UPPER COLUMBIA RIVER

Final
Quality Assurance Project Plan for the Bossburg Flat Beach Refined Sediment and Soil Study

Prepared for

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SECTION A: PROJECT MANAGEMENT

A1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN FOR THE BOSSBURG FLAT BEACH REFINED SEDIMENT AND SOIL STUDY

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EPA Quality Assurance Manager	Ginna Grepo-Grove		Date 01/27/2015
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Senior Technical Advisor	Mark Velleux	Mark Velleux	Date Jan 21, 2015
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Analytical Chemistry Laboratory Coordinator	Dave Enos		Date Jan 20, 2015
Analytical Laboratory Project Manager	Jeff Christian		Date 01/21/2015
Analytical Laboratory Quality Assurance Manager	Lee Wolf		Date 01/21/2015
Database Administrator	Cristy Kessel	Cristy Kessel	Date 01/21/2015

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ACRONYMS AND ABBREVIATIONS

Agreement	June 2, 2006, Settlement Agreement
ACG	analytical concentration goal
ALS	ALS Environmental
CEC	cation exchange capacity
COC	chain-of-custody
DQI	data quality indicator
DQO	data quality objective
DMP	data management plan
DU	decision unit
EcoSSL	ecological soil screening level
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ESI	Environmental Services, Inc.
FEM	Forum on Environmental Measurement
FSP	field sampling plan
GIS	geographic information system
ICS	incremental composite sampling
ITRC	Interstate Technology and Regulatory Council
IVBA	*in vitro* bioaccessibility assay
LCS	laboratory control sample
LCSD	LCS duplicate
MDL	method detection limit
MQO	measurement quality objective
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NIST	National Institute of Standards and Technology
PARCC	precision, accuracy or bias, representativeness, completeness and comparability
QA	quality assurance
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan

QC	quality control
RI/FS	remedial investigation and feasibility study
RM	river mile
RPD	relative percent difference
RSD	relative standard deviation
SHSP	Site Health and Safety Plan
SOP	standard operating procedure
START	Superfund Technical Assessment and Response Team
TAI	Teck American Incorporated
TAL	target analyte list
TOC	total organic carbon
UCR	Upper Columbia River
YAM	Young America Mill
XRF	X-ray fluorescence

UNITS OF MEASURE

°C	degree(s) Celsius
cm	centimeter(s)
dw	dry weight
g	gram(s)
in.	inch(es)
ft	foot/feet
m	meter(s)
mg/kg	milligram(s) per kilogram
mm	millimeter(s)
ppm	parts per million
µm	micrometer(s)

A3 DISTRIBUTION LIST

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A4 INTRODUCTION AND TASK ORGANIZATION

A4.1 Introduction

This document presents the quality assurance project plan (QAPP) for the Bossburg Flat Beach refined sediment and soil study (herein the 'study') along the Upper Columbia River (UCR). This work is being completed as part of the remedial investigation and feasibility study (RI/FS) conducted by Teck American Incorporated (TAI) under U.S. Environmental Protection Agency (EPA) oversight. Elevated lead concentrations were identified during sampling activities associated with the beach sediment study (TAI 2009). Subsequent investigations conducted by EPA under the Superfund Technical Assessment and Response Team (START) program in adjacent sites (i.e., the Young America Mine and Mill sites) identified elevated metal (i.e., lead) concentrations associated with historic mining and milling activities (WDNR 2008; Emerson 2012; TechLaw 2012a,b; and USEPA 2012a[1]).

The objective of this study is to generate data to refine exposure estimates and further inform risk evaluations for both human health and ecological receptors associated with near-shore sediments and soil adjacent to and down-gradient of the Young America Mill (YAM) site. Specifically, further refinement in near-shore sediments and soil is needed in areas adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (river mile [RM] 716) to Evans Campground Beach (RM 710) to determine the concentration of contaminants and determine, to the extent practicable, the sources of contamination. To meet this objective, data for target analyte list (TAL) metals[2] and *in vitro* bioaccessibility assay (IVBA) data for lead and arsenic will be collected to support human health and baseline ecological risk assessment efforts.

