.

Previous Experience

ALS Group USA Corp dba ALS Environmental — **Project Manager V '11 –'13**
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements. Provide technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies. Responsible for direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received and reported by the laboratory. Specializes in complex or highly sensitive projects which may involve difficult matrices and analytes..

Columbia Analytical Services, Inc. — **Project Manager V, '03 – '11**
Kelso, WA

Responsibilities include Project Management, including quotation preparation and data reporting, as well as providing technical support to the laboratory as needed. Responsibilities also include oversight of the organic extractions lab, managing resources and providing technical support for all organic preparation work flows

B&B Laboratories — **Project Manager**, '99-'03
College Station, TX

Supervisor/responsible for analysis of TPH (waters, tissues, sediments), organotins (waters, tissues, sediments), Atterberg Limits (sediments), and total organic/inorganic carbon (sediments, waters). Also responsible for report generation on specific projects. Instrumentation operated included GCs with FID and FPD detectors, Combustion TOC, Water TOC, and Dionex Accelerated Solvent Extractor.

Texas A&M University — **Graduate Student**,'91-'99
College Station, TX

While working toward MS in Oceanography, performed organic extractions for pesticides, PCBs, PAHs, and butyltins. While working toward Ph.D. in Oceanography determined stable carbon isotope ratios in sediments, waters, and bacterial phospholipid fatty acids. Other responsibilities included field sample collection, and operation/maintenance of FinniganMAT 252 isotope ratio MS.

Science Applications International — **Analytical Chemist**, '89-'90
San Diego, CA

Performed organic extraction and GC/FID analysis on sediment/rock samples for the Exxon Valdez oil spill.

Analytical Technologies — **GC Chemist**, '87-'89
San Diego, CA

Responsible for analysis of volatile organics using purge and trap and GC/PID/ELCD.

Carl S. Degner

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ALS Environmental

Education

University of Houston, Houston, TX
MS in Environmental Management 1998

University of Houston, Houston, TX
BS in Biochemistry/ Biophysical Science 1984

Kelso QA Manager

2015 – Present

Directing the quality systems and ethics programs for the Kelso, WA laboratory facility. Responsible for ensuring that ALS quality systems and data integrity standards are implemented. Act as liaison with government entities involving quality, technical and operational issues. This includes maintaining accreditations and certifications, and maintaining all necessary documents (QA Manual, SOPs, and QA records). Act as primary point of contact during laboratory audits and provide audit responses and corrective actions. Coordinate performance audits (PE/PT testing) and conduct internal audits. Provide QA input and policy as needed for operations, development initiatives, special projects, planning, and information technology implementation.

Previous Experience

ALS Group USA Corp. — **Technical Manager, SVM Laboratory '11–'14**
Kelso, WA
Responsible for daily operation of Semi-volatiles GC/MS laboratory. This includes scheduling workloads of 3 analyst, data review, reporting and long-range planning for SVM laboratory. Work with PCs on client specific project requirements.

Columbia Analytical Services, Inc. — **Technical Manager, SVM Laboratory '01–'11**
Kelso, WA
Essentially the same as current duties above.

Columbia Analytical Services, Inc. — **Scientist IV, SVM Laboratory '98 – '01**
Kelso, WA
Responsible for all phases of operation of GC/MS systems, utilizing SIM and 8270C methodologies, including preparation of standards, QC verifications, data review, and reporting.

Environ Express Laboratory — **Project Chemist/Principal Organic Scientist '93 – '98**
LaPorte, TX
Responsible for SV Extractions and GC/MS laboratories. Set up, operated, and maintained three HP GC/MS systems and worked with clients on technical issues.

BETZ Analytical Services — **GCMS Supervisor, '91– '93 GCMS Operator: '90–'91**
The Woodlands, TX
Supervised GC/MS Volatiles laboratory and oversaw staff's operation of four GC/MS systems. Served as system manager for HP 1000 utilizing RTE-A software. As operator performed routine sample analysis in Volatiles laboratory.

Harris County Pollution Control — **Instrument Technician, '88 – '90**
Pasadena, TX
Operated and maintained various equipment in instrumentation laboratory, including GC/MS, GC, HPLC, UV-Vis and Fluorescence spectrophotometers. Selected to meet with EPA and Texas Air Control Board at industrial sampling sites.

Harris County Pollution Control — **Chemist, '84 – '88**
Pasadena, TX
Performed wide variety of inorganic analyses utilizing gravimetric, titrimetric, and colorimetric techniques. Brought analytical methods online e.g. TKN, ortho-Phosphate. Performed metals digestions and analyzed samples using Flame AAS and GFAA.

Eileen M. Arnold

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ALS Environmental

Education

Immaculata College,
Immaculata, PA
BA, Chemistry, 1977

Affiliations

American Chemical Society, Member since 1987.

Scientist, Metals Laboratory/Kelso Health and Safety Officer

2011 - Present

Supervisor of the Metals reporting group responsible for ensuring timely, accurate reporting of all metals reports. Responsible for updating instrument specific data, such as MDL and control limits. Analyst for the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Environmental, Health and Safety Officer responsibilities include development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment, review of monthly safety audits, and completion of all Federal and State mandated EH&S reports.

Previous Experience

Columbia Analytical Services, Inc. — **Scientist IV Metals Laboratory/Kelso Health and Safety Officer,** *'94-'11*
Kelso, WA
Duties as described above.

Columbia Analytical Services, Inc. — **Project Chemist,** '92-'94
Kelso, WA
Duties included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to act as liaison for all client-related activities within Columbia Analytical Services, Inc.

Columbia Analytical Services, Inc. — **Scientist IV Metals Laboratory,** '87-'92
Kelso, WA
Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Dow Corning Corporation. — **Chemist,** '86-'87
Springfield, OR
Responsibilities included ICP and atomic absorption work in silicon manufacturing. Methods development for ICP analysis of minor impurities found in silicon.

Ametek, Inc. — **Chemist,** '86-'87
Harleysville, PA
Responsibilities included product research and development chemist involved in production of thin-film semiconductors for use as solar cells. Work involved AA and SEM techniques

Janbridge, Inc.. — **Chemist,** '78-'82
Philadelphia, PA
Responsibilities included maintaining electroplating process lines through wet chemical analysis techniques, and performed Quality Assurance testing on printed circuit boards.

Jeffrey A. Coronado

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Education

Western Washington University – Bellingham, WA
BS, Chemistry, 1988

Western Washington University – Bellingham, WA
BA, Business Administration, 1985

Winter Conference on Plasma Spectrochemistry – Tucson, AZ, 2012

LC/ICP-MS Training Course – PerkinElmer, 2008

Field Immunaossay Training Course – EnSys Inc., 1995

Winter Conference on Plasma Spectrochemistry – San Diego, CA, 1994

ICP-MS Training Course – VG-Elemental, 1992

Technical Manager IV, Metals Department Manager

1992 – Present

Management of the Kelso Metals Department with a staff of 22 chemists and technicians, and annual revenues approaching $4 million. Responsible for data quality and timeliness, annual budgeting, revenues, expenses, workload coordination, method development efforts, and resource allocation. 2001 to Present—Project Manager: Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects.2008 to Present— Participation in the corporate Information Technology governance team ensuring software development activities are in line with the companies operational objectives.2010 to Present—Participation in multiple LIMS development teams responsible for defining the CAS product. Team leader for defining specifications of the Sample Preparation Module to capture preparation information across all laboratory departments.

Previous Experience

Columbia Analytical Services, Inc. — **Metals Department Manager, '92 – present**
Kelso, WA

Responsibilities included management of all aspects of the metal laboratory operation, including personnel training and evaluation, review of all metals data, and report generation. Also responsible for client service on a number of ongoing CAS accounts. Technical duties include primary analytical responsibility for trace level metals analysis by ICP/MS. Analyses range from routine water and soil analysis, to marine tissues, as well as industrial applications such as ultra-trace QA/QC work for various semiconductor clients. Also responsible for a number of specialized sample preparation techniques including trace metals in seawater by reductive precipitation, and arsenic and selenium speciation by ion-exchange chromatography. Developed methodology for performing mercury analysis at low part per trillion levels by cold vapor atomic fluorescence.

Columbia Analytical Services, Inc. — **Supervisor, GFAA Laboratory, '89 – '92**
Kelso, WA

Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW 846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

Harvey Jacky

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ALS Environmental

Education

Oregon State University – Corvallis, OR
BS, Zoology, 1988

Oregon State University – Corvallis, OR
BS, General Science, 1988

Linfield College – McMinnville, OR
General Studies, 1981 - 1982

40-Hour Hazmat Certification, PBS Environmental, 1996

Industrial Emergency Response, SFSP Seminar, 1991

Presentations

American Chemical Society, Member since 1988

Biochemical and Physical Factors Involved in the Application and Measurement of a Soil Bioremediation System. Biogeochemistry, Portland State University, 1996

General Chemistry Department Manager

2008 – Present

Oversee the operation of the General Chemistry and Microbiology groups. Responsible for the quality and timeliness of the inorganic laboratories analytical reports, departmental budgets, workload coordination, method development efforts, cost-effectiveness, and resource allocation.

Previous Experience

Columbia Analytical Services, Inc. — **Project Manager III, '99 – '08**
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies.

Coffey Laboratories — **Director of Project Management, '97 – '99**
Portland, OR

Responsible for technical project management. Communicated with clients to determine needs and expectations. Monitored laboratory production and ensured the timely completion of analytical projects. Technical consultant for clients regarding environmental compliance. Supervised and managed other members of the project management team. Served as a member of the senior management team for oversight of general operations, strategic planning, finances, and policy.

Coffey Laboratories — **Project Manager/Chemist, '97 – '99**
Portland, OR

Responsibilities: Served as primary liaison between Coffey Laboratories and major clients. Ensured that work was completed in a timely manner and done to client specifications. Served as technical consultant regarding environmental chemistry, soil remediation, and waste water industrial compliance. Clients included the Oregon Department of Transportation, Hazmat Unit, Portland, Oregon; Raythion Demilitarization Co., Umatilla, Oregon; Hydroblast - Wastewater Evaporator Systems, Vancouver, Washington; and Union Pacific Railroad, Northwest Region, Klamath Falls, Oregon.

Coffey Laboratories — **Technical Sales Representative, '95 – '97**
Portland, OR

Responsible for marketing and sales, including actively prospecting for new potential clients. Additional responsibilities included procurement and preparation of all major project bids; ensuring that client expectations were met; and maintaining customer satisfaction. Served as consultant regarding industrial compliance issues, environmental remediation projects, and hazardous waste management.

Coffey Laboratories — **Senior Chemist/Laboratory Chemical Hygiene Officer, '88 – '95**
Portland, OR

Responsibilities: Performed analytical tests including Anions by Ion Chromatography (EPA 300.0), PAHs by HPLC (EPA 8310), Cyanides (EPA 335), and other inorganic, wet chemistry, and organic analytical tests on a wide variety of sample matrices. Responsible for the initial quality assurance review of work performed, supervised and managed personnel. Developed and implemented Laboratory Chemical Hygiene Plan. Directed personnel in regards to safety issues and hazardous waste management. Served as consultant and teacher regarding analytical methodology, environmental compliance, and industrial hygiene.

Jonathan (Jon) James

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ALS Environmental

Education

Evergreen State College
Olympia, WA
BA, Chemistry/Biology
1991

Introduction to LC Methods Development & Troubleshooting, *Hewlett-Packard, Tacoma, WA,* **1995.**
HPLC Maintenance Seminar, *Waters, Portland, OR,* **1994.**
GC/HPLC Maintenance Seminar, *Hewlett-Packard, Olympia, WA,* **1993.**
Gas Chromatography Seminar, *Curtis Matheson Scientific, Kelso, WA,* **1992.**
HPLC Seminar, *Hewlett-Packard, Kelso, WA,* **1991.**

VOA/MS, GC/MS and HPLC Department Manager

2009 – Present

Oversee the operation of the Volatiles GC/MS, Semivolatile GC/MS and HPLC laboratories. Responsibilities include organizing and prioritizing workload, training and development of staff, working with PCs on client specific project requirements, departmental budgets, workload coordination, method development efforts and resource allocation. Responsible for the quality and timeliness of analytical reports. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Manager VOA and PHC/HPLC Laboratories, '04– '09

Oversee daily operation of the Volatiles GC/MS and PHC/HPLC laboratories. Responsibilities include organizing and prioritizing workload, initiating process improvements, training and development of staff and working wit PCs on client specific project requirements. Responsible for analytical duties as listed below for Scientist IV. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Columbia Analytical Services, Inc.
Kelso, WA
Scientist IV, VOA Laboratory, '99 – '04

Perform sample analysis and data review for EPA methods 524.2, 624 and 8260. Duties also include Project Management.

Columbia Analytical Services, Inc.
Kelso, WA
Project Chemist, Supervisor Pesticides GC Laboratory, '98 – '99

Primary responsibilities included workload scheduling, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, SVOC GC Lab '92 – '98

Primary responsibilities included analysis of samples using GC and HPLC techniques, report generation, data review, preparation of analytical standards, maintenance of instrumentation, Client Services and some Project Management. Routine duties included analysis of soil and water samples for pesticides, PCBs, CLP Pesticides, Explosives and PAHs using EPA methods.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, Organic Extractions Lab, '91 – '92

. Responsibilities included extraction of soil and water samples for various SVOCs, and TCLP extraction of SVOC and VOC compounds using TCLP equipment. Other duties included performing cleanup procedures, validation studies, MDL studies, and the training of employees in advanced extraction procedures and techniques..

Loren E. Portwood

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ALS Environmental

Education

Whitworth College
Spokane, WA
BS in Chemistry, Emphasis in Biochemistry 1990

HP 5890 GC Maintenance and Troubleshooting,
Hewlett Packard, 1993

Capilliary Chromatography
Restek, 1993

HP6890 - Fast GC
Hewlett Packard, 1996

HP5890-C+GC Advanced Operations
Hewlett Packard, 1996

Purge and Trap Theory and Troubleshooting, Full Spectrum Analytics, 2001

Comprehensive HPLC,
Restek, 2002

Technical Manager I, Semivolatile Organics Laboratory

2011 - Present

Responsible for the overall operation and supervision of the Semivolatile Organics Gas chromatograph department. Perform method development.

Previous Experience

ALS Group USA Corp. — **Technical Manager I, DW Laboratory, '08 - '13**
Kelso, WA
Columbia Analytical Services, Inc.
Kelso, WA

Responsible for management of the Semivolatile Organics Gas chromatograph and drinking water department. Also responsible for implementation and oversight of UCMR2 analyses. Perform method development. Project management of drinking water accounts. Develop SOPs for Drinking Water methods, EPA 600 methods and SW-846 methods. Operation of Varian GC/MS ion trap, Thermo GC/MS ion trap, Agilent GC/ECD, Agilent GC/FPD, Agilent GC/FID.

Columbia Analytical Services, Inc. — **Technical Manager I, DW Laboratory, '08 - '11**
Kelso, WA

Plan, conduct, and, as lead analyst, supervise analyses using advanced instrumentation such as HPLC with post column derivatization, GC/MS, and GC/ECD. Responsible for data interpretation, quality control and data reporting. Additional responsibilities include SOP generation; handling routine and advanced maintenance and troubleshooting of instrumentation; and assisting in the training of staff department analysts. Assists the department manager and/or other senior scientists in setting up more complex procedures. Serves as senior technical advisor for teams and projects

Columbia Analytical Services, Inc. — **Lead Analyst DW Laboratory, , '02 - '08**
Kelso, WA

Primary responsibilities include management of the petroleum hydrocarbon team, initiating new methods and process improvements, and staff development and training. Other duties include department wide compliance with CAS quality assurance guidelines, routine system checks, assist and encourage staff in troubleshooting equipment and procedural problems in a manner consistent with company, state and federal guidelines..

Columbia Analytical Services, Inc. — **Petroleum Hydrocarbons Supervisor, , '98 - '02**
Kelso, WA

Analysis, reporting, and archiving of water, soil, and product samples for semi-volatile petroleum hydrocarbons and miscellaneous FID tests. Methods include EPA methods 8100, 8310, 8315, 8330, 8040, 8015 and various state modifications of 8015 (OR, WA, CA, AK). Additional analyses include solvent scans, alcohols, glycols, and EPA methods 413.2 and 418.1. Other responsibilities include sample preparation and instrument maintenance

Columbia Analytical Services, Inc. — **Petroleum Hydrocarbons, '93 - '98**
Kelso, WA

SVOC sample preparations for water, soil, and oil to be analyzed in the GC, GC/MS, and PH Departments. These extraction methods included hazardous waste, wastewater, and drinking water procedures. Other responsibilities included extract cleanup via Florisil®, GPC, and Hg.

Treclen Laboratories — **Bench Chemist, Extractions, '92 - '93**
Spokane, WA

Inorganic water and soil testing and sample preparation by EPA methods.

Lester "Les"Kennedy

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ALS Environmental

Education

Lower Columbia College, Longview, WA
Coursework, general Studies, 1988 - 1990

Portland Bible College Portland, OR
Batchelor ofTheology, 2009

Support Services Manager/Sample Management Manager

2010 - Present

Responsible for the operation of the Sample Management, Sample Control, Bottle preparation departments, including sample receiving, courier service, sample control, storage and disposal, bottle preparation and shipping, and general freight receiving. Responsible for employee supervision, personnel evaluations, workload coordination, and adherence to all standard operating procedures within said departments. Additional duties include oversight of quarantined soil importation for laboratory testing. Is the designated Sample Custodian for the laboratory.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Project Manager '99 -'11
SMO Supervisor, '06 -'11

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and serving as liaison to clients and regulatory agencies. Oversight of the daily activities in sample management department including receipt, login, storage, and proper disposal of all samples received in the laboratory.

Columbia Analytical Services, Inc.
Kelso, WA
Supervisor Organic Extractions Laboratory, '97-'99

Responsible for managing work load; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work. Additional responsibilities include data processing of GC/MS analytical runs including all steps of the data review and reporting process.

Columbia Analytical Services, Inc.
Kelso, WA
Senior Analyst, GC/MS Laboratory, '96-'97

Primary duties were performing analyses by EPA Method 8270, SIM TCL. SIM PAH, including all steps in the data review and reporting process.

Columbia Analytical Services, Inc.
Kelso, WA
Senior Analyst, Organic Extractions Laboratory, '93-'96

Primary responsibilities include managing workload; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, Organic Extractions Laboratory, '91-'93

Duties primarily as listed above

Jeffery D. Christian

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ALS Environmental

Education

Evergreen State College – Olympia, WA
BS in Chemistry 1993

Coursework, *Pacific Lutheran University, Tacoma, WA.* 1988-1989.
Coursework, *Tacoma Community College, Tacoma, WA* 1970-1971, 1988-1989.
CERTIFICATION, Chemistry, *L.H. Bates Technical, Tacoma, WA,* 1976-1978.
Coursework, *Central Washington University, Ellensburg, WA.* 1969-1970.
Numerous Training/Educational Activities via Conferences, Professional Seminars, and Factory Training, 1989-2010

Publications

Mr. Christian has a number of publications and presentations. For a list of these publications and presentations, please contact ALS

Director of Operation, Western USA

2011 – Present

Responsible for oversight of operating units In the territory designated Western reporting to the COO. Primary responsibilities include establishment of consistent quality, technical, and client service enhancements across the group, as well as the financial performance of the individual operating units. In addition, a significant role is to represent operations as a member of the management team consisting of the Directors of Operations of other territories, Laboratory Directors for all locations, and senior management of the North America Environmental Division of ALS USA.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Chief Operating Officer/Vice President – '10 to '11

Responsible for oversight of operating units of Columbia Analytical Services, Inc. with all Laboratory Directors reporting to the COO. Primary responsibilities include establishment of consistent quality, technical, and client service enhancements across the company, as well as the financial performance of the individual operating units. In addition, a significant role is to represent operations as a member of the Senior Management Team (SMT) consisting of the Chief Executive Officer, Chief Financial Officer, Chief Quality Officer, and the Director of Information Technology.

Columbia Analytical Services, Inc.
Kelso, WA
Vice President/Kelso Laboratory Director '93–'10

Responsible for all phases of laboratory operations, including project planning, budgeting, and quality assurance.

Columbia Analytical Services, Inc.
Kelso, WA
Operations Manager, Kelso Laboratory '92–'93

. Responsibilities included directing the daily operation of the Kelso laboratory. Other responsibilities and duties included functioning as a technical consultant to clients, providing assistance in developing and planning analytical schemes to match client objectives, and writing and developing analytical procedures/methods. Also, served as Project Manager for State of Alaska Department of Environmental Conservation contract and Coordinator for EPA Special Analytical Services (SAS) contracts.. Always leave an extra space after this paragraph to separate from the next job.

Columbia Analytical Services, Inc.
Kelso, WA
Project Chemist & Manager, Metals Analysis Lab, '89–'92

Responsible for directing the daily operation of the Metals Laboratory, including the sample preparation, AAS, ICP-OES, and ICP-MS Laboratories

Weyerhaeuser Technology Center,
Federal Way, WA
Scientist '86–'89

Responsibilities included supervising atomic spectroscopy laboratory which included flame and furnace AAS, ICP-OES, and sample preparation capabilities to handle a wide variety of sample types. Interfaced with internal and external clients to provide technical support. Wrote and developed analytical procedures/methods.

Weyerhaeuser Technology Center,
Federal Way, WA
Lead Technician, Metals Lab '81–'86

Responsibilities included primary ICP and AAS analyst for EPA-CLP contract work. Extensive experience in wide variety of environmental and product-related testing.

ITT Rayonier, Olympic Research Division,
Shelton, WA
Research Assistant, '78–'81

Responsibilities included performing water quality tests, product-related analytical tests, corrosion tests operated pilot equipment specific to the pulp and paper ind

APPROVED SIGNATORIES FOR FINAL ANALYTICAL REPORTS

ALS Environmental, Kelso, WA

CHRISTIAN, JEFF
CORONADO, JEFFREY
DEGNER, CARL
GRINDSTAFF, JEFF
HOLMES, HOWARD
JACKY, HARVEY
JAMES, JON
JUELL, AMANDA
KENNEDY, LES
LEAF, CHRIS
MALLOCH, JANET
MIHAI-LAZAR, CARMEN
MOORE, RACHEL
SALATA, GREGORY
SAMY, SHAR
SCHROEDER, COLLEEN

Update: May, 2015 Approved by: Gregory Salata, Client Services Manager

APPENDIX C

ALS Environmental Confidentiality Agreement

Confidentiality Agreement

The Confidentiality Agreement (the "Agreement") is entered into by and between ALS Group (hereinafter referred to as the "Company") and _____ (hereinafter referred to as "Employee").

WHEREAS, employee is presently employed by the Company in a position in which Employee will receive and have access to confidential business information and other secrets of the Company, and shall, to the best of Employee's ability, assist the Company in improving and developing the products and services of the Company; and

WHEREAS, employee is desirous of continuing such employment and receiving such disclosures of confidential business information, and assisting the Company in improving and developing its products and services.

NOW, this Agreement being a condition therefore and ancillary thereto, and in further consideration of the benefits to Employee pursuant to the employment by the Company, the receipt and sufficiency of all such consideration being hereby acknowledged by Employee, it is agreed between the Company and Employee as follows:

1. **Confidential Business Information.** Employee recognizes and agrees that the Company has certain confidential business information, including, but not limited to, compilations of information, customer lists, customer data, records, specifications, and trade secrets, and related business methods and techniques, which confidential business information are used by the Company to obtain a competitive advantage over the Company's competitors who do not know or use this information. Employee further recognizes and agrees that the protection of such confidential business information against unauthorized disclosure and use is of critical importance to the company to maintain its competitive position and Employee therefore agrees that use of, or disclose to any other person or entity, except as authorized by the Company in writing, any of the confidential business information of the Company. Employee also agrees not to disclose to the Company or utilize on the Company's behalf, any of the trade secrets or other confidential information of any of the Employee's former employers.

2. **Return of Confidential Business Information.** Upon termination of his employment for any reason, employee shall promptly deliver to the Company all drawings, manuals, letters, photographs, tapes or video recordings, records of any kind, and all copies thereof, that may be in the possession of, or under the control of, Employee pertaining to the Company's employers.

3. **Assignment of Rights to Company.** Employee agrees to assist the Company in all possible ways in the discovery, perfection, and development of new ideas, inventions, discoveries, devices, and methods in processes, all for the benefit of the Company and as its exclusive property. Employee agrees to and does hereby assign, transfer, and convey to the Company, or at the written direction of the Company and which are made, developed or conceived by Employee, either solely or jointly with others, during Employee's employment with the Company, whether prior or subsequent to the signing of this Agreement, whether made, developed or conceived by Employee during or outside of regular working hours or on or away from the

Company's premises or at Employee's expense, the expense of the Company or some other person or persons. At any time, the Employee shall execute such documents requested by the Company to confirm the rights of the Company in the ideas, inventions, discoveries, and devices, methods and processes referenced in this Section 3.

4. **Reasonableness of Covenants**. Employee specifically acknowledges and agrees as follow: (I) the covenants set forth in this Agreement are reasonable and necessary to protect the goodwill and the operations and business of the Company; (ii) the time duration of the covenants set forth in this Agreement and are reasonable and necessary to protect the goodwill and the operations and business of the Company; (iii) the geographical area limitations of the covenants set forth in this Agreement are reasonable and necessary to protect the goodwill and the operations and business of the Company; (iv) the covenants set forth in this Agreement are not oppressive to Employee and do not impose a greater restraint on Employee than is necessary to protect the goodwill and the operations and business of the Company.

5. **Remedies**. Employee recognizes that irreparable injury or damage will result to the business of the company in the event to the breach of any covenant contained in this Agreement and Employee therefore agrees that in the event of such breach on the part of the Employee, the Company shall be entitled, in addition to any legal or equitable remedies and damages available, to an injunction to restrain the violation thereof by Employee and all other persons action for or on behalf of Employee. Any claim of Employee against the Company shall not prevent the Company from enforcing any provision of this agreement. Further, in the event legal action is necessary to enforce any of Employee's obligations hereunder and the Company prevails in such legal action, the Company shall be entitled to a recovery of its attorney's fees expended in such action.

6. **Reformation**. Whenever possible, each provision of this agreement shall be interpreted in such manner as to be effective and valid under applicable law; provided, however, incase any on or more of the provisions contained in this Agreement shall, for any reason, be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall no affect any other provision of this agreement, and this Agreement shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein. Should a court of competent jurisdiction declare any of the provisions of this Agreement unenforceable due to any restriction of duration, territorial coverage, scene of activity, or otherwise, in lieu of declaring such provisions unenforceable, the parties hereto expressly authorize the court, to the extent permissible by law, to revise or reconstruct such provisions in a manner sufficient to cause them to be enforceable.

7. **Affiliates**. This agreement, and Employee's obligations hereunder, shall apply to any confidential business information, formulas, recipes, patterns, devices, secret inventions, processes, compilations of information, materials, ingredients, customer lists, records, specifications and trade secrets of any affiliate of the Company. For the purpose of this Agreement, the "affiliate" means any person that, directly or indirectly, controls, or controlled by, or is under common control with, another person'; "person" means any individual, corporation, partnership, joint venture, limited liability company, association, joint stock company, trust, unincorporated

organization or any other form of entity; and "control" means the power to direct or cause the direction of the management and policies of a person, directly or indirectly, whether through the ownership of voting securities by contract, or otherwise.

8. **Compelled Disclosure**. In the event that Employee is requested or required (by oral questions, interrogatories, requested for information or documents, subpoenas, civil investigative demand or similar process) to disclose any of the confidential business information of the Company, it is agreed that Employee will provide the Company with immediate notice of such request(s), so that the Company may seek an appropriate protective order or, if appropriate, waive Employee's compliance with this agreement. Employee agreed that, if in the absence of a protective order or the receipt of a waive hereunder, Employee is nonetheless, in the reasonable opinion of Employee's counsel, legally compelled to disclose the confidential business information of the Company or else stand liable for contempt or suffer other censure or penalty, Employee may, after prior notice to the Company, disclose such the confidential business information of the Company to the extent legally required.

9. **Indemnity**. Employee agrees to indemnify and hold harmless the Company, and its directors, officers, employees, agents, and attorneys, from and after the date hereof, against any and all actions, causes of action, claims, suites, proceedings, demands, assessments, demands, settlement, judgment, damages, loses, costs, and legal and other expenses arising out of or resulting from the breach or failure of Employee to Company with any covenant or agreement made herein.

10. **Choice of Law: Waiver of Trial by Jury**. This Agreement shall be construed in accordance with, and governed for all purposes by the laws of the State of Texas and obligations and undertakings of each of the parties to this contract shall be performable at Houston, Harris County. TO THE EXTENT NOT PROHIBITED BY APPLICABLE LAW, THE PARTIES HEREBY KNOWLINGLY, VOLUNTARILY, AND INTENTIONALLY WAIVE ANY RIGHT TO TRIAL BY JURY THAT THE COMPANY OR EMPLOYEE MAY HAVE IN ACTION OR PROCEEDING, IN LAW OR IN EQUITY, IN CONNECTION WITH THIS AGREEMENT, EACH PARTY REPRESENTS AND WARRANTS THAT NEITHER PARTY HAS REPRESENTED, EXPRESSLY, OR OTHERWISE THAT IT WILL NOT, IN THE EVENT OF LITIGATION, SEEK TO ENFORCE THIS RIGHT TO JURY TRIAL WAIVER. EACH PARTY ACKNOWLEDGES THAT THE OTHER PARTY HAS BEEN INCLUDED TO ENTER INTO THIS AGREEMENT BY, AMONG OTHER THINGS, THE PROVISIONS OF THE WAIVER.

11. **Waiver**. No waiver of any provision of this Agreement shall constitute a waiver of any other provision of this agreement, nor such waiver constitute a waiver of any subsequent breach of such provision.

12. **Acknowledgement of Receipt.** Employee acknowledges a receipt of a copy of this Agreement, which has been executed in multiple copies, all executed copies of that shall be deemed originals.

13. **No Promise of Employment.** It is expressly agreed that this Agreement is not a promise of future employment.

14. **Assignment**: **Survival**. This agreement shall not be assignable by Employee. This agreement and the obligations of Employee hereunder, shall survive the termination of Employee's employment with the Company.

15. **Entire Agreement**. This Agreement entered into by the Company and Employee, embodies the entire agreement and understanding between the Company and the Employee relating to the subject matter hereof, and supersedes all prior agreements and understandings relating to the employment and compensation of the Employee and may only be amended by a written agreement signed by all parties hereto.

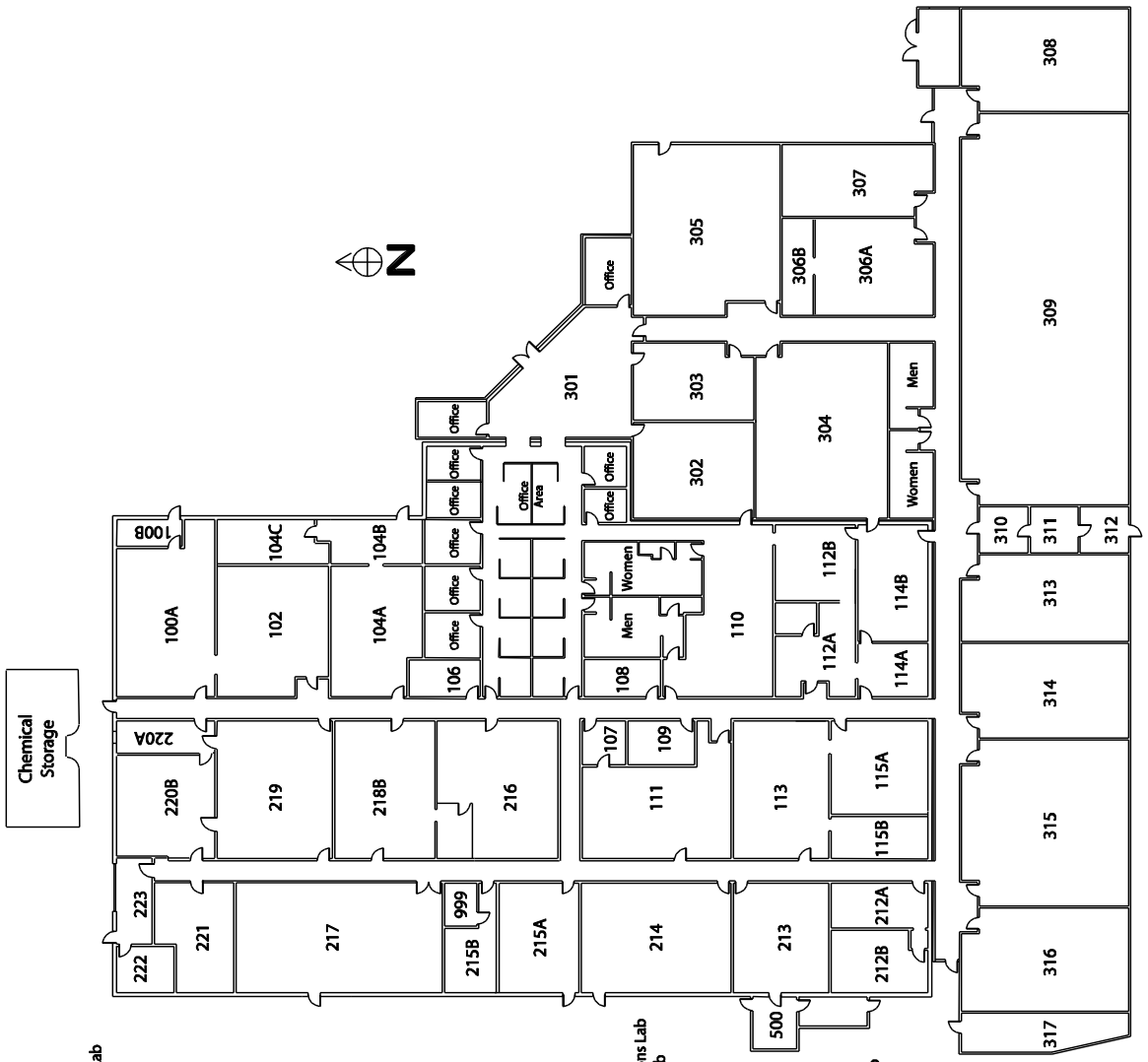
Employee Signature: _____ Date: _____

Employee Printed Name: _____

Witness: _____ Date: _____

Witness Printed Name: _____

APPENDIX D – Laboratory Floor Plan



Room #	
100A	Semivolatile Organics GC Instrument Lab
100B	Electrical Room
102	Semivolatile Organics GC Office
104 A - C	Organics LC Labs and Offices
106	Deionized Water System Room
107	Oven Room
108	Zero Headspace Extraction Lab
109	Storeroom
110	Lunch Room
111	General Chemistry Lab
112A	Microbiology Lab
112B	Copy Center
113	ICP MS Lab
114A	Grain Size
114B	Total Solids/Oven Room
115A	ICP Lab
115B	Metals Reporting
212A	Mercury and Flame AA Lab
212B	Low Level Mercury Lab
213	General Chemistry Lab
214	General Chemistry Lab
215A	Drinking Water Lab
215B	Information Technology
216	Data Review & Storage
217	Sample Storage
218	Volatiles Organics Lab
219	Semivolatile Organics GC/MS Lab
220A	Semivolatile Organics GC/MS Office
220B	Semivolatile Organics GC/MS Extractions Lab
221	Drinking Water Sample Preparation Lab
222	Purchasing Office
223	General Receiving
301	Reception Lobby
302	Lunch Room
303	Conference Room
304	Sample Storage
305	Sample Receiving
306A	Pharmaceutical Metals
306B	Pharmaceutical Microbiology
307	Pharmaceutical Instrument Lab
308	Pharmaceutical General Chemistry Lab
309	Organics Sample Preparation Lab
310	Communication Room
311	Electrical Room
312	Fire Room/Water System
313	Glass Wash Room
314	Clean Room
315	Metals Digestion Room
316	Tissue Preparation
317	Mechanical
500	Janitorial Room
999	Computer Room

Revised 9/21/10

APPENDIX E – Analytical Equipment

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (14):			
Precisa,Mettler,OHOUS, Adams models	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
Autoclave – Heidolph Brinkman 3870EP	2010	LM	3
Autotitrator – Thermo Orion 500	2007	LM	3
Calorimeters (2):			
Parr 1241 EA Adiabatic	1987	LM	4
Parr 6300 Isoparabolic	2005	LM	4
Centrifuge - Damon/IEC Model K	1992	LM	13
Colony Counter - Quebec Darkfield	1988	LM	2
Conductivity Meter (1):			
YSI Model 3200	2004	LM	4
Digestion Systems (3):			
COD (2)	1989	LM	4
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (2)	1988, 1991	LM	4
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	5
Drying Ovens (12):			
Shel-Lab and VWR models	1990-2010	LM	13
Air Drying Cabinets	2011	LM	-
Flash Point Tester (1):			
Petroleum Systems Services	2005	LM	3
Flow-Injection Analyzers (2):			
Bran-Leubbe	2002	LM	2
Lachat 8500	2007	LM	2
Ion Chromatographs (4)			
Dionex DX-120 with Peaknet Data System	1998	LM	3
Dionex ICS-2500 with Chromchem Data System	2002	LM	3
	2006	LM	3
Dionex ICS-2000 with Chromchem Data System	2009	LM	3
Dionex ICS-1600 with Chromchem Data System			
Meters (ISE and pH) (4)			
Fisher Scientific Accument Model 50	1997	LM	4
Fisher Scientific Accument Model 25	1993	LM	4
Fisher Scientific Accument Model 20	2000	LM	4
Fisher Scientific Accument Model AR25	1992	LM	4

Microscope - Olympus	1988	LM	1
Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13
Shatter Box (2): GP 1000 SPEX 8530	 1989 2011	LM	5
Sieve Shakers (2): CE Tyler - Portable RX 24 WS Tyler - RX 86	 1990 1991	 LM LM	 5 5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	5
Total Organic Carbon (TOC) Analyzers (4) Coulemetrics Model 5012 OI 1010 Teledyne Tekmar Fusion 1 Analytik Jena 2500	 1997 2000 2009 2013	 LM LM LM LM	 3 3 3 3
Total Organic Halogen (TOX) Analyzers (2): Mitsubishi TOX-100	2001	LM	2
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (4): SpectraMax 384 Plus Beckman-Coulter DU520 Perkin Elmer Lambda 25 Abrazix	 2009 2005 2008 2011	 LM LM LM LM	 4 4 4 2
Discrete Autoanlayzer –Westco SmartChem AD20-1	2011	LM	2
Vacuum Pumps (3): Welch Duo-Seal Model 1376 Busch R-5 Series Single Stage Chem Star 1402N-01	 1990 1991 2011	LM	13
Water Baths/Incubators (5): Various Fisher Scientific and VWR Models	1986 - 2009	LM	13
Drill Press – Craftsman	2012	-	4
METALS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (8) Mettler AE 200 analytical balance Various Mettler, Sartorius, and Ohaus models	1988-2010	MM	12
Atomic Absorption Spectrophotometers (4): Varian SpectrAA Zeeman/220 AA Perkin Elmer AAnalyst 200 Flame AA CETAC Mercury Analyzer M-6100	 2000 2005 2010	 LM MM MM	 2 2 2
Buck AA Spectrophotometer Model 205	2008	LM	2

Atomic Fluorescence Spectrophotometer Brooks-Rand Model III (1)	2005	LM	3
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (1) - Labconco	2006	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) (2) Thermo Scientific Model iCAP 6500 Thermo Scientific Model iCAP 6500	 2007 2012	 MM MM	 3 3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS) (3): Agilent 7700 Thermo X-Series Nexion Model 300D	 2014 2006 2011	 MM MM MM	 2 2 2
Muffle Furnace (2) - Thermolyne Furnatrol - 53600	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5
Turbidimeter – Hach			
SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (3) Mettler PM480, AG204 OHaus EP613	1999 - 2011	MM	15
Centrifuge – Sorvall GLC-1 (2)	2014	LM	15
Drying Ovens (2) Fisher Model 655G VWR Model 1305U	 1991 1999	 LM LM	 15 15
Evaporators/concentrators Organomation N-Evap (6) Organomation S-Evap (8) Biotage Turbovap (2)	 1990-2010 1990-2010 2013	 LM LM LM	 15 15 15
Extractor Heaters: Lab-Line Multi-Unit for Soxhlet and Continuous Liquid-Liquid Extractions (90)	1987-2007	LM	9
Solids Extractors: Sonic Bath VWR Sonic Horn (4) Soxhtherm Gerhardt (2) OI Analytical (5)	 1994 1994 2000 2008	 LM LM LM LM LM	 6 6 6 6

Extractors, TCLP (8):			
Millipore TCLP Zero Headspace Extractors (20)	1992-2011	LM	2
TCLP 12 position Extractor/Tumbler (2)	1989-2011	LM	2
Gel Permeation Chromatography (GPC) (3)			
J2 Scientific AccuPrep (2)	2005, 2010	LM	4
Gilson (1)	2013	LM	4
Muffle Furnace (2)	2006, 2009	LM	4
Solid Phase Extractors (18) – Horizon SPE-Dex 4790	2003, 2006,2008	LM	4
Microwave Extractor – Mars 6	2014	LM	2
GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Gas Chromatographs (18):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors	1995	LM	6
Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (6)	2001, 2005, 2007,2011	LM	6
Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors	2003	LM	3
Agilent 7890A Dual ECD Detectors Agilent 7683B autosampler (4)	2010 - 2014	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and FID Detector	1995	LM	3
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (4)	2001, 2005	LM	6
Agilent 7890A Dual NPD Detectors and Agilent 7683B autosampler	2012	LM	3
Varian Ion trap GC/MS:	2003	LM	2
Varian 3800 GC w/CP8400 autosampler	2006	LM	2
Varian Saturn 2100T mass spectrometer	2003	LM	2
Thremo Ion Trap ITQ-90C GC/MS w/TriPlus autosampler	2008	LM	2
GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler AB 104-S	2000	MM	6
Gas Chromatograph: Hewlett-Packard 5890 with HP 7673 autosampler and FID Detector	1994	LM	6

Semivolatile GC/MS Systems (11):			
Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1997, 2001	LM	6
Agilent 5890/5970 and HP 7673 Autosampler	1990	LM	6
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1993, 1994	LM	6
Agilent 6890/5973 with ATAS Optic3 LVI and HP 7683 Autosampler	2005	LM	6
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	2007	LM	6
Agilent7890A/5975C with Agilent 7693 Autosampler (4)	2010 - 2011	LM	6
Semivolatile GC/MS/MS –			
Waters Quattro Micro GC Micromass with Agilent 6890, Agilent PTV Injector, 7683B Autosampler	2008	MM	2
HPLC LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB240	1994	MM	6
Drying Oven - Fisher Model 630F	1991	LM	5
Evaporator – Turbo Vap	2009	LM	6
Centrifuge (2)			
Beckman Coulter	2002	LM	6
Eppendorf	2012	LM	6
High-Performance Liquid Chromatographs (3):			
Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	4
High-Performance LC/MS (3)			
Spectrometer - Thermo Electron TSQ Vantage LC/MS/MS and autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC autosampler	2008	MM	4
AB Sciex 5500 and Schimadzu DGU 20A5	2011	MM	4
Agilent 1100 HPLC -UV/Fluorescence detector	2003	LM	3
VOLATILE ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler PE 160	1989	MM	5
Fisher Vortex Mixer	1989	LM	5

Drying Ovens (1): Boekel 107801	1989	LM	5
Sonic Water Bath - Branson Model 2200	1989	LM	5
Volatile GC/MS Systems (8):			
Agilent 5890/5970	1989	LM	5
Tekmar 3000 Purge and Trap Concentrator	1995	LM	5
Dynatech ARCHON 5100 Autosampler	1996	LM	5
Agilent 6890/5973	2001	LM	4
Tekmar 3100 Purge and Trap Concentrator	2001	LM	4
Encon Centurion Autosampler	2001	LM	4
Agilent 6890/5973	2005	LM	4
Tekmar Velocity Purge and Trap Concentrator	2005	LM	4
Tekmar Aquatech Autosampler	2005	LM	4
Agilent 6890/5973	2007	LM	4
Tekmar 3000 Purge and Trap Concentrator	2007	LM	4
Varian Archon 5100 Autosampler	2007	LM	4
Agilent 7980A/5975C (2)	2010, 2011	LM	4
Teledyne Tekmar-Atomx	2010, 2011	LM	4
Agilent 6890/5973	2013	LM	4
Encon Evolution Purge and Trap Concentrator	2013	LM	4
Encon Centurion Autosampler	2013	LM	4
Agilent 7890/5977A	2014	LM	4
Encon Evolution Purge and Trap Concentrator	2014	LM	4
Encon Centurion Autosampler	2014	LM	4
Agilent 7890 GC with FID Encon Evolution Purge and Trap Concentrator Encon Centurion Autosampler	2013	LM	3

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1 - WAN: LIMS Sample Manager using Oracle 11gR2 Enterprise RDBMS running on Red Hat Enterprise Linux Advanced Server v.6.6 platform connected via DMVPN circuits (100 Mbps)	2013	LM	NA
1 - Network Server for reporting and data acquisition running Windows Server 2008 R2 with a 1.4 TB capacity, 1 - Application server running Windows Server 2008 R2	2012	LM	NA
Approximately 90+ HP (3015, 4000, 4014, 4050, 4200, 4250, 4300), Dell 1720dn, and Lexmark M5155 printers.	2010 - 2015	LM	NA
Approximately 220+ Dell/HP PC workstations running Windows XP/Windows 7 on LAN connected via 100BT/1GigE network	2010 - 2015	LM	NA

Microsoft Office 2013 Professional as the base office application suite for all PC workstations. Some systems using Microsoft Office 2003/2007/2010	1996 - 2014	LM	NA
E-mail via Exchange 2010 with webmail via Outlook Web Access. Microsoft Outlook 2013 is standard email client, with some using Outlook 2010	2011 - 2014	LM	NA
Facsimile Machines - Brother 4750e, Brother 2920, and Brother 1860	2005 - 2008	LM	NA
Copier/Scanners - BizHub 283, BizHub 600, BizHub 601 (2), BizHub 654, BizHUb754e (2), BizHub 951, BizHub 1050.	2005 - 2015	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS, & LabCoat reporting software systems.	1998 - 2014	LM	NA
Data processing terminals (79) - Enviroquant, Target, Saturn, MassHunter, Chromeleon	1996 - 2014	LM	NA

APPENDIX F – Containers, Preservation and Holding Times

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Bacterial Tests				
Coliform, Colilert (SM 9223)	W, DW	P, Bottle or Bag	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Coliform, Fecal and Total (SM 9221, 9222D)	W, S, DW	P,G	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Enterococci (Enterolert)	W	P	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	8 hours
Inorganic Tests				
Acidity (SM 2310B)	W	P,G	Cool, 4˚C	14 days[EPA]
Alkalinity (SM 2320B)	W, DW	P,G	Cool, 4˚C	14 days[EPA]
Ammonia (SM 4500 NH_3)	W, DW	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand(SM 5210B)	W	P,G	Cool, 4˚C	48 hours
Bromate (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4˚C	28 days
Bromide (EPA 300.1)	W, DW	P,G	None Required	28 days
Chemical Oxygen Demand (SM 5220C)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Chloride (EPA 300.0)	W, DW	P,G	None Required	28 days
Chloride (EPA 9056)	W, S	P,G	Cool, 4˚C	28 days
Chlorine, Total Residual (SM 4500 Cl F)	W, S	P,G	None Required	24 hours
Chlorite (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4˚C	14 days
Chlorophyll-A (SM 11200H)	W	G Amber	Cool, 4˚C	Analyze immediately
Chromium VI (EPA 7196A)	W	P,G	Cool, 4˚C	24 hours
Color (SM 2120B)	W, DW	P,G	Cool, 4˚C	48 hours
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500 CN E,G)	W, S, DW	P,G	Cool, 4˚C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable (SM 4500 CN I)	W, S	P,G	Cool, 4˚C, NaOH to pH >12	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Ferrous Iron (ALS SOP)	W, D	G Amber	Cool, 4˚C	24 hours
Fluoride (EPA 300.0, 9056, SM 4500 F-C)	W, S	P,G	Cool, 4˚C	28 days
Formaldehyde (ASTM D6303)	W	G Amber	Cool, 4˚C	48 hours
Hardness (SM 2340C)	W, DW	P,G	HNO_3 to pH<2	6 months
Hydrogen Ion (pH) (SM 4500H B)	W, DW	P,G	None Required	Analyze immediately
Kjeldahl and Organic Nitrogen (ASTM D3590-89)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Nitrate (EPA 300.0)	W, DW	P,G	Cool, 4˚C	48 hours
Nitrate (EPA 353.2)	W, S	P,G	Cool, 4˚C, H_2SO_4 to pH<2	48 hours
Nitrate (EPA 9056)	W, S	P,G	Cool, 4˚C	Analyze immediately
Nitrate-Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Nitrite (EPA 300.0)	W, DW	P,G	Cool, 4˚C	48 hours
Nitrite (EPA 353.2)	W, S	P,G	Cool, 4˚C, H_2SO_4 to pH<2	48 hours
Nitrite (EPA 9056)	W, S	P,G	Cool, 4˚C	Analyze immediately
Nitrocellulose	S	G	Cool, 4˚C	28 days
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon Lined Cap	Cool, 4˚C, H_2SO_4 or HCL to pH<2	28 days
Organic Carbon, Total (9060 & SM 5310 C)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (ASTM-D4129)	S	P,G	Cool, 4˚C	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon Lined Cap	Cool, 4˚C, HNO_3 to pH<2	6 months
Organic Halogens, Total (EPA 9020)	W	G, Teflon Lined Cap	Cool, 4˚C, H_2SO_4 to pH<2, No headspace	28 days
Orthophosphate (SM 4500 P-E)	W, DW	P,G	Cool, 4˚C	Analyze immediately
Oxygen, Dissolved (Probe) (SM 4500O G)	W, DW	G, Bottle and Top	None Required	Analyze immediately
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Perchlorate (EPA 314.0)	W, DW ,S	P,G	Protect from temp. extremes	28 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Phenolics, Total (EPA 420.1, 9056)	W, S	G Amber	Cool, 4˚C, H_2SO_4 to pH<4	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Residue, Filterable (TDS) (SM 2540C)	W	P,G	Cool, 4˚C	7 days
Residue, Nonfilterable (TSS) (SM 2540D)	W	P,G	Cool, 4˚C	7 days
Residue, Settleable (SM 2540F)	W	P,G	Cool, 4˚C	48 hours
Residue, Total (SM 2540B)	W	P,G	Cool, 4˚C	7 days
Residue, Volatile (EPA 160.4)	W	P,G	Cool, 4˚C	7 days
Silica (SM 4500 SiO2 C)	W	P Only	Cool, 4˚C	28 days
Specific Conductance (SM 2510 B)	W, DW	P,G	Cool, 4˚C	28 days
Sulfate (EPA 300.0)	W, DW	P,G	Cool, 4˚C	28 days
Sulfate (EPA 9056)	W, S	P,G	Cool, 4˚C	28 days
Sulfide (9030/934)	W, S	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S_2 D)	W	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S_2 F)	W	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfite (SM 4500 SO_3 B)	W	P,G	None Required	24 hours
Sullfides, Acid Voaltile	S	G	Cool, 4˚C	14 days
Surfactants (MBAS) (SM 5540 C)	W	P,G	Cool, 4˚C	48 hours
Tannin and Lignin (SM 5550B)	W	P,G	Cool, 4˚C	28 days
Turbidity (EPA 180.1)	W, DW	P,G	Cool, 4˚C	48 hours
Metals				
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4ºC	28 days
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4˚C	24 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Mercury (1631E)	W	F	Cool, 4˚C, HCl or H_2SO_4 to pH<2	90 days
Mercury (1631E)	S	F	Freeze < -15ºC	1 Yr
Mercury (7471)	S	P,G	Cool, 4˚C	28 days
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO_3 to pH<2	28 days
Metals (200.7, 200.8, 200.9, 6010, 6020)	W, DW	P,G	HNO_3 to pH<2	6 months
Metals (200.7, 200.8, 200.9, 6010, 6020)	S	G, Teflon Lined cap	Cool, 4˚C	6 months
Methyl Mercury 1630	W, S, T	F	HCL to pH<2	6 months
Volatile Organics				
Gasoline Range Organics (8015, NWTPH-Gx)	W	G, Teflon-Lined, Septum Cap	Cool, 4˚C, HCl to pH<2, No headspace	14 days
Gasoline Range Organics (8015, NWTPH-Gx)	S	G, Teflon- Lined Cap	Cool, 4ºC, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	No Residual Chlorine Present; HCl to pH<2, Cool, 4˚C, No Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	Residual Chlorine Present; 10% $Na_2S_2O_3$, HCl to pH<2, Cool, 4˚C	14 days
Purgeable Halocarbons (8260)	S	G, Teflon- Lined Cap	Cool, 4˚C, Minimize Headspace	14 days
Purgeable Halocarbons (8260)	S	Method 5035	Terracore/Encore device, Freeze at -20˚C Methanol, Cool, 4C	48 hrs to prepare from device, 14 days after preparing.
Purgeable Halocarbons (8260)	S	Method 5035	Sodium Bisulfate Cool, 4˚C	48 hrs to prepare, 14 days after preparation
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	No Residual Chlorine Present: HCl to pH<2, Cool, 4˚C, No Headspace	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	Residual Chlorine Present: 10% $Na_2S_2O_3$,, HCl to pH<2, Cool 4˚C	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	G, Teflon- Lined Cap	Cool, 4˚C, Minimize Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Encore, Freeze at -20˚C Methanol, Cool, 4C	48 hr to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Sodium Bisulfate, Cool, 4˚C	48 hr to prepare from Encore, 14 days after preparation
Acrolein, Acrylonitrile, Acetonitrile (624, 8260)	W	G, Teflon - Lined Septum Cap	Adjust pH to 4-5, Cool, 4˚C, No headspace	14 days
2-chloroethyl vinyl ether (8260)	W	G, Teflon - Lined Septum Cap	Cool, 4˚C, Minimize Headspace	7 days
Semivolatile Organics				
Nonyl Phenols	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4˚C	28 days
Organotins (CAS SOP)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction;40 days after extraction
Otto Fuel		G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction;40 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4˚C	30 days
HAPS – Condensates NCASI 99.01		G, Teflon-Lined Cap	Cool, 4˚C	14/30 days
HAPS – Impinger/Canisters NCASI 99.02			Cool, 4˚C	21 days
Perfluorinated Compounds HPLC/MS/MS	W	P	Cool, 4˚C	14 days until extraction; 40 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
PBDE/PBB – ROHS GC/MS	W, S, T	G	Cool, 4˚C	40 days after extraction
Pharma Personal Care Products 1694	W, S	Amber G, Teflon-Lined Cap	Cool, < 6˚C	7[f] days until extraction; 30 days after extraction
Nitroaromatics and Nitramines 8330B	W, S	G, Teflon-Lined Cap	Cool, 4˚C	S 14, W 7 days until extraction; 40 days after extraction
Nitroaromatics/Nitroamines HPLC/MS/MS	W, S, T	G	Cool, 4˚C Tissues < -10 C	S 14, W 7 days until extraction; 40 days after extraction
Organic acids HPLC/MS/MS	W	G, Teflon-Lined, Septum Cap	H_2SO_4 to pH<2, Cool, 4˚C	14 days
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics) (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction, 40 days after extraction
Alcohols and Glycols (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4˚C[g]	14[f] days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4˚C[g]	14[f] days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 8151)	W, S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4˚C[g]	30 days until extraction; 30 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W, S	G, Teflon-Lined Cap	Cool, 4˚C, Store in Dark[g]	7[f] days until extraction; 40 days after extraction
Organochlorine Pesticides and PCBs (EPA 608, 8081, 8082, GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction; 40 days after extraction
Organophosphorus Pesticides (EPA 8141, GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4˚C, Store in Dark[g]	7[f] days until extraction; 40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Drinking Water Organics				
Purgeable Organics (EPA 524.2)	DW	G, Teflon-Lined, Septum cap	Ascorbic Acid, HCl to pH≤2, Cool, 4˚C, No Headspace	14 days
EDB, DBCP, and TCP (EPA 504.1)	W	G, Teflon Lined Cap	Cool, 4˚C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/40 mL NaS; Cool , <6ºC	14 days until extraction; 21 days after extraction
Chlorinated Pesticides (EPA 508.1, 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool 4ºC	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$, Res.Cl.Cool 4ºC	7 days until extraction; 21 days after extraction
Endothall (EPA 548.1)	DW	G, Amber, Teflon-Lined Cap	Cool, 4˚C	7 days until extraction; 14 days after extraction
Haloacetic Acids (EPA 552.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH_4Cl, Cool, 4˚C	14 days until extraction; 7 days after extraction
Semivolatile Organics (EPA 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool, 4˚C	14 days until extraction; 30 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Nitrosoamines (EPA 521)	DW	G, Amber, Teflon-Lined Cap	Dechlorinate at collection[g]	14 days until extraction; 28 days after extraction
Selected Pesticides and Flame Retardants (EPA 527)	DW	G, Amber, Teflon-Lined Cap	See Method, Cool, 4˚C	14 days until extraction; 28 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)				
Semivolatile Organics (EPA 1311/8270)	HW	G, Teflon - Lined Cap	Sample: Cool, 4˚C, Store in dark[g]	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C, Store in dark[g]	7 days until extraction; 40 days after extraction
Organochlorine Pesticides (EPA 1311/8081)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C	7 days until extraction;40 days after extraction
Chlorinated Herbicides (EPA 1311/8151)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C	7 days until extraction;40 days after extraction
Mercury(EPA 1311/7470)	HW	P,G	Sample: Cool, 4°C	28 days until extraction
			TCLP extract: HNO_3 to pH<2	28 days after extraction
Metals, except Mercury (EPA 1311/6010)	HW	P,G	Sample: Cool, 4°C	180 days until extraction;
			TCLP extract: HNO_3 to pH<2	14 days until TCLP extraction
Volatile Organics (EPA 1311/8260)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C , Minimize Headspace	14 days until TCLP extraction
			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