This QAPP describes the organization, data quality objectives (DQOs), study design, analytical procedures, and quality assurance and quality control (QA/QC) procedures upon which the study will be based. EPA's DQO process (USEPA 2006a) was used to guide development of the requirements and design rationale for data collection activities presented in this QAPP. The field sampling plan (FSP) describes field procedures and protocols that will be followed and is presented in Appendix A.

[1]Final documentation (including analytical data) associated with removal actions remain in preparation. Site profile information for the work can be accessed at the following web sites: Young America Mine @ http://www.epaosc.org/site/site_profile.aspx?site_id=7048 and Hahnlen Property @ http://www.epaosc.org/site/site_profile.aspx?site_id=8194.

[2]TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

A4.2 Task Organization

This section presents the organizational structure for activities associated with the study, including task management and oversight, fieldwork, sample analysis, and data management. Contact information for team task members is provided in Table A4-1.

A4.2.1 EPA Organization and Responsibilities

EPA will oversee TAI activities associated with the study and will coordinate U.S. Department of the Interior, Washington State Department of Ecology, and tribal (i.e., the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians) input with respect to review of technical documents submitted by TAI. In addition EPA, under Section 106 of the National Historic Preservation Act, has the primary responsibility for consulting with interested parties. EPA's project coordinators, Dr. Laura Buelow and Matt Wilkening, will be responsible for ensuring that the work performed is consistent with all applicable EPA guidance. EPA's quality assurance (QA) manager is Ginna Grepo-Grove, or designee.

A4.2.2 TAI Organization and Responsibilities

Kris McCaig will serve as TAI's project coordinator and will have the primary responsibility for ensuring that TAI meets all requirements and associated deliverables specified within the June 2, 2006, Settlement Agreement (Agreement) (USEPA 2006b). Drs. Mark Velleux and Nicholas Gard will be responsible for overseeing technical aspects of this study.

A4.2.3 Key Task Personnel

TAI technical team members for the study and their respective responsibilities are identified below.

Technical Team Coordinator—Dr. Nicholas Gard (Exponent, Inc.) will oversee task activities, review QA reports, and ensure that required activities are completed in sequence. Dr. Gard will work closely with the senior technical advisor and task QA coordinator to ensure that all requirements are met and study objectives achieved.

Senior Technical Advisor—Dr. Mark Velleux (HDR) will serve as the senior technical advisor and will oversee and approve all project activities, review QA reports, approve final project QA needs, and authorize necessary actions and adjustments needed to accomplish program QA objectives. Dr. Velleux will provide on-site supervision as needed, and coordinate with the field supervisor to ensure that proper sample collection, preservation, storage, transport, and chain-of-custody (COC) procedures are

followed. Dr. Velleux will inform the technical team coordinator when problems occur and will communicate and document corrective actions taken.

Task QA Coordinator—Rock Vitale (Environmental Services, Inc. [ESI]) is the task QA coordinator and is responsible for providing overall QA support for the study. Mr. Vitale will coordinate the validation of laboratory data; communicate data quality issues; and work with the database administrator to address potential data limitations. Mr. Vitale will report directly to the analytical chemistry laboratory coordinator, the database administrator, and the laboratories to ensure that data are of high quality.

Analytical Chemistry Laboratory Coordinator—Dave Enos (TAI) is the analytical chemistry laboratory coordinator and is responsible for ensuring that laboratory method selection and/or development is satisfactorily completed prior to the analysis of samples; coordinating with the testing laboratory and tracking the laboratory's progress; verifying that the laboratory has implemented the requirements of this QAPP; addressing QA issues related to the laboratory analyses; ensuring that laboratory capacity is sufficient to undertake the required analyses in a timely manner; and addressing scheduling issues related to laboratory analyses. Mr. Enos will report directly to the TAI project coordinator and will work closely with the technical team coordinator.

Database Administrator—Ms. Cristy Kessel (Exponent, Inc.) is the database administrator and will have primary responsibility for data management and database maintenance and development. Ms. Kessel will be responsible for overseeing and/or conducting the following activities: establishing storage formats and procedures appropriate for data collected; ensuring all data packages are complete and delivered in the correct format; maintaining the integrity and completeness of the database; and providing data summaries to data users for interpretation and reporting. Ms. Kessel will report directly to the technical team coordinator and will work closely with the task QA coordinator and laboratories.