a For EPA SW-846 methods the method listed generically, without specific revision suffixes
b DW = Drinking Water, W = Water; S = Soil or Sediment; HW = Hazardous Waste
c P = Polyethylene; G = Glass, F- Fluoropolymer
d For chlorinated water samples
e The maximum holding time dependent upon the geographical proximity of sample source to the lab.
f Fourteen days until extraction for soil, sediment, and sludge samples.
g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.

APPENDIX G – Standard Operating Procedures

Corporate General and Quality Assurance SOPs

SOP TITLE	SOP ID	Revision
Laboratory Ethics and Data Integrity	CE-GEN001	2.00
(proprietary– client specific)	CE-GEN002	1.00
Records Management Policy	CE-GEN003	1.00
Preventive Action	CE-GEN004	1.00
Document Control	CE-GEN005	1.00
Data Recall	CE-GEN006	0.00
Procurement and Control of Laboratory Services and Supplies	CE-GEN007	0.00
Method Development	CE-GEN008	0.00
Establishing Standard Operating Procedures	CE-GEN009	0.00
Handling Customer Feedback	CE-GEN010	0.00
Assigning and TSR to a Project	CE-GEN011	0.00
Policy for the Use of Accreditation Organization Names, Symbols, and Logos	CE-GEN012	0.00
(proprietary – client specific)	CE-GEN013	0.00
(proprietary– client specific)	CE-GEN014	0.00
Internal Audits	CE-QA001	1.00
Manual Integration Policy	CE-QA002	1.00
Training Policy	CE-QA003	1.00
Qualification of Subcontract Laboratories	CE-QA004	2.00
Laboratory Management Review	CE-QA005	1.00
Proficiency Testing Sample Analysis	CE-QA006	1.00
Making Entries onto Analytical Records	CE-QA007	1.00
Nonconformance and Corrective Action	CE-QA008	1.00
Control Limits	CE-QA009	1.00
Estimation of Uncertainty of Analytical Measurements	CE-QA010	0.00
Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation	CE-QA011	0.00
Quality of Reagents and Standards	CE-QA012	0.00

LABORATORY SOPs

SOP TITLE	SOP ID	Revision
DATA ARCHIVING	ADM-ARCH	6
DOCUMENTING LABORATORY BALANCE AND TEMPERATURE CHECKS	ADM-BAL	6
SAMPLE BATCHES	ADM-BATCH	10
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT	3
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD	6
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT – QSM 5.0	ADM-DOD5	0
LABORATORY DATA REVIEW PROCESS	ADM-DREV	8
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP	3
METHOD VALIDATION DOCUMENTATION	ADM-MDLC	4
MANUAL INTEGRATION OF CHROMATOGRAPHIC PEAKS	ADM-MI	0
PROJECT MANAGEMENT	ADM-PCM	12
DATA REPORTING AND REPORT GENERATION	ADM-RG	9
REAGENT AND STANDARDS LOGIN AND TRACKING	ADM-RLT	5
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC	13
SOFTWARE QUALITY ASSURANCE AND DATA SECURITY	ADM-SWQADATA	0
ALS KELSO TRAINING PROCEDURE	ADM-TRAIN	2
CHECKING VOLUMETRIC LABWARE	ADM-VOLWARE	4
SOP FOR WISCONSIN PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT, WI ADMINISTRATIVE CODE, CHAPTER NR 149	ADM-WISC	1
COLIFORM, FECAL	BIO-9221FC	9
COLIFORM, TOTAL	BIO-9221TC	6
COLIFORM, TOTAL (MEMBRANE FILTER PROCEDURE)	BIO-9222B	0
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D	4
COLILERT® , COLILERT-18®, & COLISURE®	BIO-9223	9
ENTEROLERT	BIO-ENT	2
HEPTEROTROPHIC PLATE COUNT	BIO-HPC	7
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC	16
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN	3

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510	11
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520	16
SOLID PHASE EXTRACTION	EXT-3535	6
SOXHLET EXTRACTION	EXT-3540	11
AUTOMATED SOXHLET EXTRACTION	EXT-3541	10
ULTRASONIC EXTRACTION	EXT-3550	10
WASTE DILUTION EXTRACTION	EXT-3580	6
SILICA GEL CLEANUP	EXT-3630	5
GEL PERMEATION CHROMATOGRAPHY	EXT-3640A	8
REMOVAL OF SULFUR USING COPPER	EXT-3660	7
REMOVAL OF SULFUR USING MERCURY	EXT-3660M	3
SULFURIC ACID CLEANUP	EXT-3665	6
CARBON CLEANUP	EXT-CARCU	4
DIAZOMETHANE PREPARATION	EXT-DIAZ	6
FLORISIL CLEANUP	EXT-FLOR	6
ORGANIC EXTRACTIONS GLASSWARE CLEANING	EXT-GC	7
PERCENT LIPIDS IN TISSUE	EXT-LIPID	5
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER, AND TISSUE	EXT-OSWT	8
PREPARATION OF REAGENTS AND BLANK MATRICES USED IN SEMIVOLATILE ORGANICS ANALYSIS	EXT-REAG	3
ADDITION OF SPIKES AND SURROGATES	EXT-SAS	10
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL	3
FACILITY AND LABORATORY CLEANING	FAC-CLEAN	2
OPERATION AND MAINTENANCE OF LABORATORY REAGENT WATER SYSTEMS	FAC-WATER	2
FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020	7
COLOR	GEN-110.2	7
TOTAL SOLIDS	GEN-160.3	14
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4	7
SETTEABLE SOLIDS	GEN-160.5	5
HALIDES, ADSORBABLE ORGANIC (AOX)	GEN-1650	4

GRAVIMETRIC DETERMINATION OF HEXANE EXTRACTABLE MATERIAL (1664)	GEN-1664	9
ALKALINITY TOTAL	GEN-2320	9
HARDNESS, TOTAL	GEN-2340	8
DETERMINATION OF INORGANIC ANIONS IN DRINKING WATER BY ION CHROMATOGRAPHY	GEN-300.1	8
ACIDITY	GEN-305.2	4
PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314.0	14
CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3	5
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330.4	3
TOTAL RESIDUAL CHLORINE - METHOD 330.5	GEN-330.5	2
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1	10
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2	9
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3	12
PHENOLICS, TOTAL	GEN-420.1	15
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-4500 NH3 E	7
DISSOLVED SILICA	GEN-4500 SIO2C	3
SILICA DETERMINATION USING SMARTCHEM METHOD	GEN-4500 SiO2E	2
NITRITE BY COLORIMETRIC PROCEDURE	GEN-4500NO2 B	3
ORTHOPHOSPHATE DETERMINATION USING COLORIMETRIC PROCEDURE	GEN-4500-P-E	2
SULFIDE, METHYLENE BLUE	GEN-4500S2D	3
SULFIDE, TITRIMETRIC (IODINE)	GEN-4500S2F	3
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050	3
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B	6
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B	3
AQUATIC HUMIC SUBSTANCES	GEN-5510B	1
DETERMINATION OF METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)	GEN-5540C	7
TANNIN AND LIGNIN	GEN-5550	6
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020	9
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M	4
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030	10

TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076	2
TOTAL CARBON IN SOIL	GEN-ASTM	9
AUTOFLUFF	GEN-AUTOFLU	2
SULFIDES, ACIDS VOLATILE	GEN-AVS	7
HEAT OF COMBUSTION	GEN-BTU	5
CHLOROPHYLL-a BY COLORIMETRY	GEN-CHLOR	3
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-CN	19
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD	2
CHEMICAL OXYGEN DEMAND	GEN-COD	9
CONDUCTIVITY IN WATER AND WASTES	GEN-COND	10
CORROSIVITY TOWARDS STEEL	GEN-CORR	2
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6	12
STANDARD TEST METHODS FOR DETERMINING SEDIMENT CONCENTRATION IN WATER SAMPLES	GEN-D3977	0
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M	1
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2	3
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109	1
FDA EXTRACTABLES	GEN-FDAEX	2
FERROUS IRON IN WATER	GEN-FeII	4
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE	9
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM	3
HYDROGEN PEROXIDE BY PERMANGANATE TITRATION	GEN-H2O2	2
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26	3
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD	2
TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS	2
ION CHROMATOGRAPHY	GEN-IONC	17
COLOR, NCASI	GEN-NCAS	3
NITROCELLULOSE IN SOIL	GEN-NCEL	1
OXYGEN CONSUMPTION RATE	GEN-O2RATE	1
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU	3

Ph IN SOIL AND SOLIDS	GEN-Phs	13
Ph IN WATER	GEN-Phw	13
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM	2
PARTICLE SIZE DETERMINATION	GEN-PSP	8
SULFIDES, REACTIVE	GEN-RS	5
TOTAL SULFIDE BY PSEP	GEN-S2PS	2
SULFITE	GEN-SO3	3
SPECIFIC GRAVITY	GEN-SPGRAV	1
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS	6
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-TDS	11
THIOCYANATE	GEN-THIOCN	2
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN	14
TOTAL NITROGEN AND TOTAL PHOSPHORUS BY ALKALINE PERSULFATE DIGESTION NCASI METHOD TNTP-W10900	GEN-TNTP	1
TOTAL ORGANIC CARBON IN WATER	GEN-TOC	14
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-TSS	11
TURBIDITY MEASUREMENT	GEN-TURB	6
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH	4
PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS BY HPLC/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-1694	5
DETERMINATION OF SELECTED PERFLUORINATED ALKYL ACIDS IN DRINKING WATER BY SOLID PHASE EXTRACTION AND TANDEM (LC/MS/MS)	LCP-537	2
DETERMINATION OF HORMONES IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY ELECTROSPRAY IONIZATION	LCP-539	2
PERCHLORATE IN WATER, SOILS, AND SOLID WASTE USING LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MS/MS)	LCP-6850	0
ALDEHYDES BY HPLC	LCP-8315	7
Quantitative Determination of Carbamate Pesticides in Solid Matrices by High Performance Liquid Chromatography/Tandam Mass Spectrometry (HPLC/MS/MS)	LCP-8321(S)	1
Determination of Carbamates in Water by EPA 8321 Using LC Tandem Mass Spectrometry	LCP-8321W	2
NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY(HPLC)	LCP-8330B	4
Acrylamide by High Performance Liquid Chromatography/tandem mass spectrometry (HPLC/ms/ms)..	LCP-ACRYL	2
Dioctyl sulfosuccinate by High Performance Liquid Chromatography/tandem mass spectrometry (HPLC/ms/ms)..	LCP-DOS	5
QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-	LCP-LCMS4	2
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	LCP-NITG	7

QUANTITATION OF NITROPHENOLS IN SOILS BY LIQUID CHROMATOGRAPHYAND TANDEM MASS SPECTROMETRY (LC-MS/MS)	LCP-NITRO	3
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	LCP-OALC	5
QUANTITATIVE DETERMINATION OF OPTICAL BRIGHTENER 220 By High Performance Liquid Chromatography (HPLC)	LCP-OPBr	1
OXYANIONS IN WATER USING LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MS/MS)	LCP-OXY	0
PERFLUORINATED COMPOUNDS BY HPLC/MS/MS	LCP-PFC	4
DETERMINATION OF PHTHALATES IN FOOD BY LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MSMS)	LCP-PHT	1
PICRIC ACID AND PICRAMIC ACID BY HPLC	LCP-PICRIC	3
METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S	3
METHYL MERCURY IN TISSUE BY ALCOHOLIC POTASSIUM HYDROXIDE DIGESTION, ETHYLATION, PURGE AND TRAP, AND COLD VAPOR ATOMIC FLUORESCENCE	MET-1630T	2
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W	3
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631	13
DETERMINATION OF ARSENIC SPECIES BY HYDRIDE GENERATION CRYOGENIC TRAPPING GAS CHROMATOGRAPHY ATOMIC ABSORPTION SPECTROPHOTOMETRY	MET-1632	3
MERCURY IN WATER	MET-245.1	14
METALS DIGESTION	MET-3010A	12
METALS DIGESTION	MET-3020A	15
METALS DIGESTION	MET-3050B	14
CLOSED VESSEL OIL DIGESTION	MET-3051M	3
CLOSED VESSEL DIGESTION OF SILICEOUS AND ORGANICALLY BASED MATRICIES	MET-3052M	1
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 6020)	MET-6020	16
ARSENIC BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7062	4
METALS DIGESTION FOR HEXAVALENT CHROMIUM	MET-7195	9
MERCURY IN LIQUID WASTE	MET-7470A	16
MERCURY IN SOLID OR SEMISOLID WASTE	MET-7471	17
SELENIUM BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7742	4
BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE	MET-BIOACC	1
METALS DIGESTION OF AQUEOUS SAMPLES	MET-DIG	15
SAMPLE FILTRATION FOR METALS ANALYSIS	MET-FILT	4
METALS LABORATORY GLASSWARE CLEANING	MET-GC	5
DETERMINATION OF TRACE METALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAA)	MET-GFAA	21

DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP/AES	MET-ICP	25
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICPMS	16
TRACE METALS IN WATER BY PRECONCENTRATION USING REDUCTIVE PRECIPITATION FOLLOWED BY ICP-MS	MET-RPMS	7
METALS AND SEMIVOLATILES SPLP EXTRACTION (EPA METHOD 1312)	MET-SPLP	1
WASTE EXTRACTION TEST (WET) PROCEDURE (STLC) for NONVOLATILE and SEMIVOLATILE PARAMETERS	MET-STLC	2
METALS AND SEMIVOLATILES TCLP EXTRACTION (EPA METHOD 1311)	MET-TCLP	9
SAMPLE PREPARATION OF BIOLOGICAL TISSUES FOR METALS ANALYSIS BY GFAA, ICP-OES, AND ICP-MS	MET-TDIG	4
TISSUE SAMPLE PREPARATION	MET-TISP	9
ANALYSIS OF WATER AND SOLID SAMPLES FOR ALIPHATIC HYDROCARBONS	PET-ALIPHAT	2
GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO	10
ANALYSIS OF WATER, SOLIDS AND SOLUBLE WASTE SAMPLES FOR SEMI-VOLATILE FUEL HYDROCARBONS	PET-SVF	14
ANALYSIS OF WATER AND SOLIDS SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS	PET-TPH	2
ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO	5
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD	16
SAMPLE DISPOSAL	SMO-DISP	12
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT	11
SAMPLE RECEIVING	SMO-GEN	31
SAMPLE TRACKING AND INTERNAL CHAIN OF CUSTODY	SMO-SCOC	15
ORGANOCHLORINE PESTICIDES AND PCBs (METHOD 608)	SOC-608	8
1,2-DIBROMOETHANE (EDB) AND 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP) IN AQUEOUS SAMPLES BY MICROEXTRACTION AND GAS CHROMATOGRAPHY	SOC-8011	0
1,2-DIBROMOETHANE (EDB) AND 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP) IN SOLIDS BY MICROEXTRACTION AND GAS CHROMATOGRAPHY	SOC-8011S	0
GLYCOLS	SOC-8015	11
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081	18
PCBS AS AROCLORS	SOC-8082Ar	16
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD	SOC-8082Co	13
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141	13
CHLORINATED HERBICIDES	SOC-8151	16
CHLORINATED PHENOLS METHOD 8151 MODIFIED	SOC-8151M	11
METHANOL IN PROCESS LIQUIDS AND STATIONARY SOURCE EMISSIONS	SOC-9403	8

HAZARDOUS AIR POLLUTANTS (HAPS) IN PULP AND PAPER INDUSTRY CONDENSATES	SOC-9901	5
HAPS AND OTHER COMPOUNDS IN IMPINGER/CANISTER SAMPLES FROM WOOD PRODUCTS FACILITIES	SOC-9902	4
ALCOHOLS	SOC-ALC	2
BUTYLTINS	SOC-BUTYL	13
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL	9
CONFIRMATION PROCEDURE FOR GC AND HPLC ANALYSES	SOC-CONF	6
DETERMINATION OF OTTO FUEL II IN WATER	SOC-OTTO	2
PREPARATION OF POLYETHYLENE (PE) PASSIVE SAMPLERS WITH PERFORMANCE REFERENCE COMPOUNDS (PRC) LOADING	SOC-PE/PRC	0
SEMI-VOLATILE ORGANICS SCREENING	SOC-SCR	5
1,2-DIBROMOETHANE, 1,2-DIBROMO-3-CHLOROPROPANE, AND 1,2,3-TCP BY GC	SVD-504	10
ORGANOCHLORINE PESTICIDES AND PCBS IN DRINKING WATER	SVD-508_1	8
CHLORINATED HEBICIDES IN DRINKING WATER	SVD-515.4	10
N-NITROSAMINES BY GC/MS/MS	SVD-521	6
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (METHOD 525.2)	SVD-525	9
ENDOTHALL IN DRINKING WATER BY GC/MS	SVD-548	10
DIQUAT AND PARAQUAT BY HPLC	SVD-549	8
HALOACETIC ACIDS IN DRINKING WATER	SVD-552	8
CHLORINATED PHENOLICS BY IN-SITU ACETYLATION AND GC/MS	SVM-1653A	10
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-625	8
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - METHOD 8270D	SVM-8270D	4
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SVM-8270L	9
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P	9
Quantifying and Reporting Alkylated Homologs of Polycyclic Aromatic Hydrocarbons for Gulf Oil Spill Analyses	SVM-8270PQAH	0
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S	7
QUANTITATIVE GEOCHEMICAL BIOMARKERS BY GC/MS SELECTIVE ION MONITORING	SVM-BIO	1
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN AQUEOUS SAMPLES BY GC/MS	SVM-D4AQ	0
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN SEDIMENTS AND BIOSOLIDS BY GC/MS	SVM-D4SO	0
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN BIOLOGICAL MATRICES BY GC/MS	SVM-D4TI	0
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SVM-NONYL	5

ORGANOPHOSPHOROUS PESTICIDES BY GC/MS/MS	SVM-OPPMS2	2
CHLORINATED PESTICIDES BY GC/MS/MS	SVM-PESTMS2	4
POLYBROMINATED DIPHENYL ETHERS (PBDEs) AND POLYBROMINATED BIPHENYLS (PBBs) BY GC/MS	SVM-ROHS	2
DIMP	SVM-SIM	0
1,2,3-TRICHLOROPROPANE BY ISOTOPE DILUTION-GC/MS SIM	SVM-TCP	0
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030	9
PURGE AND TRAP/EXTRACTION FOR VOC IN SOIL AND WASTE SAMPLES , CLOSED SYSTEM	VOC-5035	10
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-524.2	16
VOLATILE ORGANIC COMPOUNDS IN WATER BY GC/MS SIM	VOC-524.2SIM	0
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-624	13
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260	18
VOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTIVE ION MONITORING	VOC-8260S	3
VOA STORAGE BLANKS	VOC-BLAN	10
SAMPLE SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL, WATER AND MISC. MATRICES	VOC-BVOC	8
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	VOC-ZHE	8

APPENDIX H – Data Qualifiers

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

APPENDIX I – Controlled and Normative Documents

Internal QA Documents	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
ALS-Kelso Certifications/Accreditations	Cert_kel.xls (QA Dept.)
MDL/LOD/LOQ Tracking Spreadsheet	MDL_LIST.(*date*).xls
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR Department
Personnel Job Descriptions	HR Department
ALS – Kelso Data Quality Objectives	Kelso DQO 20XX.rX.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedures and Spreadsheet	1_ Kelso SOP.xls
Proficiency Testing Schedule and Tracking Spreadsheet	PT_Schedule.xls
External Normative Documents	**Location**
USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Edition, EPA 815-B-97-001 (January 2005	QA Department
USEPA 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and EPA Method Update Rule 2007 and 2012.	QA Department and online access
USEPA 40 CFR Part 141, National Primary Drinking Water Regulations and EPA Method Update Rule 2007.	QA Department and online access
National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.	QA Department
TNI: TNI Standard – Environmental Laboratory Sector, Volume 1, Management and Technical Requirements for Laboratories Performing Environmental Analysis, EL-V1-2009.	QA Department
Quality Standards. American National Standard General requirements for the competence of testing and calibration laboratories, ANSI/ISO/IEC 17025:2005(E)	QA Department
DoD Quality Systems Manual for Environmental Laboratories, Versions 4.2 and 5.0	QA Department and online access
Analytical Methods (see References section)	Laboratory Departments and Online access

APPENDIX J – Laboratory Accreditations

The list of accreditations, certifications, licenses, and permits existing at the time of this QA Manual revision is given below, followed by the entire primary NELAP and DOD ELAP accreditations (un-numbered attachments). Current accreditation information is available at any time by contacting the laboratory or viewing the ALS Global website www.alsglobal.com.

Program	Number
National Programs	
DoD ELAP	L14-51-R2
ISO 17025	L14-50
State Programs	
Alaska DEC UST	UST-040
Arizona DHS	AZ0339
Arkansas - DEQ	88-0637
California DHS	2795
Florida DOH	E87412
Hawaii DOH	-
Louisiana DEQ	3016
Maine DHS	WA01276
Michigan DEQ	9949
Minnesota DOH	053-999-457
Montana DPHHS	CERT0047
Nevada DEP	WA012762015-3
New Jersey DEP	WA005
North Carolina DWQ	605
Oklahoma DEQ	9801
Oregon - DOH (primary NELAP)	WA100010
South Carolina DHEC	61002
Texas CEQ	T104704427-14-7
Utah	WA012762015-4
Washington DOE	C544
Wisconsin DNR	998386840
Wyoming (EPA Region8)	-
Miscellaneous	
Foreign Soil Permit	USDA
Plant Import Permit	USDA
Controlled Substances Permit	US DEA
Controlled Substances Permit	WA DOH

Oregon

Environmental Laboratory Accreditation Program

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

NELAP Recognized

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

As of 02/11/2015 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

MATRIX : Biological Tissue

Reference	Code	Description
ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

CAS SOC-Butyl	**60035009**	**Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1631E	**10237204**	**Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A	**10123407**	**Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
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EPA 3541 **10140406** **Automated Soxhlet Extraction**

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 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1908	Total Phosphate

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 5035A **10284807** **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
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1175	Tin
1185	Vanadium
1190	Zinc

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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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
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
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 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1140	Selenium

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
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin

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Analyte Code	*Analyte*
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)

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

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
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)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
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)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
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)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
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)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)
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)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)

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Analyte Code	*Analyte*
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
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)
9105	Decachlorobiphenyl (BZ-209)

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

Analyte Code	*Analyte*
5660	4-Bromophenyl phenyl ether (BDE-3)
5562	Azobenzene
5570	Benzaldehyde
5640	Biphenyl
6545	n-Nitrosodi-n-propylamine

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6380	1-Methylnaphthalene
9501	1-Methylphenanthrene
6852	2,3,5-Trimethylnaphthalene
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)
6188	2,6-Dimethylnaphthalene
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
6412	3 & 4 Methylphenol
5660	4-Bromophenyl phenyl ether (BDE-3)

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Analyte Code	*Analyte*
5700	4-Chloro-3-methylphenol
5825	4-Chlorophenyl phenylether
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6665	Pyrene

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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Kelso WA 98626

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Analyte Code	*Analyte*
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

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MATRIX : Drinking Water

Reference	Code	Description
EPA 180.1	**10011402**	**Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4	**10013806**	**ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4	**10014605**	**Metals by ICP-MS**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1055	Copper
1075	Lead
1090	Manganese
1105	Nickel
1140	Selenium
1150	Silver
1165	Thallium

EPA 245.1 3	**10036609**	**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*
1575	Chloride
1730	Fluoride

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Analyte Code	*Analyte*
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
2000	Sulfate

EPA 300.1 **10053608** **Ion chromatography - anions.**

Analyte Code	*Analyte*
1535	Bromate
1540	Bromide
1570	Chlorate
1595	Chlorite

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1645	Total cyanide

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

Analyte Code	*Analyte*
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 504.1 **10082607** **EDB/DBCP/TCP micro-extraction, GC/ECD**

Analyte Code	*Analyte*
5180	1,2,3-Trichloropropane
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)

EPA 508.1 2 **10086405** **Chlorinated Pesticides, Herbicides, and Organohalides, liquid/solid extraction by GC/ECD**

Analyte Code	*Analyte*
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.)
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

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Analyte Code	*Analyte*
7810	Methoxychlor
8870	PCBs
8250	Toxaphene (Chlorinated camphene)

EPA 515.4 1 **10088503** **Chlorinated acids Liquid/Solid and GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8600	3,5-Dichlorobenzoic acid
6500	4-Nitrophenol
8505	Acifluorfen
8530	Bentazon
8540	Chloramben
8555	Dalapon
8570	DCPA di acid degradate
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
6605	Pentachlorophenol
8645	Picloram
8650	Silvex (2,4,5-TP)

EPA 524.2 4.1 **10088809** **Volatile Organic Compounds GC/MS Capillary Column**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
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)
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
4535	2-Chlorotoluene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

ALS Environmental, Kelso

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Kelso WA 98626

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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
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
5205	Total trihalomethanes
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 525.2 2 **10090003** **Semi-Volatile by SPE extraction and GC/MS**

Analyte Code	*Analyte*
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
4310	Acetochlor
7005	Alachlor
7065	Atrazine
5580	Benzo(a)pyrene
6062	bis(2-Ethylhexyl)adipate
7160	Butachlor
5670	Butyl benzyl phthalate
8550	Dacthal (DCPA)
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7555	EPTC (Eptam, s-ethyl-dipropyl thio carbamate)
6275	Hexachlorobenzene
6285	Hexachlorocyclopentadiene
6320	Isophorone
7835	Metolachlor
7845	Metribuzin
7875	Molinate
8045	Propachlor (Ramrod)
8125	Simazine
8180	Terbacil

ORELAP Fields of Accreditation

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EPA 548.1 1 **10092805** **Endothall by Ion Exchange, Methylation and GC/MS**

Analyte Code	*Analyte*
7525	Endothall

EPA 549.2 **10093206** **Diquat/Paraquat, Liquid/Solid Extraction and HPLC/UV**

Analyte Code	*Analyte*
9390	Diquat
9528	Paraquat

EPA 552.2 1 **10095804** **Haloacetic Acid/Dalapon, Liquid/Liquid Extraction, Derivitization and GC/ECD**

Analyte Code	*Analyte*
9312	Bromoacetic acid
9315	Bromochloroacetic acid
9336	Chloroacetic acid
9357	Dibromoacetic acid
9360	Dichloroacetic acid
9414	Total haloacetic acids
9642	Trichloroacetic acid

SM 2120 B 20th ED **20224004** **Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2320 B 20th ED **20045209** **Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED **20046202** **Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2510 B 20th ED **20048208** **Conductivity by Probe**

Analyte Code	*Analyte*
1610	Conductivity

SM 2540 C 20th ED **20050004** **Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 4500-Cl F 20th ED **20080506** **Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-F¯ C 20th ED **20102005** **Fluoride by Ion Selective Electrode**

Analyte Code	*Analyte*
1730	Fluoride

SM 4500-H+ B 20th ED **20104807** **pH by Probe**

Analyte Code	*Analyte*

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Analyte Code	*Analyte*
1900	pH

SM 4500-P E 20th ED **20123802** **Phosphorus by Ascorbic Acid Reduction**

Analyte Code	*Analyte*
1870	Orthophosphate as P

SM 5310 C 20th ED **20138403** **Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

SM 9215 B (PCA) 20th ED **20181208** **Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9223 B (Colilert-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert®) 20th ED **20212208** **Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 20th ED **20214204** **Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 21st ED **20214408** **Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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MATRIX : Non-Potable Water

Reference	Code	Description
ALS Kelso LCP-Acryl 1	**60001712**	**ALS Kelso - Acrylamide by HPLC/MS/MS**

Analyte Code	*Analyte*
4330	Acrylamide

ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

ASTM D1426-08B	**30007397**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D1426-98B	**30023406**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D3590-02(06)A	**30016819**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D3590-89B	**30016809**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

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)

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Kelso WA 98626

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Analyte Code	*Analyte*
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7300	Chlorpyrifos
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
7725	Isodrin
7810	Methoxychlor
7870	Mirex
5553	Octachlorostyrene
3890	Oxychlordane
7910	trans-Nanochlor

CAS SOC-Butyl **60035009** **Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

Enterolert® **60030208** **Chromogenic/Fluorogenic Quantitative (Enterolert®): Enterococci**

Analyte Code	*Analyte*
2520	Enterococci

EPA 1020A **10117007** **Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

EPA 160.4 **10256801** **Total Volatile Solids, ignition @ 550 C.**

Analyte Code	*Analyte*
4075	Vol. residue, density, water & solids content of coatings

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A **10123407** **Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*

ORELAP Fields of Accreditation

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EPA CODE: WA01276
Certificate: WA100010 - 010

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Kelso WA 98626

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Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 1650C **10125005** **Adsorbable Organic Halides by Adsorption and Coulometric Titration**

Analyte Code	*Analyte*
4345	Adsorbable organic halogens (AOX)

EPA 1653A **10125403** **Chlorinated Phenolics by "In Situ" Acetylation and GC/MS**

Analyte Code	*Analyte*
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6805	3,4,5-Trichlorocatechol
6815	3,4,5-Trichloroguaiacol
6810	3,4,6-Trichlorocatechol
6820	3,4,6-Trichloroguaiacol
6825	4,5,6-Trichloroguaiacol
6605	Pentachlorophenol
6720	Tetrachlorocatechol
6725	Tetrachloroguaiacol
6875	Trichlorosyringol

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)
1860	Oil & Grease

EPA 1694 1.0 **10132908** **Pharmaceuticals and Personal Care Products by HPLC/MS/MS**

Analyte Code	*Analyte*
6769	17a-estradiol
6771	17a-ethynylestradiol
6773	17ß-estradiol
4307	Acetominophen
7052	Androstenedione
7065	Atrazine
9301	Bisphenol A
5675	Caffeine
7194	Carbamazepine
7375	DEET
7086	Diazepam
7087	Diclofenac
6075	Diethylstilbestrol
7253	Estriol
7254	Estrone
7257	Fluoxetine
7258	Gemfibrozil
7219	Hydrocodone
7259	Ibuprofen
7719	Iopromide
7313	Meprobamate
7316	Methadone
7269	Naproxen
7317	Oxybenzone
7318	Pentoxifylline

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Analyte Code	*Analyte*
7284	Progesterone
9585	Salicylic acid
7297	Sulfamethoxazole
7301	Testosterone
7304	Triclosan
7307	Trimethoprim

EPA 180.1 **10011402** **Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4 **10013806** **ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1160	Strontium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4 **10014605** **Metals by ICP-MS**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel

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Analyte Code	*Analyte*
1140	Selenium
1150	Silver
1165	Thallium
3035	Uranium
1185	Vanadium
1190	Zinc

EPA 200.9 2.2 **10015404** **Metals by Graphite Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 245.1 3 **10036609** **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
1820	Nitrate-nitrite
1840	Nitrite as N
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*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 330.4 **10059004** **Residual Chlorine - DPD-FAS Titration**

Analyte Code	*Analyte*
1940	Total residual chlorine

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*

ALS Environmental, Kelso

1317 South 13th Ave.
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Analyte Code	*Analyte*
1645	Total cyanide

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
1825	Total nitrate+nitrite

EPA 3535A **10139409** **Solid-Phase Extraction (SPE)**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3610B **10144602** **Alumina Cleanup**

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 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1908	Total Phosphate

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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EPA 420.1 **10079206** **Phenolics - Spectrophotometric, manual.**

Analyte Code	*Analyte*
1905	Total phenolics

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
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
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
1165	Thallium
3035	Uranium
1185	Vanadium
1190	Zinc

EPA 608 **10103603** **Organochlorine Pesticides & PCBs by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
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)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor
8250	Toxaphene (Chlorinated camphene)

EPA 624 **10107207** **Volatile Organic Compounds by purge and trap GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4500	2-Chloroethyl vinyl ether
4995	4-Methyl-2-pentanone (MIBK)
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
4680	cis-1,3-Dichloropropene
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 625 **10300002** **Base/Neutrals and Acids by GC/MS**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
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)
6490	2-Nitrophenol
5945	3,3'-Dichlorobenzidine
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol
5825	4-Chlorophenyl phenylether
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	Analyte
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
6665	Pyrene

EPA 6850 **10304606** **Perchlorate in Water, Soils and Solid Wastes Using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry**

Analyte Code	Analyte
1895	Perchlorate

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic

EPA 7195 **10162002** **Chromium, Hexavalent (Coprecipitation) by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1045	Chromium VI

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 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1140	Selenium

EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	Analyte
9369	Diesel range organics (DRO)
4785	Ethylene glycol

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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

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
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
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
4840	Hexachloroethane
7725	Isodrin
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*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
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)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
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)

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
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)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
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)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)
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)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9217	2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
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)
8920	2,3-Dichlorobiphenyl (BZ-5)
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)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
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)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	*Analyte*
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o

ALS Environmental, Kelso

1317 South 13th Ave.
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Analyte Code	*Analyte*
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
7475	Dimethoate
8625	Disulfoton
7550	EPN
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

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
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
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
5167	1,1,2-Trichlorofluoroethane
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
6800	1,3,5-Trichlorobenzene
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane

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1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4355	Allyl chloride (3-Chloropropene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)

ALS Environmental, Kelso

1317 South 13th Ave.
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Analyte Code	*Analyte*
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
5260	Xylene (total)

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
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5660	4-Bromophenyl phenyl ether (BDE-3)
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol

ORELAP Fields of Accreditation

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
6125	a-a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5562	Azobenzene
5570	Benzaldehyde
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
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
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine

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Analyte Code	*Analyte*
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
9501	1-Methylphenanthrene
6852	2,3,5-Trimethylnaphthalene
6188	2,6-Dimethylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5640	Biphenyl
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5910	Dibenzothiophene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6665	Pyrene

EPA 8315A **10188008** **Determination of Carbonyl Compounds by HPLC/UV-VIS**

Analyte Code	*Analyte*
4815	Formaldehyde

EPA 8321B **10189205** **Solvent Extractable non-volatile compounds by HPLC/TS/MS**

Analyte Code	*Analyte*

ORELAP Fields of Accreditation

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1317 South 13th Ave.
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Analyte Code	*Analyte*
7010	Aldicarb (Temik)
7040	Aminocarb
7080	Barban
7130	Bromacil
7195	Carbaryl (Sevin)
7205	Carbofuran (Furaden)
7275	Chloropropham
7505	Diuron
7610	Fenuron
7630	Fluometuron
7765	Linuron (Lorox)
7800	Methiocarb (Mesurol)
7805	Methomyl (Lannate)
7855	Mexacarbate
7885	Monuron
7915	Neburon
7940	Oxamyl
8075	Propham
8080	Propoxur (Baygon)
8120	Siduron

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	*Analyte*
1510	Amenable cyanide
1645	Total cyanide

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	*Analyte*
2045	Total organic halides (TOX)

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

Analyte Code	*Analyte*
1900	pH

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1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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

Analyte Code	*Analyte*
2040	Total organic carbon

NCASI 94.03 0	**60031507**	**Methanol in Process Liquids and Wastewaters**

Analyte Code	*Analyte*
4930	Methanol

NCASI 99.01	**60002804**	**Selected HAPS in Condensates by GC/FID**

Analyte Code	*Analyte*
4930	Methanol

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

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
9506	Residual Range Organics (RRO)

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 20th ED	**20224004**	**Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2310 B 20th ED	**20044206**	**Acidity by Titration**

Analyte Code	*Analyte*
1500	Acidity, as CaCO3

SM 2320 B 20th ED	**20045209**	**Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED	**20046202**	**Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2340 C 20th ED	**20047205**	**Hardness by EDTA Titration**

Analyte Code	*Analyte*
1750	Hardness

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

Analyte Code	*Analyte*
1610	Conductivity

ORELAP Fields of Accreditation

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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SM 2540 B 20th ED	**20049007**	**Total Solids**

Analyte Code	*Analyte*
1950	Residue-total

SM 2540 C 20th ED	**20050004**	**Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 2540 D 20th ED	**20050800**	**Total Suspended Solids**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 D-2011	**20051212**	**Total Suspended Solids Dried at 103 - 105 C**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

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

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 F 20th ED	**20051803**	**Settleable Solids**

Analyte Code	*Analyte*
1965	Residue-settleable

SM 4500-Cl C 20th ED	**20078802**	**Chlorine by Iodometric Method II**

Analyte Code	*Analyte*
1575	Chloride

SM 4500-Cl F 20th ED	**20080506**	**Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-CN E 20th ED	**20092404**	**Cyanide by Colorimetric Determination**

Analyte Code	*Analyte*
1635	Cyanide
1645	Total cyanide

SM 4500-CN G 20th ED	**20093203**	**Cyanide Amenable to Chlorination after Distillation**

Analyte Code	*Analyte*
1510	Amenable cyanide

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

Analyte Code	*Analyte*
1635	Cyanide

SM 4500-F^- C 20th ED	**20102005**	**Fluoride by Ion Selective Electrode**

Analyte Code	*Analyte*
1730	Fluoride

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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SM 4500-H+ B 20th ED	**20104807**	**pH by Probe**

Analyte Code	*Analyte*
1900	pH

SM 4500-NH3 E 20th ED	**20109802**	**Ammonia by Selective Ion Probe**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-NH3 G 20th ED	**20111006**	**Ammonia by Automated Phenate**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-O G 20th ED	**20121204**	**Dissolved Oxygen by Membrane Electrode Method**

Analyte Code	*Analyte*
1880	Oxygen, dissolved

SM 4500-S2 F-2011	**20126663**	**Sulfide by Iodometric Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ D 20th ED	**20125400**	**Sulfide by Methylene Blue Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ D-97 online	**20125808**	**Sulfide by Methylene Blue Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ F 20th ED	**20126209**	**Sulfide by Iodometric Titration**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$SO3^{-}$ B 20th ED	**20130205**	**Sulfite by Iodometric Method**

Analyte Code	*Analyte*
2015	Sulfite-SO3

SM 5210 B 20th ED	**20134809**	**Biochemical Oxygen Demand, 5-Day (BOD5)**

Analyte Code	*Analyte*
1530	Biochemical oxygen demand

SM 5220 C 20th ED	**20135608**	**Chemical Oxygen Demand by Closed Reflux and Titration**

Analyte Code	*Analyte*
1565	Chemical oxygen demand

SM 5310 C 20th ED	**20138403**	**Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

ORELAP Fields of Accreditation

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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SM 5540 C 20th ED	**20144609**	**Surfactants as MBAS**

Analyte Code	*Analyte*
2025	Surfactants - MBAS

SM 5550 B 20th ED	**20145306**	**Tannin and Lignin**

Analyte Code	*Analyte*
9597	Tannin & Lignin

SM 9215 B (PCA) 20th ED	**20181208**	**Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9221 B (LTB) + C MPN 20th ED	**20186805**	**Multiple Tube Fermentation Quantitative (LTB): Total Coliform**

Analyte Code	*Analyte*
2500	Total coliforms

SM 9221 E (EC) 20th ED	**20226806**	**Multiple Tube Fermentation Quantitative (EC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9222 D (m-FC) 20th ED	**20209603**	**Membrane Filtration Quantitative (m-FC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert®) 20th ED	**20212208**	**Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18 Quanti-Tray®) 20th ED	**20213201**	**Chromogenic/Fluorogenic Quantitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 20th ED	**20214204**	**Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 21st ED	**20214408**	**Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

WI(95) DRO	**90019457**	**Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID**

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

ORELAP Fields of Accreditation

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1317 South 13th Ave.
Kelso WA 98626

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WI(95) GRO **90019468** **Wisconsin DNR - Modified Method for Determining Gasoline Range Organics GC-FID**

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

ORELAP Fields of Accreditation

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1317 South 13th Ave.
Kelso WA 98626

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MATRIX : Solids

Reference	Code	Description
ALS Kelso LCP-Acryl 1	**60001712**	**ALS Kelso - Acrylamide by HPLC/MS/MS**

Analyte Code	*Analyte*
4330	Acrylamide

ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

ASTM D1426-08B	**30007397**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D3590-02(06)A	**30016819**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

ASTM D422-63	**30030854**	**Partical Size Distribution (Grain sizing)**

Analyte Code	*Analyte*
6118	Distribution of particle sizes

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

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)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC

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Analyte Code	*Analyte*
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
7725	Isodrin
7810	Methoxychlor
7870	Mirex
5553	Octachlorostyrene
3890	Oxychlordane
7910	trans-Nanochlor

CAS SOC-Butyl **60035009** **Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1020A **10117007** **Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

EPA 1110A **10235208** **Corrosivity Toward Steel**

Analyte Code	*Analyte*
1615	Corrosivity

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 160.3 **10009800** **Total Solids, dried @ 103-105 C.**

Analyte Code	*Analyte*
1950	Residue-total

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*

ORELAP Fields of Accreditation

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1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
1095	Mercury

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)
1860	Oil & Grease

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

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
2000	Sulfate

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

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

Analyte Code	*Analyte*
1515	Ammonia as N

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

Analyte Code	*Analyte*
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate+nitrite

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3541 **10140406** **Automated Soxhlet 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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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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 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1908	Total Phosphate

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035A **10284807** **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

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
1125	Potassium
1140	Selenium
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
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 6850 **10304606** **Perchlorate in Water, Soils and Solid Wastes Using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic

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 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1140	Selenium

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
4785	Ethylene glycol
9408	Gasoline range organics (GRO)

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
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
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
4840	Hexachloroethane
7725	Isodrin
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*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
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)

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Certificate: WA100010 - 010

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
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)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
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)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
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)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
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)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
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)
8920	2,3-Dichlorobiphenyl (BZ-5)
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)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
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)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	*Analyte*
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
7475	Dimethoate
8625	Disulfoton
7550	EPN
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

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
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
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
5167	1,1,2-Trichlorofluoroethane
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
6800	1,3,5-Trichlorobenzene

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4355	Allyl chloride (3-Chloropropene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
4370	T-amylmethylether (TAME)
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
5260	Xylene (total)

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
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5660	4-Bromophenyl phenyl ether (BDE-3)
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether

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ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

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Analyte Code	*Analyte*
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a-a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5562	Azobenzene
5570	Benzaldehyde
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
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
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

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Analyte Code	*Analyte*
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
6852	2,3,5-Trimethylnaphthalene
6188	2,6-Dimethylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5640	Biphenyl
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5910	Dibenzothiophene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6545	n-Nitrosodi-n-propylamine
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6665	Pyrene

EPA 8321B **10189205** **Solvent Extractable non-volatile compounds by HPLC/TS/MS**

Analyte Code	*Analyte*
7710	3-Hydroxycarbofuran
7010	Aldicarb (Temik)

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

As of 02/11/2015 ***this list supercedes all previous lists for this certificate number. Customers. Please verify the current accreditation standing with ORELAP.***

Analyte Code	*Analyte*
7015	Aldicarb sulfone
7020	Aldicarb sulfoxide
7195	Carbaryl (Sevin)
7205	Carbofuran (Furaden)
7800	Methiocarb (Mesurol)
7805	Methomyl (Lannate)
7940	Oxamyl
8080	Propoxur (Baygon)

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	*Analyte*
1510	Amenable cyanide
1645	Total cyanide

EPA 9013A **10308802** **Cyanide Extraction Procedure for Solids and Oils**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	*Analyte*
2045	Total organic halides (TOX)

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

Analyte Code	*Analyte*
1900	pH

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
1805	Nitrate
1835	Nitrite
2000	Sulfate

EPA 9071A **10201408** **Oil and Grease Extraction Method for sludge and sediment samples**

Analyte Code	*Analyte*
1860	Oil & Grease

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

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
9506	Residual Range Organics (RRO)

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** **Extraction/Preparation**

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

WI(95) DRO **90019457** **Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID**

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

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 5.0 July 2013 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President/Operations Manager

Initial Accreditation Date:	*Issue Date:*	*Revision Date:*
July 19, 2011	March 13, 2014	February 25, 2015
Expiration Date:	*Accreditation No.:*	*Certificate No.:*
March 13, 2016	65188	L14-51-R2

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1631E	CVAFS	Mercury (Low level)
Aqueous	EPA 1664A	Gravimetry	Hexane Extractable Material (HEM)
Aqueous	EPA 1664A	Gravimetry	Total Petroleum Hydrocarbons (TPH)
Aqueous	EPA 180.1	Nephelometer	Turbidity
Aqueous	EPA 2340B	Calculation by 6010	Hardness as $CaCO_{3)}$
Aqueous	EPA 245.1	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate + Nitrite as N
Aqueous	EPA 300.0	IC	Nitrate as N
Aqueous	EPA 300.0	IC	Nitrite as N
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 353.2	Automated Colorimetry	Nitrate + Nitrite as N
Aqueous	EPA 1632	HG-CT-GC-AAS	Arsenic (III)
Aqueous	EPA 1632	HG-CT-GC-AAS	Arsenic (V)
Aqueous	EPA 1632	HG-CT-GC-AAS	Total Inorganic Arsenic
Aqueous	EPA 7196A	Colorimetry	Chromium VI
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8260C SIM	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dibromoethane
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,3 Butadine
Aqueous	EPA 8260C SIM	GC-MS	1,4-Dichlorobenzene
Aqueous	EPA 8260C SIM	GC-MS	Bromodichloromethane
Aqueous	EPA 8260C SIM	GC-MS	Carbon Tetrachloride
Aqueous	EPA 8260C SIM	GC-MS	Chlorodibromomethane
Aqueous	EPA 8260C SIM	GC-MS	Chloroform
Aqueous	EPA 8260C SIM	GC-MS	Chloromethane
Aqueous	EPA 8260C SIM	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous	EPA 8260C SIM	GC-MS	Tetrachloroethene
Aqueous	EPA 8260C SIM	GC-MS	trans-1,2-Dichloroethene

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 8260C SIM	GC-MS	Trichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Vinyl chloride
Aqueous	EPA 9020B	Microcoulometric-titration detector	Total Organic Halides (TOX)
Aqueous	EPA 9040C	pH Meter	pH
Aqueous	EPA 9060A	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SM 10200 H	Colorimetry	Chlorophyll-A
Aqueous	SM 2130B	Nephelometer	Turbidity
Aqueous	SM 2320B	Titrimetry	Total Alkalinity (as $CaCO_3$)
Aqueous	SM 2510B	Conductivity Meter	Specific Conductance
Aqueous	SM 2540B	Balance	Solids, Total
Aqueous	SM 2540C	Balance	Solids, Total Dissolved
Aqueous	SM 2540D	Balance	Solids, Total Suspended
Aqueous	SM 4500-CN- G	Colorimetry	Cyanide, Amenable
Aqueous	SM 4500-P-E	Colorimetry	ortho-phosphorous
Aqueous	SM 4500-S2 D	Distillation Unit	Sulfide
Aqueous	SM 4500-CN E	Colorimetry	Total Cyanide
Aqueous	SM4500-NH3 G	Colorimetry	Ammonia
Aqueous	SM5220C	Titrimetry	Chemical Oxygen Demand (COD)
Aqueous	SM5310C	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n butanoic acid (PFBA)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanesulfonate (PFOS)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanoic acid (PFOA)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,1,1,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,1-Trichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,2,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichloropropane
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trimethylbenzene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,2-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,3,5-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,4-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	2,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	2-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Isopropyltoluene
Drinking Water	EPA 524.2	GC-MS	Benzene
Drinking Water	EPA 524.2	GC-MS	Bromobenzene
Drinking Water	EPA 524.2	GC-MS	Bromochloromethane
Drinking Water	EPA 524.2	GC-MS	Bromodichloromethane
Drinking Water	EPA 524.2	GC-MS	Bromoform
Drinking Water	EPA 524.2	GC-MS	Bromomethane
Drinking Water	EPA 524.2	GC-MS	Carbon Tetrachloride
Drinking Water	EPA 524.2	GC-MS	Chlorobenzene
Drinking Water	EPA 524.2	GC-MS	Chlorodibromomethane
Drinking Water	EPA 524.2	GC-MS	Chloroethane
Drinking Water	EPA 524.2	GC-MS	Chloroform
Drinking Water	EPA 524.2	GC-MS	Chloromethane
Drinking Water	EPA 524.2	GC-MS	cis-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	cis-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Dibromomethane
Drinking Water	EPA 524.2	GC-MS	Dichlorodifluoromethane
Drinking Water	EPA 524.2	GC-MS	Dichloromethane (Methylene Chloride)
Drinking Water	EPA 524.2	GC-MS	Ethylbenzene
Drinking Water	EPA 524.2	GC-MS	Hexachlorobutadiene
Drinking Water	EPA 524.2	GC-MS	Isopropylbenzene
Drinking Water	EPA 524.2	GC-MS	m+p-Xylene
Drinking Water	EPA 524.2	GC-MS	Naphthalene
Drinking Water	EPA 524.2	GC-MS	n-Butylbenzene