A4.2.4 Analytical Laboratory

The analytical laboratory for this study will be ALS Environmental (ALS). Project and QA managers will have the following responsibilities.

Analytical Laboratory Project Manager—Jeff Christian is responsible for the successful and timely completion of sample analyses, as well as the following:

- Ensuring that samples are received and logged correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times

- Reviewing analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory standard operating procedures (SOPs)
- Apprising the analytical chemistry laboratory coordinator of schedule and status of sample analyses and data package preparation
- Notifying the analytical chemistry laboratory coordinator if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met
- Taking appropriate corrective action as necessary
- Reporting data and supporting QA information as specified in this QAPP
- Providing electronic data deliverables (EDDs) in a format consistent and compatible with the database.

Analytical Laboratory Quality Assurance Manager—Lee Wolf is responsible for overseeing QA activities in the laboratory and ensuring the quality of data for this study. Specific responsibilities include the following:

- Oversee and implement the laboratory's QA program
- Maintain QA records for each laboratory production unit
- Ensure that QA/QC procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures
- Review and address or approve non-conformity and corrective action reports
- Coordinate responses to any quality control (QC) issues that affect this task with the analytical laboratory project manager.

A5 PROBLEM DEFINITION AND BACKGROUND

Lead concentrations above a screening level of 400[3] ppm[4] were identified at Bossburg Flat Beach (RM 716) and Evans Campground Beach (RM 710) during beach sediment sampling activities conducted for the RI/FS. Additional investigations conducted in areas adjacent to Bossburg Flat Beach confirmed elevated lead concentrations associated with historic mining and milling activities (WDNR 2008; Emerson 2012; TechLaw 2012a,b; and USEPA 2012a). Based on the elevated lead concentrations, a removal action at the YAM site was completed by EPA in 2012. At the time of writing, final

[3] As defined within EPA's April 2012 fact sheet, the lead screening level of 400 ppm is considered "residential use" or safe for small children (http://yosemite.epa.gov/R10/CLEANUP.NSF/UCR/Fact+Sheets).

[4] ppm are equivalent to mg/kg.

documentation of work completed (including analytical data) remains in preparation. Consistent with EPA's level-of-effort (USEPA 2012b) and comment letter (USEPA 2013), further refinement and characterization is needed to refine exposure estimates of near-shore sediment and soil contamination in areas adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (RM 716) to Evans Campground Beach (RM 710) to determine concentration of contaminants and determine, to the extent practicable, the sources of contamination. These data are needed to support the human health and baseline ecological risk assessments.

Sediment and soil sampling in the area of the Young America Mill Site, Bossburg Flat Beach, and Evans Campground Beach is focused on a relatively small portion of the Upper Columbia River site. The intent of this effort is to gather more detailed information for a human health risk assessment; however, data gathered for this study are also expected to be useful in the RI/FS for the baseline ecological risk assessment. Sediment data generated as part of this investigation are expected to also be appropriate for use in the baseline ecological risk assessment, in part, because all of the detection limits for this study are approved for use in sediment ecological risk assessment. Similarly, soil data generated by this study are expected to be appropriate for use in the baseline ecological risk assessment because detection limits for all analytes are acceptable. The lead MRL of 0.05 mg/kg is essentially equal to the EPA EcoSSL for mammals of 0.053 mg/kg lead. However, lead is commonly found at concentrations much elevated compared to this value so this detection limit should not pose an issue either.

A6 DATA NEEDS

As noted in Section A5, further refinement and characterization of exposure concentrations in near-shore sediments and soil adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (RM 716) to Evans Campground Beach (RM 710) is needed to inform risk evaluations to people and ecological receptors. Therefore, the purpose of this study is to collect near-shore sediment and soil samples to further characterize TAL metal concentrations and relative bioaccessibility of lead and arsenic. These data will be used to refine exposure concentrations in the evaluation of unacceptable risks in the human health and baseline ecological risk assessments (see Figure A6-1).