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	n-Propylbenzene
Drinking Water	EPA 524.2	GC-MS	o-Xylene
Drinking Water	EPA 524.2	GC-MS	sec-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	Styrene
Drinking Water	EPA 524.2	GC-MS	tert-butylbenzene
Drinking Water	EPA 524.2	GC-MS	Tetrachloroethene
Drinking Water	EPA 524.2	GC-MS	Toluene
Drinking Water	EPA 524.2	GC-MS	trans-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	trans-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Trichloroethene
Drinking Water	EPA 524.2	GC-MS	Trichlorofluoromethane (Freon 11)
Drinking Water	EPA 524.2	GC-MS	Vinyl chloride
Drinking Water	EPA 524.2	GC-MS	Xylenes, total
Solid	ASTM D4129-92M, Lloyd Kahn	TOC Meter	Total Organic Carbons (TOC)
Solid	EPA 160.3M	Gravimetry	Solids, Total
Solid	EPA 1631E	CVFAS	Mercury (low level)
Solid	EPA 7471A, B	CVAA	Mercury
Solid	EPA 9045D	pH Meter	pH
Solid	EPA 9056A	IC	Nitrate as N
Solid	EPA 9056A	IC	Nitrite as N
Solid	EPA 9071B	Gravimetry	Hexane Extractable Material (HEM)
Solid	GEN-AVS	Colorimetry	Acid Volatile Sulfides
Solid	GEN-NCEL	Colorimetry	Nitrocellulose
Solid	LCP-LCMS4	HPLC/MS/MS	1,3,5-Trinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	1,3-Dinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4,6-Trinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,6-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2-Amino-4,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	3,5-Dinitroaniline
Solid	LCP-LCMS4	HPLC/MS/MS	4-Amino-2,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Solid	LCP-LCMS4	HPLC/MS/MS	Pentaerythritoltetranitrate
Solid	LCP-LCMS4	HPLC/MS/MS	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Solid	LCP-LCMS4	HPLC/MS/MS	Tetryl (methyl-2,4,6-trinitrophenylnitramine)

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ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Solid	LCP-Nitro	HPLC/MS/MS	2,4-Dinitrophenol
Solid	LCP-Nitro	HPLC/MS/MS	Picramic Acid
Solid	LCP-Nitro	HPLC/MS/MS	Picric Acid
Solid	PSEP	Gravimetry	Particle Size
Solid	SOP-GEN-AVS	Colorimetry	Acid Volatile Sulfides
Tissue	EPA 1631E	CVAFS	Mercury (low level)
Tissue	EPA 1632	HG-CT-GC-AAS	Arsenic (III)
Tissue	EPA 1632	HG-CT-GC-AAS	Arsenic (V)
Tissue	EPA 1632	HG-CT-GC-AAS	Total Inorganic Arsenic
Tissue	EPA 6010B, C/200.7	ICP	Aluminum
Tissue	EPA 6010B, C/200.7	ICP	Antimony
Tissue	EPA 6010B, C/200.7	ICP	Arsenic
Tissue	EPA 6010B, C/200.7	ICP	Barium
Tissue	EPA 6010B, C/200.7	ICP	Beryllium
Tissue	EPA 6010B, C/200.7	ICP	Boron
Tissue	EPA 6010B, C/200.7	ICP	Cadmium
Tissue	EPA 6010B, C/200.7	ICP	Calcium
Tissue	EPA 6010B, C/200.7	ICP	Chromium, total
Tissue	EPA 6010B, C/200.7	ICP	Cobalt
Tissue	EPA 6010B, C/200.7	ICP	Copper
Tissue	EPA 6010B, C/200.7	ICP	Iron
Tissue	EPA 6010B, C/200.7	ICP	Lead
Tissue	EPA 6010B, C/200.7	ICP	Magnesium
Tissue	EPA 6010B, C/200.7	ICP	Manganese
Tissue	EPA 6010B, C/200.7	ICP	Molybdenum
Tissue	EPA 6010B, C/200.7	ICP	Nickel
Tissue	EPA 6010B, C/200.7	ICP	Potassium
Tissue	EPA 6010B, C/200.7	ICP	Selenium
Tissue	EPA 6010B, C/200.7	ICP	Silver
Tissue	EPA 6010B, C/200.7	ICP	Sodium
Tissue	EPA 6010B, C/200.7	ICP	Strontium
Tissue	EPA 6010B, C/200.7	ICP	Thallium
Tissue	EPA 6010B, C/200.7	ICP	Tin
Tissue	EPA 6010B, C/200.7	ICP	Titanium
Tissue	EPA 6010B, C/200.7	ICP	Vanadium

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 6010B, C/200.7	ICP	Zinc
Tissue	EPA 6020A/200.8	ICP-MS	Aluminum
Tissue	EPA 6020A/200.8	ICP-MS	Antimony
Tissue	EPA 6020A/200.8	ICP-MS	Arsenic
Tissue	EPA 6020A/200.8	ICP-MS	Barium
Tissue	EPA 6020A/200.8	ICP-MS	Beryllium
Tissue	EPA 6020A/200.8	ICP-MS	Boron
Tissue	EPA 6020A/200.8	ICP-MS	Cadmium
Tissue	EPA 6020A/200.8	ICP-MS	Chromium, total
Tissue	EPA 6020A/200.8	ICP-MS	Cobalt
Tissue	EPA 6020A/200.8	ICP-MS	Copper
Tissue	EPA 6020A/200.8	ICP-MS	Iron
Tissue	EPA 6020A/200.8	ICP-MS	Lead
Tissue	EPA 6020A/200.8	ICP-MS	Manganese
Tissue	EPA 6020A/200.8	ICP-MS	Molybdenum
Tissue	EPA 6020A/200.8	ICP-MS	Nickel
Tissue	EPA 6020A/200.8	ICP-MS	Selenium
Tissue	EPA 6020A/200.8	ICP-MS	Silver
Tissue	EPA 6020A/200.8	ICP-MS	Strontium
Tissue	EPA 6020A/200.8	ICP-MS	Thallium
Tissue	EPA 6020A/200.8	ICP-MS	Tin
Tissue	EPA 6020A/200.8	ICP-MS	Titanium
Tissue	EPA 6020A/200.8	ICP-MS	Vanadium
Tissue	EPA 6020A/200.8	ICP-MS	Zinc
Tissue	EPA 7471A, B	CVAA	Mercury
Tissue	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Tissue	EPA 8081A, B	GC-ECD	Aldrin
Tissue	EPA 8081A, B	GC-ECD	Alpha-BHC
Tissue	EPA 8081A, B	GC-ECD	DDD (4,4)
Tissue	EPA 8081A, B	GC-ECD	DDE (4,4)
Tissue	EPA 8081A, B	GC-ECD	DDT (4,4)
Tissue	EPA 8081A, B	GC-ECD	delta-BHC
Tissue	EPA 8081A, B	GC-ECD	Dieldrin
Tissue	EPA 8081A, B	GC-ECD	Endosulfan I
Tissue	EPA 8081A, B	GC-ECD	Endosulfan II

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
1317 South 13th Avenue, Kelso, WA 98626
Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Tissue	EPA 8081A, B	GC-ECD	Endrin
Tissue	EPA 8081A, B	GC-ECD	Endrin aldehyde
Tissue	EPA 8081A, B	GC-ECD	Endrin ketone
Tissue	EPA 8081A, B	GC-ECD	gamma-BHC
Tissue	EPA 8081A, B	GC-ECD	gamma-Chlordane
Tissue	EPA 8081A, B	GC-ECD	Heptachlor
Tissue	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Tissue	EPA 8081A, B	GC-ECD	Methoxychlor
Tissue	EPA 8081A, B	GC-ECD	Toxaphene (total)
Tissue	EPA 8081B	GC-ECD	2,4-DDD
Tissue	EPA 8081B	GC-ECD	2,4-DDE
Tissue	EPA 8081B	GC-ECD	2,4-DDT
Tissue	EPA 8081B	GC-ECD	Chlorpyrifos
Tissue	EPA 8081B	GC-ECD	cis-Nonachlor
Tissue	EPA 8081B	GC-ECD	Hexachlorobenzene
Tissue	EPA 8081B	GC-ECD	Hexachloroethane
Tissue	EPA 8081B	GC-ECD	Hexchlorobutadiene
Tissue	EPA 8081B	GC-ECD	Isodrin
Tissue	EPA 8081B	GC-ECD	Mirex
Tissue	EPA 8081B	GC-ECD	Oxychlordane
Tissue	EPA 8081B	GC-ECD	trans-Nonachlor
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6,6' Decachlorobiphenyl (PCB 209)
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB 206)
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)
Tissue	EPA 8082A	GC-ECD	2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)
Tissue	EPA 8082A	GC-ECD	2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)
Tissue	EPA 8082A	GC-ECD	2,2',3,4,4',5'-Hexachlorobiphenyl (PCB 138)
Tissue	EPA 8082A	GC-ECD	2,2',3,4,4',6,6'-Heptachlorobiphenyl (PCB 184)
Tissue	EPA 8082A	GC-ECD	2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)
Tissue	EPA 8082A	GC-ECD	2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)
Tissue	EPA 8082A	GC-ECD	2,2',3,4',5-Pentachlorobiphenyl (PCB 90)
Tissue	EPA 8082A	GC-ECD	2,2',3,5'-Tetrachlorobiphenyl (PCB 44)
Tissue	EPA 8082A	GC-ECD	2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)

ALS Environmental-Kelso
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Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8082A	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)
Tissue	EPA 8082A	GC-ECD	2,2',5,6'-Tetrachlorbiphenyl (PCB 53)
Tissue	EPA 8082A	GC-ECD	2,2',5-Trichlorobiphenyl (PCB 18)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',6-Hexachlorobiphenyl (PCB 158)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)
Tissue	EPA 8082A	GC-ECD	2,3,4,4',5-Pentachlorobiphenyl (PCB 114)
Tissue	EPA 8082A	GC-ECD	2,3,4,4'-Tetrachlorobiphenyl (PCB 60)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5,5' Hexachlorobiphenyl (PCB 167)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5',6-Hexachlorobiphenyl (PCB 168)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 118)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 123)
Tissue	EPA 8082A	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (PCB 66)
Tissue	EPA 8082A	GC-ECD	2,4,4'-Trichlorobiphenyl (PCB 28)
Tissue	EPA 8082A	GC-ECD	2,4'-Dichlorobiphenyl (PCB 8)
Tissue	EPA 8082A	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)
Tissue	EPA 8082A	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (PCB 126)
Tissue	EPA 8082A	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (PCB 77)
Tissue	EPA 8082A	GC-ECD	3,4,4',5-Tetrachlorobiphenyl (PCB 81)
Tissue	EPA 8082A	GC-ECD	Aroclor 1016
Tissue	EPA 8082A	GC-ECD	Aroclor 1221
Tissue	EPA 8082A	GC-ECD	Aroclor 1232
Tissue	EPA 8082A	GC-ECD	Aroclor 1242
Tissue	EPA 8082A	GC-ECD	Aroclor 1248
Tissue	EPA 8082A	GC-ECD	Aroclor 1254
Tissue	EPA 8082A	GC-ECD	Aroclor 1260
Tissue	EPA 8082A	GC-ECD	Aroclor 1262
Tissue	EPA 8082A	GC-ECD	Aroclor 1268
Tissue	EPA 8270 SIM	GC-MS	PBDE 100
Tissue	EPA 8270 SIM	GC-MS	PBDE 128
Tissue	EPA 8270 SIM	GC-MS	PBDE 138
Tissue	EPA 8270 SIM	GC-MS	PBDE 153
Tissue	EPA 8270 SIM	GC-MS	PBDE 154
Tissue	EPA 8270 SIM	GC-MS	PBDE 17

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8270 SIM	GC-MS	PBDE 183
Tissue	EPA 8270 SIM	GC-MS	PBDE 190
Tissue	EPA 8270 SIM	GC-MS	PBDE 203
Tissue	EPA 8270 SIM	GC-MS	PBDE 206
Tissue	EPA 8270 SIM	GC-MS	PBDE 209
Tissue	EPA 8270 SIM	GC-MS	PBDE 28
Tissue	EPA 8270 SIM	GC-MS	PBDE 47
Tissue	EPA 8270 SIM	GC-MS	PBDE 66
Tissue	EPA 8270 SIM	GC-MS	PBDE 71
Tissue	EPA 8270 SIM	GC-MS	PBDE 85
Tissue	EPA 8270 SIM	GC-MS	PBDE 99
Tissue	EPA 8270 SIM PAH	GC-MS	2-Methylnaphthalene
Tissue	EPA 8270 SIM PAH	GC-MS	Acenaphthene
Tissue	EPA 8270 SIM PAH	GC-MS	Acenaphthylene
Tissue	EPA 8270 SIM PAH	GC-MS	Anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(a)anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(a)pyrene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(b)fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(g,h,i)perylene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(k)fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Chrysene
Tissue	EPA 8270 SIM PAH	GC-MS	Dibenzo(a,h)anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Fluorene
Tissue	EPA 8270 SIM PAH	GC-MS	Indeno(1,2,3, cd)pyrene
Tissue	EPA 8270 SIM PAH	GC-MS	Naphthalene
Tissue	EPA 8270 SIM PAH	GC-MS	Phenanthrene
Tissue	EPA 8270 SIM PAH	GC-MS	Pyrene
Tissue	EPA 8270D SIM	GC-MS	1,2,4,5-Tetrachlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,2,4-Trichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,2-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,3-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,4-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	2,3,4,6-Tetrachlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4,5-Trichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4,6-Trichlorophenol

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Tissue	EPA 8270D SIM	GC-MS	2,4-Dichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dimethylphenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dinitrophenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dinitrotoluene
Tissue	EPA 8270D SIM	GC-MS	2,6-Dichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,6-Dinitrotoluene
Tissue	EPA 8270D SIM	GC-MS	2-Chloronaphthalene
Tissue	EPA 8270D SIM	GC-MS	2-Chlorophenol
Tissue	EPA 8270D SIM	GC-MS	2-Methyl-4,6-Dinitrophenol
Tissue	EPA 8270D SIM	GC-MS	2-Methylnaphthalene
Tissue	EPA 8270D SIM	GC-MS	2-Methylphenol
Tissue	EPA 8270D SIM	GC-MS	2-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	2-Nitrophenol
Tissue	EPA 8270D SIM	GC-MS	3,3-Dichlorobenzidine
Tissue	EPA 8270D SIM	GC-MS	3-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Bromophenyl-phenylether
Tissue	EPA 8270D SIM	GC-MS	4-Chloro-3-methylphenol
Tissue	EPA 8270D SIM	GC-MS	4-Chloroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Chlorophenyl-phenylether
Tissue	EPA 8270D SIM	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Tissue	EPA 8270D SIM	GC-MS	4-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Nitrophenol
Tissue	EPA 8270D SIM	GC-MS	Acenaphthene
Tissue	EPA 8270D SIM	GC-MS	Acenaphthylene
Tissue	EPA 8270D SIM	GC-MS	Anthracene
Tissue	EPA 8270D SIM	GC-MS	Benzo(a)anthracene
Tissue	EPA 8270D SIM	GC-MS	Benzo(a)pyrene
Tissue	EPA 8270D SIM	GC-MS	Benzo(b)fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Benzo(g,h,i)perylene
Tissue	EPA 8270D SIM	GC-MS	Benzo(k)fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Benzoic acid
Tissue	EPA 8270D SIM	GC-MS	Benzyl alcohol
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroethoxy)methane
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroethyl)ether
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroisopropyl)ether
Tissue	EPA 8270D SIM	GC-MS	bis(2-ethylhexy)phthalate

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Tissue	EPA 8270D SIM	GC-MS	Butyl benzyl phthalate
Tissue	EPA 8270D SIM	GC-MS	Carbazole
Tissue	EPA 8270D SIM	GC-MS	Chrysene
Tissue	EPA 8270D SIM	GC-MS	Dibenzo(a,h)anthracene
Tissue	EPA 8270D SIM	GC-MS	Dibenzofuran
Tissue	EPA 8270D SIM	GC-MS	Diethyl phthalate
Tissue	EPA 8270D SIM	GC-MS	Dimethylphthalate
Tissue	EPA 8270D SIM	GC-MS	di-n-butylphthalate
Tissue	EPA 8270D SIM	GC-MS	Di-n-octylphthalate
Tissue	EPA 8270D SIM	GC-MS	Fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Fluorene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorobenzene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorobutadiene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorocyclopentadiene
Tissue	EPA 8270D SIM	GC-MS	Hexachloroethane
Tissue	EPA 8270D SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Tissue	EPA 8270D SIM	GC-MS	Isophorone
Tissue	EPA 8270D SIM	GC-MS	Naphthalene
Tissue	EPA 8270D SIM	GC-MS	Nitrobenzene
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodiethylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodimethylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitroso-di-n-propylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodiphenylamine
Tissue	EPA 8270D SIM	GC-MS	Pentachlorophenol
Tissue	EPA 8270D SIM	GC-MS	Phenanthrene
Tissue	EPA 8270D SIM	GC-MS	Phenol
Tissue	EPA 8270D SIM	GC-MS	Pyrene
Tissue	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Tissue	EPA 8330B	HPLC	1,3-Dinitrobenzene
Tissue	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Tissue	EPA 8330B	HPLC	2,4-Dinitrotoluene
Tissue	EPA 8330B	HPLC	2,6-Dinitrotoluene
Tissue	EPA 8330B	HPLC	2-Amino-4,6-dinitrotoluene
Tissue	EPA 8330B	HPLC	2-Nitrotoluene
Tissue	EPA 8330B	HPLC	3,5-Dinitroaniline
Tissue	EPA 8330B	HPLC	3-Nitrotoluene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8330B	HPLC	4-Amino-2,6-dinitrotoluene
Tissue	EPA 8330B	HPLC	4-Nitrotoluene
Tissue	EPA 8330B	HPLC	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Tissue	EPA 8330B	HPLC	Nitrobenzene
Tissue	EPA 8330B	HPLC	Nitroglycerin
Tissue	EPA 8330B	HPLC	Pentachloronitrobenzene
Tissue	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Tissue	EPA 8330B	HPLC	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Tissue	EPA 8330B	HPLC	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Tissue	OPPMS2	GC/MS/MS	Azinphos-methyl (Guthion)
Tissue	OPPMS2	GC/MS/MS	Chlorpyrifos
Tissue	OPPMS2	GC/MS/MS	Demeton O & S
Tissue	OPPMS2	GC/MS/MS	Diazinon
Tissue	OPPMS2	GC/MS/MS	Dichlorvos
Tissue	OPPMS2	GC/MS/MS	dimethoate
Tissue	OPPMS2	GC/MS/MS	Disulfoton
Tissue	OPPMS2	GC/MS/MS	Ethoprop
Tissue	OPPMS2	GC/MS/MS	Parathion, ethyl
Tissue	OPPMS2	GC/MS/MS	Parathion, methyl
Tissue	OPPMS2	GC/MS/MS	Phorate
Tissue	OPPMS2	GC/MS/MS	Ronnel
Tissue	OPPMS2	GC/MS/MS	Stirophos
Tissue	OPPMS2	GC/MS/MS	Sulfotepp
Tissue	SOC-Butyl	GC-FPD	Di-n-butyltin
Tissue	SOC-Butyl	GC-FPD	n-Butyltin
Tissue	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Tissue	SOC-Butyl	GC-FPD	Tri-n-butyltin
Tissue	SOC-PESTMS2	GC/MS/MS	Aldrin
Tissue	SOC-PESTMS2	GC/MS/MS	Alpha-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	beta-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	DDD (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	DDE (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	DDT (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	delta-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	Dieldrin
Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan I

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ISO/IEC 17025:2005 and DoD-ELAP

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Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan II
Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan sulfate
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin aldehyde
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin ketone
Tissue	SOC-PESTMS2	GC/MS/MS	gamma-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	Heptachlor
Tissue	SOC-PESTMS2	GC/MS/MS	Heptachlor Epoxide (beta)
Tissue	SOC-PESTMS2	GC/MS/MS	Methoxychlor
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	1,3,5-Trinitrobenzene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	1,3-Dinitrobenzene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,4,6-Trinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,4-Dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,6-Dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2-Amino-4,6-dinitrtoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	3,5-Dinitroaniline
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	4-Amino-2,6-dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	Pentaerythritoltetranitrate
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Tissue	SOP LCP-Nitro	HPLC/MS/MS	2,4-Dinitrophenol
Tissue	SOP LCP-Nitro	HPLC/MS/MS	Picramic Acid
Tissue	SOP LCP-Nitro	HPLC/MS/MS	Picric Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorododecanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroheptanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexylsulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorononanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctane Sulfonate

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

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Matrix	Standard/Method	Technology	Analyte
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctylsulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoropentanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroundecanoic Acid
Aqueous/Drinking Water	EPA 200.9	GFAA	Antimony
Aqueous/Drinking Water	EPA 200.9	GFAA	Selenium
Aqueous/Drinking Water	EPA 200.9	GFAA	Thallium
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluoroheptanoic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorohexanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorononanoic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorooctanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorooctanoic Acid
Aqueous/Drinking Water	EPA 200.9	GFAA	Arsenic
Aqueous/Drinking Water	EPA 200.9	GFAA	Lead
Aqueous/Solid	ASTM D 1426-93B	ISE	Nitrogen, Total Kjeldahl (TKN)
Aqueous/Solid	EPA 1020A	Closed Cup Flashpoint	Ignitability
Aqueous/Solid	EPA 1630	CVAFS	Methyl Mercury
Aqueous/Solid	EPA 314.0	IC	Perchlorate
Aqueous/Solid	EPA 350.1	Colorimetry	Ammonia
Aqueous/Solid	EPA 365.3	Colorimetry	Total Phosphorus
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Aluminum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Antimony
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Arsenic
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Barium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Beryllium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Boron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cadmium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Calcium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Chromium, total
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cobalt
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Copper

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Iron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Lead
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Magnesium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Manganese
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Molybdenum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Nickel
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Potassium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Selenium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Silver
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Sodium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Strontium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Thallium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Tin
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Titanium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Vanadium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Zinc
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Antimony
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Barium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Boron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Chromium, total
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Copper
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Iron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Lead
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Manganese
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Nickel
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Selenium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Silver
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Strontium

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Thallium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Tin
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Titanium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Zinc
Aqueous/Solid	EPA 6850	HPLC/MS/MS	Perchlorate
Aqueous/Solid	EPA 7010	GFAA	Antimony
Aqueous/Solid	EPA 7010	GFAA	Arsenic
Aqueous/Solid	EPA 7010	GFAA	Chromium, total
Aqueous/Solid	EPA 7010	GFAA	Lead
Aqueous/Solid	EPA 7010	GFAA	Selenium
Aqueous/Solid	EPA 7010	GFAA	Thallium
Aqueous/Solid	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Aqueous/Solid	EPA 8011	GC-ECD	Ethylene Dibromide
Aqueous/Solid	EPA 8015C/AK103-RRO	GC-FID	Residual Range Organics (RRO)
Aqueous/Solid	EPA 8015C; AK101-GRO; NWTPH-Gx	GC-FID	Gasoline Range Organics (GRO)
Aqueous/Solid	EPA 8015C; AK102-DRO; NWTPH-Dx	GC-FID	Diesel Range Organics (DRO)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Aldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Alpha-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDD (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDE (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDT (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	delta-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	Dieldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan I
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan II
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin aldehyde
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin ketone
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-Chlordane

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
1317 South 13th Avenue, Kelso, WA 98626
Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Methoxychlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Toxaphene (total)
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDD
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDE
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDT
Aqueous/Solid	EPA 8081B	GC-ECD	Chlorpyrifos
Aqueous/Solid	EPA 8081B	GC-ECD	cis-Nonachlor
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobutadiene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachloroethane
Aqueous/Solid	EPA 8081B	GC-ECD	Isodrin
Aqueous/Solid	EPA 8081B	GC-ECD	Mirex
Aqueous/Solid	EPA 8081B	GC-ECD	Oxychlordane
Aqueous/Solid	EPA 8081B	GC-ECD	trans-Nonachlor
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB 206)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6,6' Decachlorobiphenyl (PCB 209)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5'-Hexachlorobiphenyl (PCB 138)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',6,6'-Heptachlorobiphenyl (PCB 184)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4',5-Pentachlorobiphenyl (PCB 90)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,5'-Tetrachlorobiphenyl (PCB 44)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',5,6'-Tetrachlorbiphenyl (PCB 53)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',5-Trichlorobiphenyl (PCB 18)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',6-Hexachlorobiphenyl (PCB 158)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5,5' Hexachlorobiphenyl (PCB 167)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5',6-Hexachlorobiphenyl (PCB 168)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4',5-Pentachlorobiphenyl (PCB 114)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 118)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 123)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4'-Tetrachlorobiphenyl (PCB 60)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (PCB 66)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4,4'-Trichlorobiphenyl (PCB 28)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4'-Dichlorobiphenyl (PCB 8)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (PCB 126)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (PCB 77)
Aqueous/Solid	EPA 8082A	GC-ECD	3,4,4',5-Tetrachlorobiphenyl (PCB 81)
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1016
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1221
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1232
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1242
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1248
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1254
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1260
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1262
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1268
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-TP (Silvex)
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-D
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-DB
Aqueous/Solid	EPA 8151A	GC-ECD	Dalapon
Aqueous/Solid	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solid	EPA 8151A	GC-ECD	Dichloroprop

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8151A	GC-ECD	Dinoseb
Aqueous/Solid	EPA 8151A	GC-ECD	MCPA
Aqueous/Solid	EPA 8151A	GC-ECD	MCPP
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dibromoethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1-phenylpropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chloroethylvinylether
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Hexanone
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Isopropyltoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetone
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrolein
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromoform

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon Tetrachloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorodibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroform
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous/Solid	EPA 8260B, C	GC-MS	Di-isopropylether (DIPE)
Aqueous/Solid	EPA 8260B, C	GC-MS	DIPE
Aqueous/Solid	EPA 8260B, C	GC-MS	ETBE
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethyl Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 11
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 113
Aqueous/Solid	EPA 8260B, C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260B, C	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Methyl-tert-butylether (MTBE)
Aqueous/Solid	EPA 8260B, C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Styrene
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-amylmethylether (TAME)
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Toluene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,3-Dichloropropene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl chloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Xylene, total
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	3,3-Dichlorobenzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloroaniline

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Aniline
Aqueous/Solid	EPA 8270C, D	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Azinphos-methyl (Guthion)
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzoic acid
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroisopropyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-ethylhexy)phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C, D	GC-MS	Chlorpyrifos
Aqueous/Solid	EPA 8270C, D	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C, D	GC-MS	Demeton O & S
Aqueous/Solid	EPA 8270C, D	GC-MS	Diazinon
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C, D	GC-MS	Dichlorvos
Aqueous/Solid	EPA 8270C, D	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	dimethoate
Aqueous/Solid	EPA 8270C, D	GC-MS	Dimethylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	di-n-butylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Di-n-octylphthalate

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Disulfoton
Aqueous/Solid	EPA 8270C, D	GC-MS	Ethoprop
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270C, D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Isophorone
Aqueous/Solid	EPA 8270C, D	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	o-Toluidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, ethyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, methyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phorate
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyridine
Aqueous/Solid	EPA 8270C, D	GC-MS	Ronnel
Aqueous/Solid	EPA 8270C, D	GC-MS	Stirophos
Aqueous/Solid	EPA 8270C, D	GC-MS	Sulfotepp
Aqueous/Solid	EPA 8270C, D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solid	EPA 8270C,D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270 SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Anthracene

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 100
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 128
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 138
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 153
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 154
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 17
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 183
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 190
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 203
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 206
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 209
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 28
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 47
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 66
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 71
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 85
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 99
Aqueous/Solid	EPA 8270 SIM	GC-MS	p-Dioxane
Aqueous/Solid	EPA 8270 SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,4-Dinitrotoluene

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Amino-4,6-dinitrtoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solid	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Amino-2,6-dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solid	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solid	EPA 8330B	HPLC	Pentachloronitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Aqueous/Solid	EPA 8330B	HPLC	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solid	EPA 8330B	HPLC	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solid	EPA 9012B	Colorimetry	Total Cyanide
Aqueous/Solid	EPA 9030B	Distillation Unit	Sulfide
Aqueous/Solid	EPA 9056A	IC	Bromide
Aqueous/Solid	EPA 9056A	IC	Chloride
Aqueous/Solid	EPA 9056A	IC	Fluoride
Aqueous/Solid	EPA 9056A	IC	Sulfate
Aqueous/Solid	EPA 9065	Spectrophotometer	Total Phenolics
Aqueous/Solid	LCP-NITG	HPLC/UV	Nitroguanidine
Aqueous/Solid	NWTPH-Dx	GC-FID	Residual Range Organics
Aqueous/Solid	SM4500 NH3 G	Colorimetry	Ammonia
Aqueous/Solid	SOC-Butyl	GC-FPD	Di-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	n-Butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tri-n-butyltin
Aqueous/Solid	SOC-OTTO	GC-ECD	Otto Fuel
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Aldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Alpha-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	beta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDD (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDE (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDT (4,4)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	delta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Dieldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan I
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan II
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan sulfate
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin aldehyde
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin ketone
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	gamma-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor Epoxide (beta)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Methoxychlor
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecane Sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorododecanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroheptanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexylsulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorononanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctylsulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoropentanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroundecanoic acid

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Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1640	Reductive Metals Precipitation	Prep Method
Aqueous	EPA 3010A	Acid Digestion	Metals Digestion
Aqueous	EPA 3020A	Acid Digestion	Metals Digestion
Aqueous	EPA 3520C	Continuous Liquid-Liquid Extraction	Extractable Prep
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Aqueous	EPA 5030B	Purge and Trap for Volatiles	Volatile Prep
Aqueous	SOP-MET-DIG	Acid Digestion	Metals Digestion
Solid	EPA 3050B	Acid Digestion	Metals Digestion
Solid	EPA 3060	Alkaline Digestion for Cr(VI)	Alkaline Digestion for Cr(VI) only
Solid	EPA 3541	Automated Soxhlet Extraction	Extractable Prep
Solid	EPA 3550B	Ultrasonic Extraction	Extractable Prep
Solid	EPA 5035A	Purge and Trap for Volatiles	Voc Organics
Solid	EPA 5050	Bomb Digestion	Prep Method
Solid	EPA 9013	Midi-Distillation	Cyanides
Solid	SOP-GEN-AVS	Acid Digestion	Simultaneously Extracted Metals
Aqueous/Solids	ASTM D3590-89	Digestion	TKN
Aqueous/Solids	EPA 1311	TCLP Extraction	Physical Extraction
Aqueous/Solids	EPA 3620C	Florisil clean up	Extractable Cleanup
Aqueous/Solids	EPA 3630C	Silica gel clean up	Extractable Prep
Aqueous/Solids	EPA 3640A	Gel-Permeation Clean-up	Extractable Cleanup
Aqueous/Solids	EPA 3660	Sulfur Clean-up	Extractable Prep
Aqueous/Solids	EPA 3665A	Acid clean up	Extractable Cleanup

END

OF

DOCUMENT

ATTACHMENT G

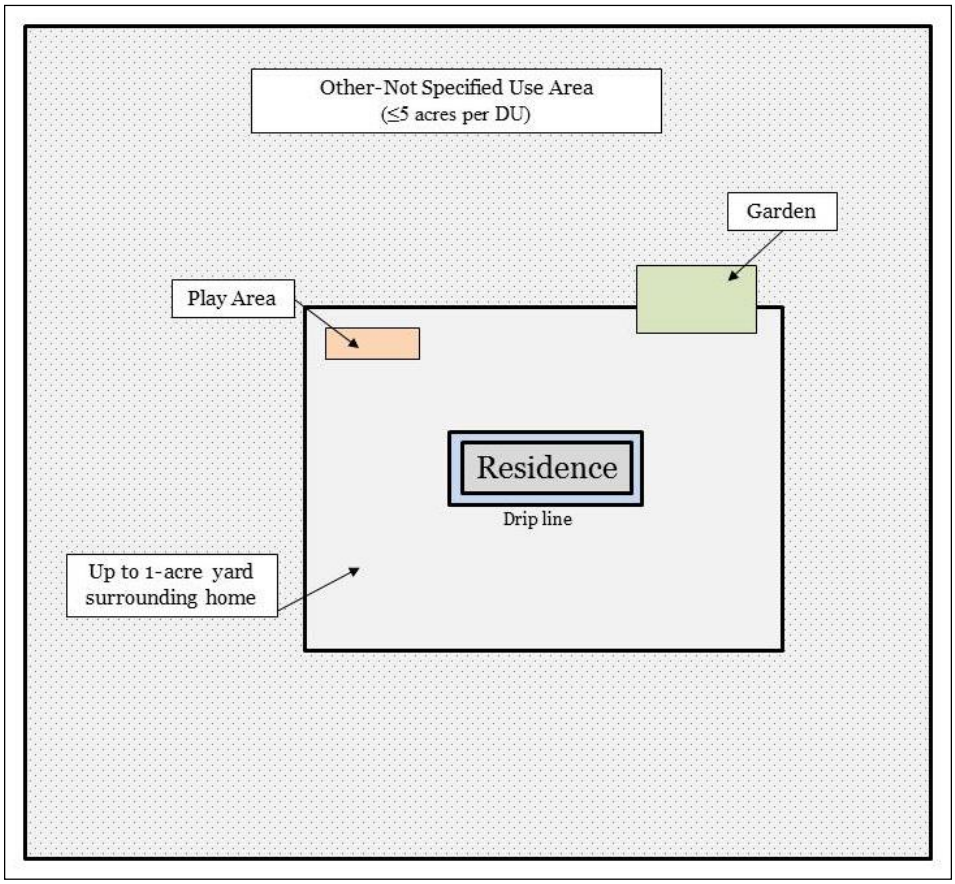
DECISION UNIT SAMPLING DESIGN TEMPLATES

Residential Property				
Template A	**Template B**	**Template C**	**Template D**	**Template E**
• Property: > 5 acres	• Property: > 5 acres	• Property: < 5 acres	• Property: < 5 acres	• Property: > 5 acres
• Play and/or Garden Area Present	• Play and/or Garden Area **NOT** Present	• Play and/or Garden Area Present	• Play and/or Garden Area **NOT** Present	• Play and/or Garden Area Present
Decision Units	**Decision Units**	**Decision Units**	**Decision Units**	**Decision Units**
• 1 DU for up to one acre surrounding the house	• 1 DU for up to one acre surrounding the house	• 1 DU for up to one acre surrounding the house	• 1 DU for up to one acre surrounding the house	• 1 DU for up to one acre surrounding the house
• 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)	• 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)	• 1 DU for the remaining acreage of the property where use is indicated	• 1 DU for the remaining acreage of the property where use is indicated	• 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)
• 1 DU for Garden	• **If there is a concern of lead-based paint** on large, painted structure (e.g., residence or barn), then 1 DU for dripline	• 1 DU for Garden	• **If there is a concern of lead-based paint** on large, painted structure (e.g., residence or barn), then 1 DU for dripline	• **If there is a concern of lead-based paint** on large, painted structure (e.g., residence or barn), then 1 DU for dripline
• 1 DU for Play Area		• 1 DU for Play Area		
• **If there is a concern of lead-based paint** on large, painted structure (e.g., residence or barn), then 1 DU for dripline		• **If there is a concern of lead-based paint** on large, painted structure (e.g., residence or barn), then 1 DU for dripline		

Template A

Decision Units

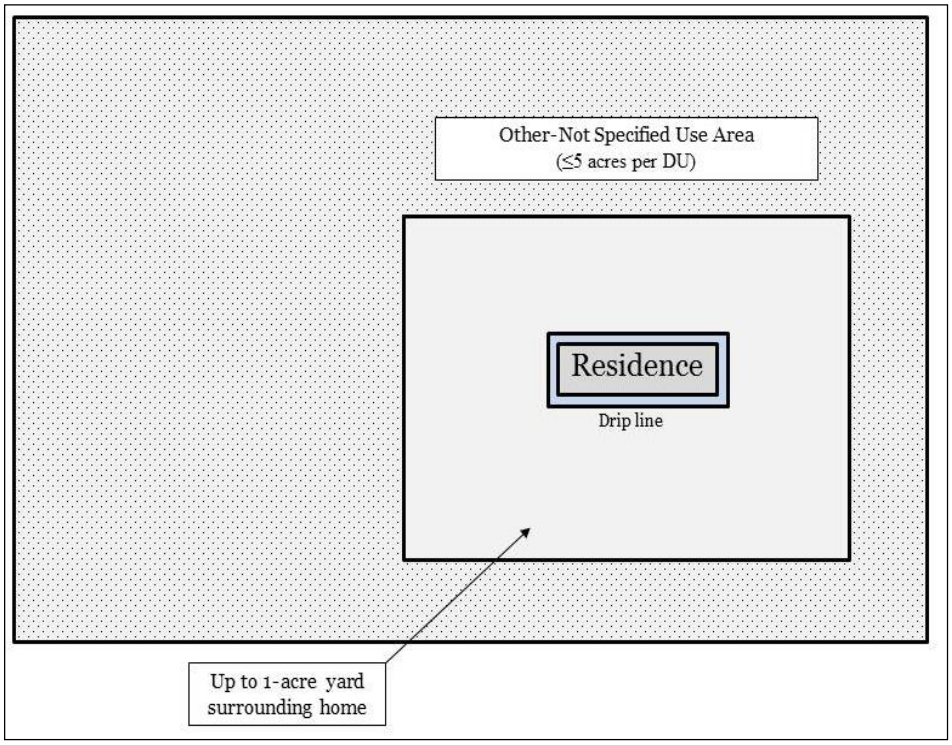
- 1 DU for up to one acre surrounding the house
- 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)
- 1 DU for Garden
- 1 DU for Play Area
- If there is a concern of lead-based paint on large, painted structure (e.g., residence or barn), then 1 DU for dripline



Template B

Decision Units

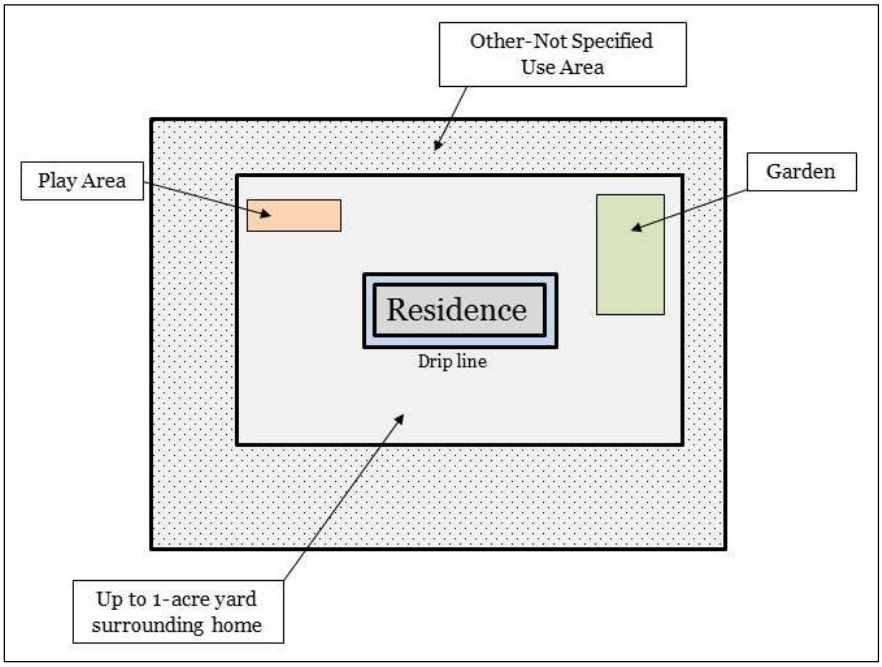
- 1 DU for up to one acre surrounding the house
- 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)
- If there is a concern of lead-based paint on large, painted structure (e.g., residence or barn), then 1 DU for dripline



Template C

Decision Units

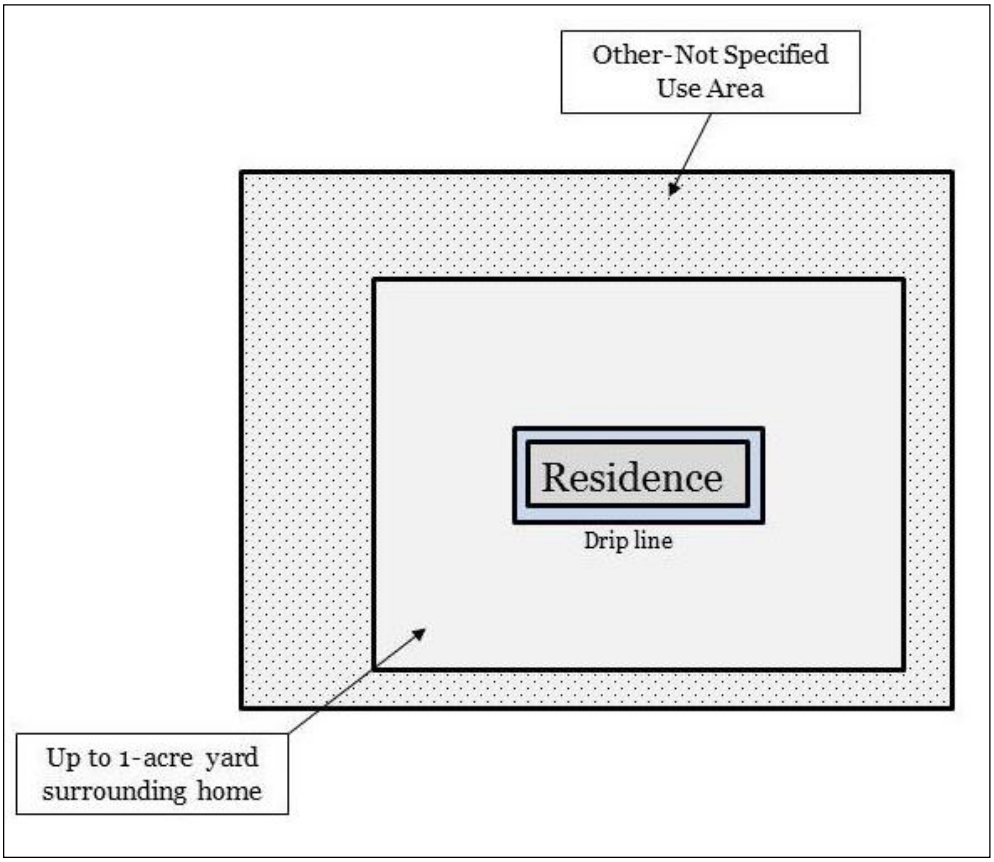
- 1 DU for up to one acre surrounding the house
- 1 DU for Garden
- 1 DU for Play Area
- 1 DU for the remaining acreage of the property where use is indicated
- If there is a concern of lead-based paint on large, painted structure (e.g., residence or barn), then 1 DU for dripline



Template D

Decision Units

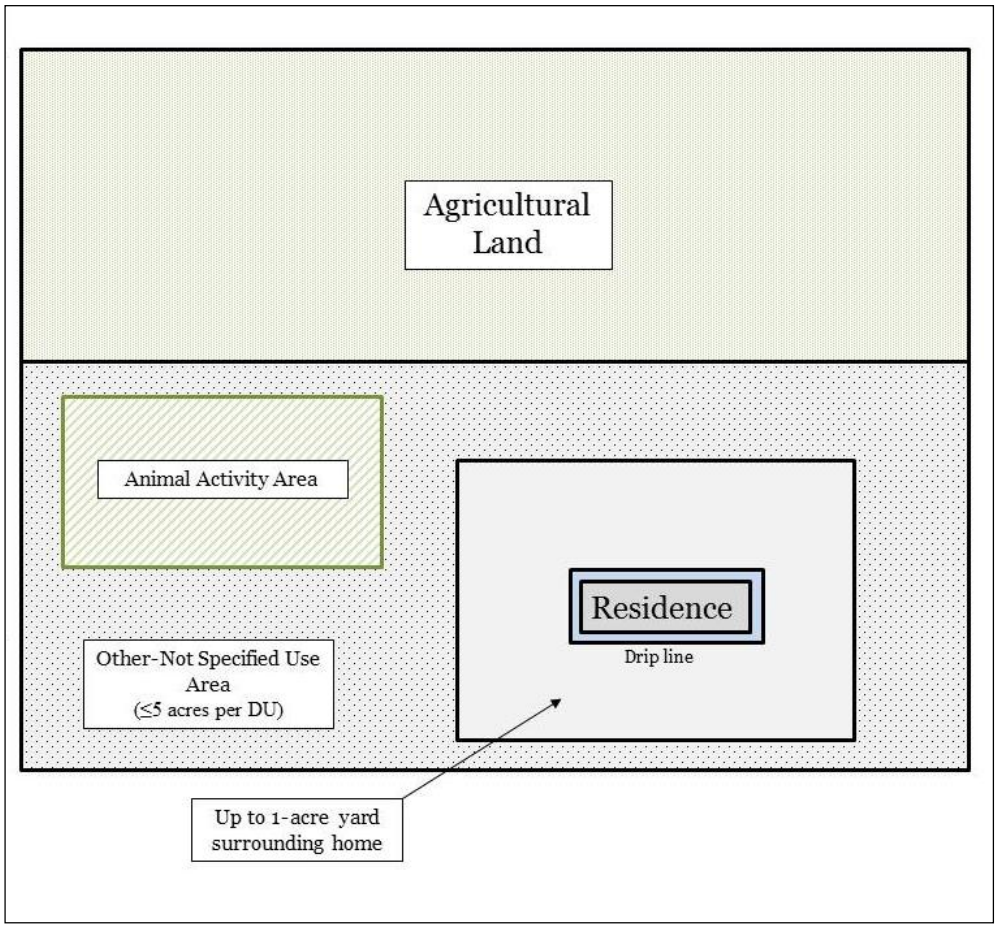
- 1 DU for up to one acre surrounding the house
- 1 DU for the remaining acreage of the property where use is indicated
- If there is a concern of lead-based paint on large, painted structure (e.g., residence or barn), then 1 DU for dripline



Template E

Decision Units

- 1 DU for up to one acre surrounding the house
- 1 DU per additional 5-acre sections of the property where use is indicated (≤5 acres per DU rounded to the nearest integer)
- If there is a concern of lead-based paint on large, painted structure (e.g., residence or barn), then 1 DU for dripline



ATTACHMENT H

CULTURAL RESOURCES COORDINATION PLAN

CONTENTS

LIST OF FIGURES iv
ACRONYMS AND ABBREVIATIONS v
1 INTRODUCTION 1-1
1.1 BACKGROUND 1-1
1.2 CULTURAL SETTING 1-2
2 OVERVIEW OF LAWS AND REGULATIONS 2-1
2.1 FEDERAL LEGISLATION AND REGULATIONS 2-1
2.1.1 National Historic Preservation Act of 1966, as Amended through 1992 (16 USC 470-470w) 2-1
2.1.2 Archeological Resources Protection Act of 1979 (16 USC 470aa-470ll) 2-6
2.1.3 Native American Graves Protection and Repatriation Act (25 USC 3001-3013) 2-6
2.1.4 American Indian Religious Freedom Act (42 USC 1996) 2-7
2.2 PRESIDENTIAL EXECUTIVE ORDERS 2-7
2.2.1 Executive Order 11593. Protection and Enhancement of the Cultural Environment 2-8
2.2.2 Executive Order 13007. Indian Sacred Sites 2-8
2.2.3 Executive Order 13175. Consultation and Coordination with Indian Tribal Governments 2-8
2.3 TRIBAL LEGISLATION AND REGULATIONS 2-8
2.3.1 Confederated Tribes of the Colville Reservation. Colville Tribal Law and Order Code Chapter 4-4, Cultural Resources Protection 2-9
2.4 STATE LEGISLATION AND REGULATIONS 2-9
2.4.1 Revised Code of Washington (RCW) Chapter 27.44, Indian Graves and Records 2-9
2.4.2 RCW Chapter 27.53, Archaeological Sites and Resources 2-10
2.4.3 RCW Chapter 68.60, Abandoned and Historic Cemeteries and Historic Graves 2-10
2.4.4 RCW Chapter 43.21C, State Environmental Policy Act 2-10
3 PROPOSED SAMPLING PROGRAM 3-1
3.1 METHOD FOR COLLECTING INCREMENT SOIL SAMPLES 3-2
3.2 METHOD FOR COLLECTING DISCRETE CORE SOIL SAMPLES 3-4
3.3 SAMPLE DEPTH 3-4

4 COORDINATION PLAN 4-1
4.1 GENERAL CONSULTATION FRAMEWORK 4-1
4.2 CULTURAL RESOURCE PROCEDURES IN THE SAMPLING PROCESS 4-1
4.2.1 Archaeological Monitoring in the Sampling Program 4-2
4.2.2 Curation 4-4
4.2.3 Reporting 4-4
4.3 CONFIDENTIALITY 4-5
5 REFERENCES 5-1
6 GLOSSARY OF TERMS 6-1

Attachment H1. USEPA Contact Information
Attachment H2. Protocols for Inadvertent Discoveries

LIST OF FIGURES

Figure H1. UCR Study Area for the 2016 Residential Soil Study
Figure H2. Overview of the IC sampling design for use in the UCR Residential Soil Study

ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
ARPA	Archaeological Resources Protection Act of 1979
bgs	below ground surface
CCT	Confederated Tribes of the Colville Reservation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CRCP	cultural resources coordination plan
DAHP	Washington State Department of Archaeology & Historic Preservation
DU	decision unit
EPA	U.S. Environmental Protection Agency
FE	fundamental error
FOIA	Freedom of Information Act
FSP	field sampling plan
HHRA	human health risk assessment
IC	incremental composite
Lake Roosevelt	Franklin D. Roosevelt Lake
MOA	Memorandum of Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
QAPP	quality assurance project plan

RCW	Revised Code of Washington
RI/FS	remedial investigation and feasibility study
RM	river mile
SHPO	State Historic Preservation Officer
Site	Upper Columbia River site
STI	Spokane Tribe of Indians
TAI	Teck American Incorporated
THPO	Tribal Historic Preservation Officer
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation
WAC	Washington Administrative Code

UNITS OF MEASURE

cm	centimeter(s)
g	gram(s)
in.	inch(es)
µm	micron(s)
mm	millimeter(s)
ppm	part per million

1 INTRODUCTION

This document presents the cultural resources coordination plan (CRCP) for the Upper Columbia River (UCR) site (herein the 'Site') remedial investigation and feasibility study (RI/FS). Emphasis is placed on sampling activities associated with the 2016 Residential Soil Study to be conducted within the UCR Study Area, as defined by the Quality Assurance Project Plan (QAPP) Addendum No. 1.

1.1 BACKGROUND

As specified in the Statement of Work associated with the June 2, 2006 Settlement Agreement (USEPA 2006), "For all RI/FS activities at the Site involving sediment collection or ground penetration/disturbance, the Company shall work with the potentially affected parties to assess the effects of the planned work and seek ways to avoid, minimize or mitigate any adverse effects on historic properties." The purpose of this CRCP is to describe known or likely physical impacts of proposed sediment/soil sampling, provide relevant background information, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and tribal parties with interests in the cultural resources of the Site and surrounding areas for this study.

The Site is located wholly within the state of Washington and includes approximately 150 river miles of the Columbia River extending from the U.S.-Canada border to the Grand Coulee Dam and those areas in proximity to such contamination necessary for implementation of the response actions described in the 2006 Settlement Agreement. The Colville Indian Reservation borders the UCR from approximately river mile (RM) 690 to the Grand Coulee Dam. The Spokane Indian Reservation borders the UCR to the east from approximately RM 650 to RM 640. Franklin D. Roosevelt Lake (Lake Roosevelt) and associated lands are administered by the U.S. Bureau of Reclamation (USBR) and the National Park Service (NPS) of the U.S. Department of the Interior.

The U.S. Environmental Protection Agency (EPA) has responsibilities under the National Historic Preservation Act (NHPA) to consider how its undertakings would affect historic properties. As defined in the NHPA, "historic properties" include archaeological resources, historic-period buildings and structures, and traditional cultural places listed in or determined eligible for listing in the National Register of Historic Places (National Register). To meet the NHPA requirements, EPA must ensure that sampling and other activities would avoid, minimize, or mitigate any adverse effects on any historic properties.

The CRCP is organized into six sections, as follows: 1) this introductory section, which includes summary information on the archaeology, prehistory, Native peoples, and Euroamerican historical development of the project area; 2) an overview of the relevant federal, state, and tribal laws and regulations, and other appropriate procedures and requirements; 3) a description of the proposed sampling program; 4) a plan for coordination and consultation with all affected parties to address known and likely impacts on cultural resources in implementing the proposed work; 5) a list of references; and 6) a glossary of terms.

1.2 CULTURAL SETTING

The broader context of the cultural development of the upper Columbia region provides the critical framework for understanding the importance of cultural resources in the area. Archaeological and historical resources reflect broad patterns of cultural use and development, just as ongoing traditional use of areas and natural resources represents cultural continuity that can be important to individual and social identities. This section of the CRCP serves as a brief introduction to the cultural history of the upper Columbia region. The primary source of information on the prehistory of the area is Goodal et al. (2004); for Native peoples, the source is Kennedy and Bouchard (1998); and for Euroamerican history, McKay and Renk (2002).

Archaeological research contributes significantly to our understanding of the prehistoric past. In the upper Columbia region, systematic archaeological research began in the late 1930s and has continued to the present. Almost 500 archaeological resources have been recorded in and along Lake Roosevelt, representing prehistoric, protohistoric, ethnohistoric, and historic-period human use and occupation. Research at some of these resources has provided the outlines of prehistoric cultural development in the upper Columbia region. Human presence in the region extends back at least 11,000 years. These first humans lived in small groups and were mobile foragers, hunting and gathering plants. The presence of the Columbia River led to an early focus on the abundance of riverine sources. Beginning about 8,000 years ago, populations appear to have increased and led to a gradual trend to less mobility and more permanent settlements. The growing population also led to use of a greater diversity of resources and increasing reliance on fish.

Permanent settlements increased in size and became concentrated in the river valleys beginning about 6,000 years ago, probably in response to continued population growth. Use of resources in upland areas expanded to meet the needs of the burgeoning populations and settlements. These trends continued until about 1,000 years ago, when

there is evidence for a decline in population size. There were fewer settlements, villages were smaller, and there was less use of upland areas.

Cultural patterns of the late prehistoric period were reflected in the lives of the Native peoples at the time of Euroamerican contact. At the time of contact, the UCR was the homeland of the Lakes, Colville, Spokane, and Sanpoil peoples. The Lakes people occupied the Columbia River valley from the vicinity of modern Northport, WA, north into the Arrow Lakes area of modern British Columbia. The Colville lived along the river downstream of the Lakes as far as around the mouth of the Spokane River. Downriver of the Colville were the Spokane, in the Spokane River drainage, and the Sanpoil, who lived along the Columbia River from around the mouth of the Spokane River to near the modern location of the Grand Coulee Dam.

All of these groups spoke Interior Salish languages and shared many cultural features. Their cultural differences largely reflected differences in the local environments in which they lived. The social, political, and economic foundation of these groups was historically the winter village. The villages were concentrated in the river valleys, and each village was politically independent. Residents of the villages relied on provisions gathered, dried, and stored during the summer to survive through the winter. With the coming of spring, families began moving out of the winter village and shifting among the warm-season camps near resource locations. Gathering of plants and hunting game in upland areas were important subsistence activities during this season, but salmon constituted the most important food staple. Kettle Falls was a major aboriginal fishery, attracting people from throughout the region.

Native life began to change with the introduction of elements of Euroamerican culture. Horses reached the region in the 1700s and significantly changed Native travel and transportation. European diseases such as smallpox appeared in the late 1700s and had disastrous consequences for Native groups. Populations may have declined as much as 80 percent between the 1780s and 1840s. Direct contact with Euroamericans came in the early 1800s, when fur-trade posts were established on the Spokane River and at Kettle Falls.

When American settlement began in the 1840s, it bypassed the upper Columbia region. The discovery of gold in the region in the 1850s led to a major influx of Americans and growing conflict between the new settlers and Indian groups. A series of treaties with Indian groups were signed in 1855 but did not include the peoples of the upper Columbia region. As American settlement continued, the federal government responded by Presidential Executive Order creating the Colville Reservation in 1872 for the Colville, Spokane, Methow, Okanogan, Sanpoil, Lakes, Calispel, Coeur d'Alene, and scattering bands. Separate reservations were later set aside for the Spokane, Calispel, and Coeur

d'Alene Tribes. Both the Colville and Spokane reservations have subsequently lost lands to the allotment process in the late 1800s and early 1900s and inundation from the waters of Lake Roosevelt. The Colville Reservation is now home to the 12 tribes that comprise the Confederated Tribes of the Colville Reservation (CCT); the Spokane Reservation is the home of the Spokane Tribe of Indians (STI).

As already noted, the direct Euroamerican presence in the upper Columbia region began with the establishment of fur-trade posts on the Spokane River and at Kettle Falls. These posts were constructed between 1810 and 1825. The fur traders were followed by Christian missionaries in the 1830s and 1840s. A more substantial Euroamerican presence in the region developed in the 1850s, with the discovery of gold near Fort Colville. Conflicts between miners and Indians led to a military campaign in the Spokane River valley in 1858 and the establishment of an army post (Fort Colville) near Kettle Falls in 1859.

American settlement in the UCR drainage accelerated in the 1860s, initially spurred by mining. Farmers eventually followed the miners, but agricultural activity was limited until the construction of the Spokane Falls and Northern Railway through the region in 1890. With improved access to markets, farming—especially orchard crops—developed as one of the economic mainstays of the area, although mining has continued to play an important role.

The growing demands for agriculture led to plans to construct a dam at Grand Coulee. The dam would provide water for irrigation and inexpensive hydroelectric power. Construction of the dam began in 1934 and was completed in 1942. More than 82,000 acres above the dam was flooded, resulting in the relocation of 11 towns and about 3,000 residents. Since its creation, Lake Roosevelt has provided a growing number of recreational and tourist activities, which have become increasingly important to local economies.

2 OVERVIEW OF LAWS AND REGULATIONS

Implementation of the residential soil sampling plan will require activities on privately owned lands and tribal allotments. This overview therefore includes a brief description of relevant federal and state law, executive orders, and tribal laws and regulations.

2.1 FEDERAL LEGISLATION AND REGULATIONS

An overview of federal legislation and regulations is provided below. There are three key laws relevant to Site RI/FS activities. The NHPA guides all federal agency actions that could affect cultural resources. Implementation of the RI/FS constitutes an "undertaking" as defined in the NHPA; therefore, complying with the NHPA requirements is the responsibility of EPA. The Archaeological Resources Protection Act (ARPA) of 1979 and the Native American Graves Protection and Repatriation Act (NAGPRA) apply to activities that could affect archaeological resources and Indian burials on federal and tribal lands. These laws and their implementing regulations would therefore apply to RI/FS activities conducted on federal and tribal lands.

2.1.1 National Historic Preservation Act of 1966, as Amended through 1992 (16 USC 470-470w)

The NHPA is the centerpiece of federal legislation protecting cultural resources. In the Act, Congress states that the federal government will "provide leadership in the preservation of the prehistoric and historic resources of the U.S.," including resources that are federally owned, administered, or controlled. For federal agencies, Sections 106 and 110 of the Act provide the foundation for how federal agencies are to manage cultural resources, but other sections provide further guidance. The implementing regulations for the NHPA are in 36 Code of Federal Regulations (CFR) Part 800. These regulations are summarized below.

Section 106

Similar to the National Environmental Policy Act of 1969 (NEPA), Section 106 of the NHPA requires federal agencies to take into account the effects of their actions or programs, specifically on historic and archaeological properties, prior to implementation. This is accomplished through consultation with the State Historic Preservation Officer (SHPO) and/or the Advisory Council on Historic Preservation (ACHP). On lands held by a tribe with a Tribal Historic Preservation Officer (THPO), the THPO has the same duties and responsibilities as the SHPO. If an undertaking on federal lands may affect properties having historic value to a federally recognized Indian tribe, such tribe shall be afforded the

opportunity to participate as interested persons during the consultation process defined in 36 CFR 800. Compliance can also be accomplished using agreed-upon streamlined methods and agreement documents such as programmatic agreements.

The Section 106 process is designed to identify possible conflicts between historic preservation objectives and the proposed activity, and to resolve those conflicts in the public's interest through consultation. Neither the NHPA nor the ACHP's regulations require that all historic properties be preserved. Rather, they only require the agency proposing the undertaking to consider the effects of the proposed undertaking prior to implementation.

Failure to take into account the effects of an undertaking on historic or cultural properties can result in formal notification from the ACHP to the head of the federal agency of foreclosure of the ACHP's opportunity to comment on the undertaking pursuant to NHPA. A notice of foreclosure can be used by litigants against the federal agency in a manner that can halt or delay critical activities or programs.

The process for compliance with Section 106 consists of the following steps:

1. **Identification of Historic Properties**—Identification of historic properties located within the area of potential effects (APE) is accomplished through review of existing documentation and/or field surveys.
2. **Property Evaluation**—Evaluation of the identified historic properties using National Register criteria (36 CFR Part 63) in consultation with the SHPO and, if necessary, the ACHP. Properties that meet the criteria will be considered "Eligible" for listing in the National Register, and will be subject to further review under Section 106. Properties that do not meet the criteria will be considered "Not Eligible" for listing in the National Register, and will not be subject to further Section 106 review.
3. **Determination of Effect**—An assessment is made of the effects of the proposed project on properties that were determined to meet the National Register criteria, in consultation with the SHPO and, if necessary, the ACHP. One of the following effect findings will be made:
    - No Historic Properties Affected—If no historic properties are found or no effects on historic properties are found, the agency official provides appropriate documentation to the SHPO/THPO and notifies consulting parties. However, the federal agency must proceed to the assessment of adverse effects when it finds that historic properties may be affected or the SHPO/THPO or

Council objects to a "No Historic Properties Affected" finding. The agency must notify all consulting parties and invite their views.

- No Historic Properties Adversely Affected—When the Criteria of Adverse Effect are applied (36 CFR 800.5(a)), and it is found that historic properties will not be adversely affected by the undertaking, the agency may make a finding of "No Historic Properties Adversely Affected." This finding is submitted to the SHPO for concurrence. Typically, the Council will not review "No Adverse Effect" determinations. However, the Council will intervene and review "No Historic Properties Adversely Affected" determinations if it deems it appropriate, or if the SHPO/THPO or another consulting party and the federal agency disagree on the finding and the agency cannot resolve the disagreement. If Indian tribes disagree with the finding, they can request the Council's review directly, but this must be done within the 30-day review period. Agencies must retain records of their findings of "No Historic Properties Adversely Affected" and make them available to the public. The public should be given access to the information when they so request, subject to Freedom of Information Act (FOIA) and other statutory limits on disclosure, including the confidentiality provisions in Section 304 of the NHPA. Failure of the agency to carry out the undertaking in accordance with the finding requires the agency official to reopen the Section 106 process and determine whether the altered course of action constitutes an adverse effect.
- Historic Properties Adversely Affected—Adverse effects occur when an undertaking may directly or indirectly alter characteristics of a historic property that qualify it for inclusion in the National Register. Reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative also need to be considered. The finding of "Historic Properties Adversely Affected" is submitted to the SHPO for concurrence. The SHPO/THPO may suggest changes in a project or impose conditions so that adverse effects can be avoided and thus result in a "No Historic Properties Adversely Affected" determination.

4. **Resolution of Adverse Effects/Mitigation**—When adverse effects are found, the consultation must continue among the federal agency, SHPO/THPO, and consulting parties to attempt to resolve them. The agency official must notify the Council when adverse effects are found and should invite the Council to participate in the consultation when circumstances as outlined within 36 CFR 15

800.6(a)(1)(i)(A)-(C) exist. A consulting party may also request the Council to join the consultation.

When resolving adverse effects without the Council, the agency official consults with the SHPO/THPO and other consulting parties to develop a Memorandum of Agreement (MOA). The MOA will outline the steps or actions to be taken prior to implementation of the project, in order to mitigate the adverse effects on the historic property. Stipulations included in an MOA may include (but are not limited to) documentation, modification of the project to lessen the adverse effects on the property, efforts to sell or relocate the resource, or step-by-step consultation with interested parties throughout the process to ensure it is carried out according to plan.

The MOA is executed between the agency official and the SHPO/THPO and filed with required documentation with the Council. This filing is the formal conclusion of the Section 106 process and must occur before the undertaking is approved.

In some cases, streamlining of the Section 106 process can be accomplished through the use of programmatic agreements. The ACHP and the agency official may negotiate a programmatic agreement to govern the implementation of a particular program or the resolution of effects from complex projects or multiple undertakings. Programmatic agreements are particularly useful when programs or projects affecting historic properties are similar and repetitive, and have known effects, such as routine maintenance or a series of similar rehabilitation projects.

Section 101(d)(2)

This section of the NHPA provides for the assumption by federally recognized Indian tribes of all or any part of the functions of a SHPO with respect to tribal lands (e.g., all lands within the exterior boundaries of any Indian reservation and all dependent Indian communities). Section 101(d)(2) requires federal agencies, in carrying out their Section 106 responsibilities, to consult with federally recognized Indian tribes that attach religious or cultural significance to a historic property. The agency will consult with federally recognized Indian tribes in the Section 106 process to identify, evaluate, and treat historic properties that have religious or cultural importance to those groups.

Section 110

Section 110 of the NHPA is intended to ensure that historic preservation is integrated into the ongoing programs of federal agencies. This section of the Act requires agencies to identify, evaluate, and nominate for listing in the National Register, historic properties

owned or controlled by the agency; use historic properties to the maximum extent feasible; ensure documentation of historic properties that are to be altered or damaged; carry out programs and projects that further the purpose of the Act; and undertake such planning and actions as may be necessary to minimize harm to any formally designated National Historic Landmark properties.

Section 111

Section 111 of the NHPA requires agency officials, to the extent practicable, to establish and implement alternatives for historic properties, including adaptive use, that are not needed for current or projected agency uses or requirements. Further, Section 111 allows the proceeds from any lease to be retained by the agency to defray the cost of administration, maintenance, repair, and related expenses of historic properties.

Section 112

Section 112 of the NHPA requires that agency officials who are responsible for protection of historic properties pursuant to the NHPA ensure that all actions taken by employees or contractors meet professional historic preservation standards established by the Secretary of the Interior (Professional Qualifications Standards of the Secretary of the Interior's Standards and Guidelines in Archaeology and Historic Preservation [NPS 1983]).

Section 304

Section 304 of the NHPA requires that information about the location, character, or ownership of a historic property be withheld from public disclosure when the federal agency head or other public official determines that disclosure may cause a significant invasion of privacy, risk and/or harm to the historic property, or impede the use of a traditional religious site by practitioners.

CERCLA and the NHPA

EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements (USEPA 1989) outlines how "substantive compliance" with the NHPA is to be achieved in CERCLA actions. The initial step is determining if cultural resources are known or are likely to be present "in or near the area under study in the RI." This step may require conducting a survey of both the location of the proposed remedial action and any associated actions that would occur off-site. The CERCLA manual referenced above defines three stages of a survey: Stage IA, literature search and sensitivity study; Stage IB, field investigation; and Stage II, site definition and

evaluation. All studies should include Stage IA but implementation of Stage IB is contingent on the results of Stage IA, and the need for Stage II is contingent on the results of Stage IB. If results of the survey identify significant cultural resources (i.e., resources listed or considered eligible for listing on the National Register), effects of the proposed remedial action and associated actions to the significant resources must be evaluated. Adverse effects on significant resources must be either avoided or mitigated. Any proposed mitigation measures must be incorporated into the remedial design process.

2.1.2 Archaeological Resources Protection Act of 1979 (16 USC 470aa-470ll)

ARPA is essentially an update to the 1906 Antiquities Act. It expands and strengthens the activities prohibited under the Antiquities Act, increases the criminal penalties for violation, establishes civil penalties, and provides further guidelines for the issuance of permits. This Act continues to apply only to federal and Indian lands (the definition of "Indian lands" in ARPA differs very slightly from the definition of "tribal lands" in the NHPA). Most archaeological excavations and collection of artifacts on these lands are allowed only with an ARPA permit. Trafficking in illegally obtained archaeological resources from federal and Indian lands is also prohibited. Individuals convicted of violating the Act are liable for the value of the archaeological resource itself, and the cost of restoration or repair of the damage caused by illegal excavation or collection.

The implementing regulations are 43 CFR Part 7 (Department of the Interior), which applies to federal lands that are not within military reservations or national forests. The regulations include detailed definitions of "archaeological resource" and "Indian lands" (lands held in trust by the United States on behalf of a federally recognized tribe or individual members of a federally recognized tribe).

2.1.3 Native American Graves Protection and Repatriation Act (25 USC 3001-3013)

NAGPRA establishes that Native American human remains and associated funerary objects found on federal or tribal lands belong to the lineal descendants of the Native American. When the lineal descendants cannot be determined, the remains belong to the tribe on whose land the remains were found (when found on tribal lands), or to the Indian tribe with the "closest cultural affiliation." This latter rule also applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony (all defined in the Act); NAGPRA applies to both human remains intentionally excavated (which would require an ARPA permit) and those accidentally discovered.

NAGPRA also requires all federal agencies and museums to inventory their holdings of Native American human remains and funerary objects. Once the inventories are completed, the agencies and museums are to notify the appropriate tribes of the remains and other objects in their collections. The remains and associated funerary objects are to be returned (repatriated) at the request of the lineal descendant(s) or tribe. The same requirement applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony for which a cultural affiliation can be demonstrated. Exceptions to the repatriation requirement are objects that are "indispensable for completion of a specific scientific study, the outcome of which would be of major benefit to the U.S."

The implementing regulations are 43 CFR Part 10, which largely expand on the elements of the statute. The regulations detail: 1) the process of consultation with Indian tribes to address either intentional excavation of human remains or inadvertent discovery of human remains; 2) how agencies and museums are to inventory their collections; and 3) the repatriation process. When human remains, funerary objects, sacred objects, and objects of cultural patrimony are inadvertently discovered on federal lands, the following steps are to be followed: 1) ongoing activity in the area of the find must cease and a reasonable effort made to protect the find; and 2) the federal land agency (i.e., the federal agency on whose lands the remains or objects have been found) must be immediately notified by telephone, with written confirmation. The federal land agency must then notify the appropriate tribe(s) and further secure and protect the discovery. The activity may be halted for up to days while an appropriate response to the find is negotiated by the federal agency and the appropriate tribe(s).

2.1.4 American Indian Religious Freedom Act (42 USC 1996)

This Act states that it is the policy of the United States to protect and preserve the rights of American Indians to practice traditional religions. That policy includes rights of access to sacred sites and to the use and possession of sacred objects. There are no implementing regulations.

2.2 PRESIDENTIAL EXECUTIVE ORDERS

Presidential executive orders define policies and procedures for federal agencies to facilitate their execution of laws passed by the Congress or clarify how specific laws are to be implemented. Presidential executive orders can be considered instructions or directives from the President to federal agencies on how to carry out specific laws. The executive orders listed below are either directly related to cultural resources or define relationships between federal agencies and tribes.

2.2.1 Executive Order 11593. Protection and Enhancement of the Cultural Environment

Issued in 1971, Executive Order 11593 states that the federal government would provide leadership in "preserving, restoring, and maintaining the historic and cultural environment of the Nation." Federal agencies were directed to inventory cultural resources under their jurisdiction and nominate National Register-eligible properties to the National Register. Properties that have been determined eligible are not to be transferred, sold, demolished, or altered without providing the ACHP on Historic Preservation with an opportunity to comment. Properties to be demolished or substantially altered were to be documented prior to demolition or alteration. National Register properties or National Register-eligible properties under federal control were to be maintained following standards set by the Secretary of the Interior. Executive Order 11593 also assigns specific responsibilities to the Secretary of the Interior, including managing the National Register and assisting and advising other federal agencies in the management of cultural resources.

2.2.2 Executive Order 13007. Indian Sacred Sites

Issued in 1996, Executive Order 13007 directs federal agencies to provide access and ceremonial use of Indian sacred sites, where practicable, legal, and not inconsistent with essential agency functions. Agencies are also directed to avoid adversely affecting sacred sites and maintain the confidentiality of such sites. A "sacred site" as defined by this executive order is a specific location that is sacred because of its religious significance to or ceremonial use in an Indian religion.

2.2.3 Executive Order 13175. Consultation and Coordination with Indian Tribal Governments

Issued in 2000, Executive Order 13175 directs federal agencies to consult with tribal officials in the development of policies and regulations that have "tribal implications" or that preempt tribal law. Executive Order 13175 also emphasizes the importance of government-to-government relationships between the United States government and tribes. Agencies must designate an official responsible for implementing the executive order and must document tribal consultation in the development of the relevant policies and regulations.

2.3 TRIBAL LEGISLATION AND REGULATIONS

Tribal laws and regulations addressing cultural resources would apply to lands on the reservations and off-reservation trust lands. The CCT and the STI are the two tribes whose laws and regulations would be potentially applicable to the Site. The legal code of the CCT

addresses cultural resources, as summarized below. This code applies to both on-reservation actions and off-reservation actions by federal agencies that could affect cultural resources. STI does not currently have laws that specifically address cultural resources. Both tribes have THPOs, who have the same authority and responsibilities as the SHPO on their respective reservations and on off-reservation trust lands.

2.3.1 Confederated Tribes of the Colville Reservation. Colville Tribal Law and Order Code Chapter 4-4, Cultural Resources Protection

This Colville Tribal Code establishes the Colville Cultural Resources Board, which has the responsibility of developing policies and procedures to protect cultural resources of interest and concern to the Colville Tribes, both on and off the Colville Reservation. The Board reviews proposed federal agency actions off the reservation and is responsible for reviewing all proposed on-reservation actions that could affect significant cultural resources. The code also establishes a Colville Register of Historic and Archaeological Properties for listing of historic properties on the Colville Reservation.

This code defines the roles and responsibilities of the Colville History and Archaeology Department, which include identifying significant cultural resources on the reservation, nominating properties to the National Register and the Colville Register, and promoting efforts to protect cultural resources on the reservation.

Chapter 4-4 of Colville Tribal Code prohibits the excavation, disturbance, or other adverse effects to archaeological resources and historic properties on the reservation without a permit issued by the History and Archaeology Department. The code defines the procedure for the issuance of permits and the duties of permittees.

2.4 STATE LEGISLATION AND REGULATIONS

Washington state laws and regulations regarding archaeological and historical resources, as well as the law protecting Indian graves, are not applicable on federal lands or on tribal trust lands. These laws would apply, however, to any RI/FS-related activities that would affect private lands, non-federal lands, or non-tribal public lands.

2.4.1 Revised Code of Washington (RCW) Chapter 27.44, Indian Graves and Records

This legislation prohibits the removal or other disturbance of Indian burials, cairns, and "glyptic or painted records." "Burials" and "graves" are not defined in the statute. Excavation or removal of burials is permitted only under provisions of a permit issued by

the Washington Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in Washington Administrative Code (WAC) Chapter 25-48.

2.4.2 RCW Chapter 27.53, Archaeological Sites and Resources

This legislation prohibits the excavation or disturbance of archaeological sites on public and private lands in Washington except under provisions of a permit issued by the Washington Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in WAC Chapter 25-48.

2.4.3 RCW Chapter 68.60, Abandoned and Historic Cemeteries and Historic Graves

This legislation prohibits the destruction, alteration, or other disturbance of historical land, abandoned cemeteries, and historic graves (Indian graves and burials are protected in RCW Chapter 27.44). A historic cemetery is defined in the statute as one established before November 1889. A historic grave is a grave or graves outside of a cemetery placed prior to June 1990.

2.4.4 RCW Chapter 43.21C, State Environmental Policy Act

This legislation directs state and local agencies in Washington to address environmental impacts of proposed projects. The implementing rules (WAC Chapter 197-11) require that impacts on historic and cultural resources are to be addressed in the State Environmental Policy Act process.

3 PROPOSED SAMPLING PROGRAM

Residential properties in the Columbia River valley just south of China Bend, WA and extending south of the U.S.-Canada border are the focus of this investigation (UCR Study Area; see Figure H1). Sampling locations are provided in Attachment B. Properties to be sampled were identified through voluntary participation. In January 2016, Teck American Incorporated (TAI) sent letters to property owners in the area to seek voluntary participation in this residential soil sampling study. TAI visited each of the volunteered properties in the spring of 2016, interviewed property owners, and defined and mapped exposure areas. No soil was disturbed during the site visit. The EPA and TAI will convene a meeting with the UCR Cultural Resources Working Group to consult and review the mapped information as soon as it is available.

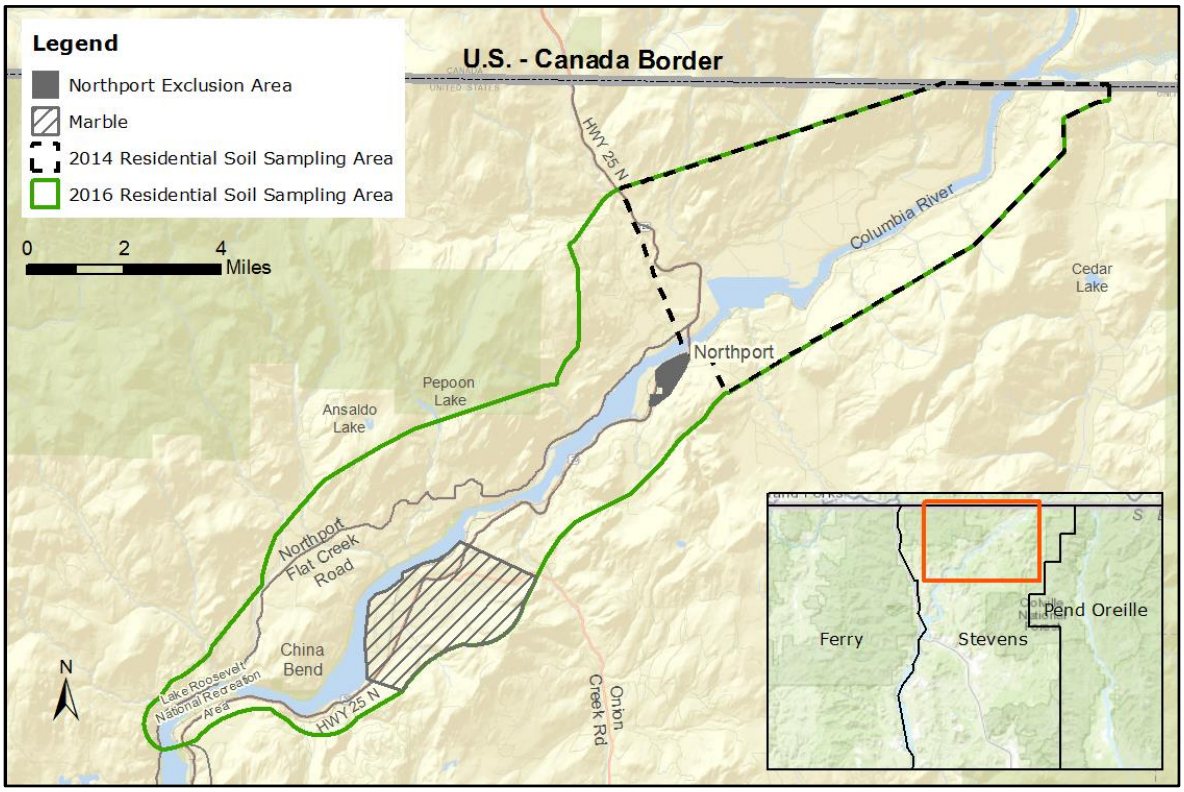


Figure H1. UCR Study Area for the 2016 Residential Soil Study

Given that the primary goal of the study is to sample metals in surface soils in areas with high human exposure potential, the investigation places emphasis on the utilized portions of each parcel (i.e., the areas around each house where residents are most likely to come into contact with surface soils). Children's play areas and gardens were targeted for soil sampling. Gardens were targeted because intermittent exposure may occur in these areas

during digging in the surface for tilling and weeding, planting, and moving plants. Animal pens or riding areas will also be sampled because of the potential exposure to surface soils. Drip lines of residences and other large painted structures (e.g., barns) will not be sampled unless there is a concern for lead-based paint. Areas near roadways and railways (with a 50-foot buffer from the roadway edge or edge of railway bed) will be avoided to prevent sampling soil that may be contaminated by non-air sources. Most of the soil samples will be collected using an incremental composite (IC) sampling design (see Figure H2). IC sampling entails the collection of multiple individual volumes of soil (termed "increments") from a target area (i.e., a decision unit [DU]) that are composited and subsampled according to a detailed standard operating procedure prior to laboratory analysis (ITRC 2012). In addition, at a representative subset of DUs where the IC sample depth is 0 to 1 inch below ground surface (bgs), five discrete core samples will be collected from the 0 to 1 inch and 1 to 6 inch bgs depth intervals.

3.1 METHOD FOR COLLECTING INCREMENT SOIL SAMPLES

Individual soil increments will be collected using a cylindrical or core-shaped sampler to ensure that each increment contains a proportionate amount of soil particles over the entire depth of interest, with an equal volume of soil particles from the top of the sample as the bottom. The diameter of the cylindrical or core-shaped sampler will be between 2 to 4 inches but will remain constant within a DU.

Care will be taken to collect an IC sample that contains the same amount of soil particles from the top of the sample as the bottom. This will be achieved by scraping the length of the core using a decontaminated trowel or disposable scoop to remove the increment sample from the corer into a bucket. Each increment across a DU will be collected in this manner, with the increments for one IC sample placed in the same large bucket, taking care to ensure that equal volumes of soil are collected from each increment location.

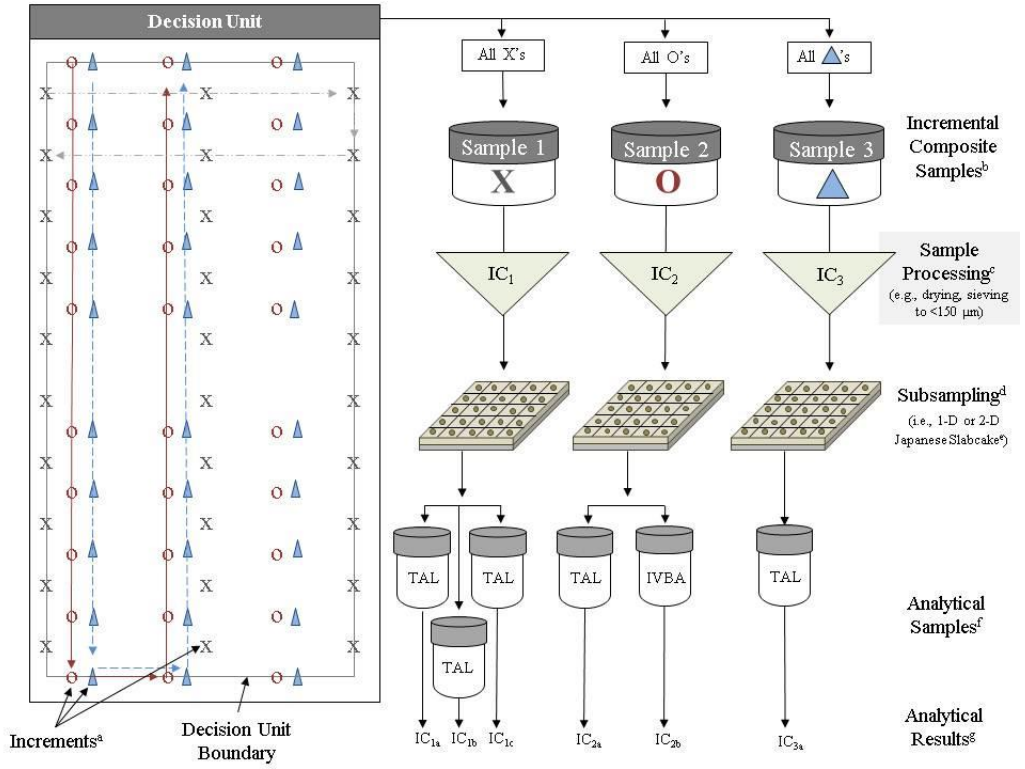


Figure adapted from ITRC (2012) and Hathaway et al. (2008).

Figure H2. Overview of the IC Sampling Design for Use in the 2016 Residential Soil Study[1]

[a] Increments will be located by using systematic random sampling and a square grid.

[b] Thirty increments will be collected during the same field sampling event for each of the IC samples. Equal volumes from each increment will be combined to create one IC sample (as shown). Additional information is available in the study field sampling plan (FSP) for the study (see Attachment D).

[c] Sample processing will take place in the laboratory, by pre-sieving the sample to 2 mm and then passing the entire IC sample through a 150 µm (or 250 µm sieve for beach DUs; see QAPP Addendum No. 1 for additional information on laboratory procedures).

[d] Laboratory subsampling will consist of 30 increments; all remaining sieved soil will be archived after analytical samples are obtained. No additional subsampling will be done once the laboratory subsample (2 g of < 150 or <250 µm soil) is placed in the jar. If laboratory replicate samples or split samples are required from a particular sample, additional jars will be required and 2 g of soil will be placed in each jar. Two g is the minimum mass required to control fundamental error (FE) at 5 percent for both <150 µm and <250 µm grain size fractions. Two g is also the minimum mass required to collect a representative subsample using incremental subsampling methods (Crumbling 2014).

[e] As described in ITRC (2012).

[f] Each of the IC samples will be analyzed for TAL metals (no mercury). Lead and arsenic bioaccessibility testing (USEPA 2007, 2012) will only be performed for non-dripline IC samples with lead concentrations ≥100 ppm or arsenic concentration ≥20 ppm with a target frequency of 20 percent of DUs. If a DU selected for bioaccessibility testing has one or more replicate IC soil samples with concentrations that are greater than or equal to 100 ppm lead or 20 ppm arsenic, one of the replicate IC soil samples will be randomly selected for testing.

[g] At least 10 percent of the IC samples will include the preparation and analysis of three laboratory replicate subsamples for the purpose of estimating variance due to sample processing and analytical error (combined).

[1] This overview example pertains to DUs where triplicate IC samples are collected and there is a single replicate IC sample that meets study design criteria for additional analysis of lead and arsenic bioaccessibility in soil.

3.2 METHOD FOR COLLECTING DISCRETE CORE SOIL SAMPLES

Individual discrete core soil samples will be collected using a cylindrical or core-shaped sampler to ensure that each sample contains a proportionate amount of soil particles over the entire depth of interest, with an equal volume of soil particles from the top of the sample as the bottom. The diameter of the cylindrical or core-shaped sampler will be between 2 to 4 in. but will remain constant within a DU.

Care will be taken to collect a discrete core sample that contains the same amount of soil particles from the top of the sample as the bottom. This will be achieved by scraping the length of the core using a decontaminated trowel or disposable scoop to remove the sample from the corer into a laboratory-supplied sample bottle.

3.3 SAMPLE DEPTH

The sampling depth will depend on the land use and will vary by DU. Surface soil will be collected from the top 0 to 1 in. depth interval (top 2 cm; USEPA 2003) in house, dripline, agriculture, and "other-not specified" DUs. For gardens (vegetable and ornamental), the depth will be the typical tilling depth (typically 0 to 12 in.). Sampling depth for play areas will generally be 0 to 1 in. For utilized areas where observed soil disturbance is greater than 1 in., the sampling depth will be 0 to 3 in. (e.g., animal activity areas). Discrete core samples will be collected to a depth of 6 in. bgs. Within each DU, 30 increments will be collected for each IC sample from each designated sample depth to support the human health risk assessment (HHRA). Details of the sampling design are provided in QAPP Addendum No. 1 and FSP (see Attachment D to the QAPP Addendum).

4 COORDINATION PLAN

The objective of the CRCP is to ensure that implementation of the RI/FS and associated sampling activities does not adversely affect any cultural resources. The plan therefore defines a general process and more specific procedures to meet this objective.

Few of the surveys conducted prior to about 1975 are likely to have met current regulatory and professional standards. In addition, many of the previous surveys focused on archaeological resources to the exclusion of other types of cultural resources (and older archaeological surveys documented only evidence of prehistoric use or occupation). Finally, it is likely that there are some locations previously surveyed at which burials or buried archaeological resources are present but not evident and therefore not recorded at the time of the survey (many surveys both in the past and in the present rely entirely or primarily on surface evidence of archaeological resources or burials).

This plan therefore defines procedures that address sampling at known locations of cultural resources and locations where no cultural resources are currently recorded. EPA is the lead federal agency for cultural resources coordination for the Site. Any issues or concerns related to cultural resources during the planning or implementation of Site work shall be brought to the attention of EPA for consultation with the UCR Cultural Resources Working Group, as appropriate.

4.1 GENERAL CONSULTATION FRAMEWORK

Successful implementation of the RI/FS and of this CRCP, given the issues defined above, will require ongoing consultation and coordination with the CCT, the STI, and the Washington State Department of Archaeology & Historic Preservation (DAHP) (i.e., the consulting parties). Other consulting parties (as defined in 36 CFR 800.2(c)) may be recognized in the future whose participation would be important for general consultation or coordination in the RI/FS process or for specific sampling locations. For the purposes of cultural resources coordination activities, the "consulting parties" referred to in this plan are distinguished from other "participating parties" to the RI/FS process.

4.2 CULTURAL RESOURCE PROCEDURES IN THE SAMPLING PROCESS

This section defines general procedures to be followed in the sampling process to minimize the potential for inadvertent disturbance of cultural resources. More specific protocols to respond to discoveries are defined in the following sections.

A tribal cultural resources monitor or a professional archaeologist will be present on-site to monitor sampling. The protocol for this monitoring is defined below.

4.2.1 Archaeological Monitoring in the Sampling Program

To ensure compliance with the NHPA and the applicable requirements, procedures, and standards of the CCT and STI, the following procedures have been developed to address potential discoveries, including inadvertent discoveries, of cultural materials and deposits (including sacred objects, funerary objects, and objects of cultural patrimony as defined in NAGPRA) and Indian burials and human remains (as defined in NAGPRA) during sediment and soil sampling and associated activity that could result in ground disturbance.

Professional Archaeologist and/or Tribal Representative On-Site

An archaeological monitor and/or tribal representative will be present on-site when ground-disturbing sampling or sampling-related activity occurs. The archaeological monitor and/or tribal representative will visually examine all samples to determine if evident or likely artifacts are present or if other deposits are present that are likely to be cultural in origin. The archaeological monitor and/or tribal representative will not make physical contact with the sample unless artifacts or other cultural deposits are present. If artifacts or likely archaeological deposits are present, the archaeologist or tribal representative will record the location of the materials and photograph the materials in place in such a manner to provide information on provenience. The artifacts and other archaeological materials will then be re-deposited at their original location.

The archaeological monitor and/or tribal representative will document their observations on a daily basis, including field notes and photographs that record the location and character of the sampling or other ground-disturbing activity, any archaeological discoveries made, and any decisions made within the provisions of this plan by the archaeological monitor and tribal representative in response to any archaeological discoveries. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

All archaeological monitors and tribal representatives will be required to have read the applicable health and safety plan and to have complete understanding of the archaeological monitoring provisions of this plan. The archaeological monitors will also be required to meet requirements for personal protective equipment. In addition, all on-site personnel are subject to the directions of the task field supervisor at all times.

Discoveries—Archaeological Monitors Present

At the discretion of the archaeological monitor or tribal representative, ground-disturbing sampling or associated activity may be slowed or halted at any time that a suspected archaeological object or archaeological resource is encountered. The objective of this slowing or halting of ground-disturbing activity is to allow the archaeologist to confirm and/or make a preliminary assessment of the discovery. At the discretion of the archaeological monitor or tribal representative, a specific sample may be relocated from the location of the discovery but at the sampling location. Such relocation will be coordinated with the on-site sampling manager or supervisor.

At the request of the archaeological monitor or tribal representative, the sampling personnel will either:

- Assist in securing access to the location of the discovery and take appropriate measures to protect the location of the discovery from rain, stormwater, and other possible disturbances, or
- Assist in moving the artifacts to a protected and secure area of the site away from the immediate sampling area. Removal of artifacts from the discovery location will be undertaken only if leaving the artifacts in place would jeopardize their integrity due to erosion or collection by unauthorized individuals.

The archaeological monitor, tribal representative, or a member of the TAI field sampling team will remain on-site to ensure the security of the find until more extensive efforts can be made to secure the site from further disturbance or a more extensive evaluation and documentation of the discovery can be made.

Notification of any archaeological discoveries must be provided to EPA for further coordination with consulting parties within 24 hours of the discovery. EPA contact information is provided in Attachment H1. All telephone notification of discoveries must be promptly followed by notification in writing (via email or conventional mail).

Discovery of Human Remains

Native peoples in the UCR Study Area consider the graves of their ancestors to be important in both their cultural identity and in defining their relationship with the land. These graves are therefore considered sacred and should be left undisturbed. Should inadvertent disturbance occur, the remains and associated materials ("funerary objects") must be treated with respect and honor. All appropriate federal, tribal, and state laws, regulations, and procedures regarding burials should be rigorously enforced. In the event that likely or confirmed human remains are encountered, all further sampling or other ground-disturbing activity will cease immediately.

Upon such discovery, the TAI field sampling team will notify EPA for further coordination with consulting parties (consisting minimally of the CCT, STI, and the DAHP). The field sampling team will assist the archaeological monitor and tribal representative in securing the location of the discovery.

If no archaeological monitor or tribal representative is present, the TAI field sampling team will secure the location of the discovery in such a manner that both maintains the physical integrity of the remains and any associated objects and precludes further disturbance, or a member of the TAI field sampling team will remain on-site until an archaeologist or tribal representative can arrive to assess the find.

Other conditions for responses to discoveries of archaeological materials may be defined in the permit(s) issued for the sampling program. Responses to any discoveries of burials must comply with provisions of NAGPRA and its implementing regulations (in addition to those referenced above), as well as the existing protocols of the CCT and STI (these protocols are provided in Attachment H2).

4.2.2 Curation

Artifacts and other cultural materials that may be recovered during the sampling program (with the exception of human remains and associated items subject to NAGPRA) will be curated at a facility that meets the standards of 36 CFR 79. The appropriate tribe will designate the curation facility for cultural materials recovered from tribal lands.

4.2.3 Reporting

Within 150 days of completion of each sampling activity that is covered under this plan, a professional archaeologist will prepare a confidential written report that presents the results of the archaeological monitoring and responses to any discoveries of archaeological resources or burials. The report will include: 1) copies of field notes, descriptions, and maps of all locations at which sampling-related archaeological monitoring was conducted; 2) descriptions of any discoveries made during such monitoring and the outcome of the discoveries (including the rationale for the decisions for the disposition of any finds); 3) descriptions and maps of all non-monitored locations at which inadvertent discoveries were made and the outcome of those discoveries; and 4) recommendations for any changes in the monitoring protocol or coordination plan that may be appropriate to address results of the monitoring or how well existing coordination procedures worked. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

The draft report will be provided to EPA for review and dissemination to the consulting parties for review and comment.

4.3 CONFIDENTIALITY

The TAI field sampling team shall make its best efforts, in accordance with state and federal law, to ensure that its employees and contractors keep the discovery of any found or suspected human remains, other cultural items, and potential historic properties confidential. Pertinent TAI employees and contractors will be required to read and sign a confidentiality statement that specifies procedures to be followed in response to media and public contacts regarding archaeological and other cultural resources. To the extent permitted by law, prior to any release of information, EPA, TAI, and the other consulting parties shall concur on the amount of information, if any, to be released to the public, any third party, and the media and the procedures for such a release.

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6 GLOSSARY OF TERMS

Burial—A burial is defined in NAGPRA as "[a]ny natural or prepared physical location, whether originally below, on, or above the surface of the earth, into which as part of the death rite or ceremony of a culture, individual human remains are deposited."

Curation—Long-term storage and preservation of archaeological collections. Archaeological collections from federal lands must be curated at facilities that meet the standards of 36 CFR 79.

Ethnohistoric—Information on Native peoples gathered from historical accounts.

Historic, historic-period, historical—The NHPA uses the term "historic" to refer to properties that are listed or have been determined eligible for listing on the National Register of Historic Places. To avoid confusion with this definition of "historic," "historic-period" or "historical" are used to reference resources, places, events, and people associated with the period since the appearance of Euroamericans and the beginning of written accounts (ca. 1780–1810 in the Pacific Northwest).

Protohistoric—The period of time transitional from prehistory to history. In the Pacific Northwest, the protohistoric can be generally defined as from the late 1600s until late 1700s.

ATTACHMENT H1

USEPA CONTACT INFORMATION

USEPA CONTACT INFORMATION

Monica Tonel is the primary contact for the EPA. Ms. Tonel's telephone number is (206) 553-0323 (office) and email is Tonel.Monica@epa.gov. Ms. Tonel will have a cell phone number that will be provided to the sampling team(s), tribes, and state, prior to field sampling activities commencing.

If Ms. Tonel cannot be reached, then Laura Buelow is the alternate EPA contact at (509) 376-5466 (office) or (509) 420-0435 (cell) and at Buelow.Laura@epa.gov.

In the event that either Ms. Tonel or Ms. Buelow cannot be contacted, then Dustan Bott will be contacted at (206) 553-5502 (office) and at bott.dustan@epa.gov.

ATTACHMENT H2

PROTOCOLS FOR INADVERTENT DISCOVERIES

PROTOCOLS FOR INADVERTENT DISCOVERIES

Lake Roosevelt Protocols for Native American Graves Protection and Repatriation Act (NAGPRA) Inadvertent Discoveries or Intentional Excavations:

Confederated Tribes of the Colville Reservation

This protocol is intended to cover NAGPRA items exposed by inadvertent discoveries or intentional excavations within EPA Sample Units. The term "NAGPRA items" in this document refers to human NAGPRA items, associated funerary objects, and objects of cultural patrimony as they are defined in 25 USC 3001. This document does not address inadvertent discoveries on lands within reservation boundaries or trust land outside of the reservation boundaries of the CCT. Funding of actions is not covered under this protocol.

1. If NAGPRA items that are potentially human are encountered, any activity in the vicinity of the discovery shall cease and all reasonable efforts shall be made to protect the NAGPRA items and all appropriate effort shall be made to determine if the NAGPRA items are human. The activity shall resume only when clearance to proceed is received by the CCT THPO and Washington State DAHP.
2. If the NAGPRA items are determined to be human, the burial or location shall not be disturbed in any way. Any discovered human NAGPRA items and associated artifacts will be treated in a respectful manner.
3. In cases where a potential crime scene exists, *personnel except those necessary to protect the location will leave the immediate vicinity in order to prevent unintentional destruction of crime scene information*. The Stevens County Sheriff's Office will be immediately notified.
4. The Colville THPO and the archaeologists working for the Colville Tribes (numbers listed below) will also be contacted immediately after law enforcement. The CCT staff will also be in contact with DAHP's State Physical Anthropologist. Live telephone contact is required; backup staff are identified if the primary contacts are unavailable. Telephone contact will be followed up by written confirmation; email is acceptable. Email should not include detailed information (site-specific) for security reasons.
5. A professional archaeologist will assist law enforcement in determining if the NAGPRA items are archaeological in origin. If the crime scene is ARPA-related (i.e., there is evidence for intentional disturbance or looting of archaeological

materials), an archaeologist shall assist law enforcement as needed in the collection of archaeological data to support the ARPA case.

6. Guy Moura, CCT THPO and Program Manager of the CCT History/Archaeology Program, is the primary contact for the CCT. Mr. Moura's telephone number at the Program is (509) 634-2695 and email is guy.moura@colvilletribes.com. After hours, Mr. Moura can be contacted at (509) 631-1705 (cell). If Mr. Moura cannot be reached, then Jon Meyer, Tribal Archaeologist is the alternate contact at (509) 634-2691 (office) or (509) 631-2130 (cell), and atjon.meyer@colvilletribes.com. In the event that neither Mr. Moura nor Mr. Meyer cannot be contacted, then Arrow Coyote, CCT Archaeologist, will be contacted at (509) 634-2736 (office) or (509) 634-1280 (cell), and at arrow.coyote@colvilletribes.com. Mr. Meyer or Ms. Coyote shall participate in the NAGPRA consultation process on Mr. Moura's behalf until his return. Jackie Cook, Repatriation Specialist, will also participate in the NAGPRA consultation process. Ms. Cook's contact information is (509) 634-2635 (office) or (509) 631-1176 (cell), and jackie.cook@colvilletribes.com.The CCT shall maintain a presence at the location of the discovery, as needed, until all contacts have been made and appropriate treatment of the NAGPRA items has been conducted.
7. As soon as the NAGPRA items have been determined to be human, then all effort shall be made in the field to determine whether human NAGPRA items are Native American. If yes, skip Steps 8 and 9 below and proceed to Step 10.
8. If the NAGPRA items are determined not to be Native American, then Washington state laws apply and shall be followed (Title 68, Chapter 68.50 RCW HUMAN NAGPRA ITEMS).
9. If the NAGPRA items' affiliation cannot be determined in the field, further non-destructive analysis of human NAGPRA items and/or associated cultural materials may be required. The CCT and DAHP shall coordinate regarding the types of non-destructive analysis to be conducted.
10. Provenience information will be collected as specified by the written plan of action.
11. Recording of provenience may include any or all of the following: documenting the location of the burial or scattered NAGPRA items and general site conditions on a site form or on an addendum to an existing form; describing the surface visible NAGPRA items to the degree that can be accomplished without causing additional disturbance to the grave; documenting the location of the burial on a USGS 7.5' topographic sheet and with a global positioning system (GPS) unit.

12. If it is possible to rebury or cap the NAGPRA items in place, then that decision shall be documented in the written plan of action (see below).
13. If NAGPRA items must be excavated or removed, procedures will be specified by the written plan of action. If NAGPRA items are to be excavated or removed by personnel other than those employed by the CCT or DAHP, an ARPA permit will be required from the NPS.
14. Excavation or removal procedures may include any or all of the following: NAGPRA items will be removed using standard professional archaeological practices in a culturally sensitive manner at the direction of a CCT History/Archaeology Department representative. Such practices may include collection of horizontal provenience data referenced to a site datum point; if excavation is required, vertical provenience data shall be tracked through the use of controlled 10-cm levels within a standard grid unit, screening of all excavated fill through 1/8-in. screen mesh, and photographic and to-scale plan map documentation of excavated features. All recovered items shall be listed in the field during collection to minimize handling after recovery.
15. Inadvertent discoveries that result from activities requiring easements or other non-ARPA permits (such as access, construction, etc.) shall be dealt with by the permitting agencies. This protocol document will be included with documents issued to permittees.
16. The written plans of action for individual discoveries will detail exact procedures for further implementation of NAGPRA. A sample written plan of action is attached.
17. Protocols on Privately-Owned Lands
    - In the event of an inadvertent discovery on private property, the discovery will be documented/recorded. The object(s) shall be left in place and cannot be taken away without the landowner's permission (Robert G. Whitlam, State Archaeologist, Washington Department of Archaeology & Historic Preservation, telephone call with Monica Tonel of EPA on July 29, 2014).

If the landowner wants information about possible sites on their property, they can contact the DAHP (Eric Oosahwee-Voss, Archaeologist, Colville Confederated Tribes, e-mail communication to Monica Tonel of EPA on December 16, 2015).

Template NAGPRA Plan of Action for Lake Roosevelt.

This plan of action shall comply with the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 USC 3001 et seq.), its implementing regulations (43 CFR Part 10), and the Archaeological Resources Protection Act (ARPA) (16 USC 470 et seq.) with its implementing regulations (43 CFR Part 7).

1. The kinds of objects to be considered as cultural items as defined in Section 10.2 (b):
   - ✓ Human remains
   - ✓ Associated funerary objects
   - ✓ Unassociated funerary objects
   - ✓ Objects of cultural patrimony
   - ✓ Sacred objects

   These objects are cultural objects as defined under NAGPRA 43 CFR Part 10.2 (d).
2. The specific information used to determine custody pursuant to Section 10.6:
   - ✓ Traditional association (this is where the tribe's area of interest is cited with reference to Lake Roosevelt)
   - ✓ Cultural affiliation
   - ✓ Evidence: geographical, archaeological, linguistic, folklore, oral tradition, historical
3. The planned treatment, care, and handling of human remains and other objects as defined in NAGPRA
4. The planned archaeological recording of the human remains and other objects as defined in NAGPRA
5. The kinds of analysis planned for each kind of object
6. Any steps to be followed to contact Indian tribe officials at the time of intentional excavation or inadvertent discovery of specific human remains and other objects as defined in NAGPRA
7. The kind of traditional treatment, if any, to be afforded the human remains and other objects as defined in NAGPRA by members of the Indian tribe
8. The nature of reports to be prepared
9. The planned disposition of human remains, and other objects as defined in NAGPRA.