To address these data needs, near-shore sediment and soil samples will be collected using incremental composite sampling (ICS) and discrete sample collection techniques.

Incremental surface sediment and surface soil (0 to 6 in.) samples will be collected and analyzed for the following:

Sediments

- Grain size distribution of whole samples (prior to sieving)
- Conventional parameters (pH, percent moisture, and total organic carbon) on sample fractions < 2 mm in size
- TAL metals[5] on the < 2 mm size fraction
- TAL metals on the < 250 μm size fraction
- IVBA for lead and arsenic on the < 250 μm size fraction.

Analyses performed on the < 2 mm and < 250 μm size fractions of sediment will be used to support the baseline ecological and human health risk assessments, respectively.

Soils

- Grain size distribution of whole samples (prior to sieving)
- Conventional parameters (pH, percent moisture, cation exchange capacity [CEC], and total organic carbon) sample fractions < 2 mm in size
- TAL metals on the < 2 mm size fraction
- TAL metals on the < 150 μm size fraction
- IVBA for lead and arsenic on the < 150 μm size fraction.

Analyses performed on the < 2 mm and < 150 μm size fractions of soil will be used to support the baseline ecological and human health risk assessments, respectively.

Additional discrete samples (i.e., core and X-ray fluorescence [XRF] samples) will also be collected to support evaluation of the spatial extent of contaminants, particularly lead. Core samples will be collected from surface and subsurface layers in consultation with EPA oversight personnel. Three core samples will be collected in each DU with the exception of sediment DU 10. Cores will also be collected in the F-1 and F-2 areas associated with the former cable ferry landings.

[5] TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

A7 DATA QUALITY OBJECTIVES, CRITERIA, AND DESIGN RATIONALE

EPA's seven-step DQO process (USEPA 2006a) was used to guide the design rationale for this study. Each step is described below.

A7.1 Step 1—State the Problem

As noted in Section A5, lead concentrations above a screening level of 400 mg/kg were identified in near-shore sediments at Bossburg Flat Beach (RM 716) and Evans Campground Beach (RM 710) during RI/FS sampling activities. Subsequent investigations confirmed elevated lead concentrations associated with historic mining and milling activities in areas adjacent to Bossburg Flat Beach (WDNR 2008; Emerson 2012; TechLaw 2012a,b; and USEPA 2012a). Accordingly, further refinement and characterization is needed to determine the extent of near-shore sediment and soil contamination between Bossburg Flat Beach and Evans Campground Beach, and adjacent to the YAM site and former cable ferry landings to determine the concentration of contaminants and determine, to the extent practicable, the sources of contamination. These data are intended to support the human health and baseline ecological risk assessments.

A7.1.1 Team Members and Roles

Team members and their roles are described in Section A4.2 of this QAPP.

A7.1.2 Schedule

Access to areas where sediment samples are to be collected is influenced by changing water levels in the Lake Roosevelt reservoir (refer to Figure A7-1). For purposes of planning and consistent with previous near-shore sediment sampling activities completed for the RI/FS, it is anticipated that sediment sampling would occur during periods of reservoir drawdown. It is anticipated that near-shore sediment sampling areas will be accessible during spring or summer drawdown. Access to upland sampling sites is not affected by water level changes. Soil sampling can be conducted independent of reservoir drawdown. It is TAI's understanding that EPA would like sediment and soil samples to be collected in a single event conducted during a timeframe coinciding with spring drawdown (e.g., late April to early May).

A7.2 Step 2—Identify the Goal of the Study

The goal of this study is to refine exposure estimates of near-shore sediment and soil contamination in areas adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (RM 716) to Evans Campground Beach (RM 710). These data will then be used in the evaluation of risks in the human health and baseline ecological risk assessments. The DQOs to be addressed by this study are:

- Do TAL metals in near-shore sediments and soil located between RMs 710 and 716 occur at concentrations that may present unacceptable risks to people or ecological receptors?
- What is the spatial extent of contamination in the areas identified above?

A7.3 Step 3—Identify Information Inputs

The third step of the DQO process (USEPA 2006a) requires consideration of the following:

- Types and potential sources of information (e.g., site characteristics or variables) that should be measured to provide estimates or resolve decisions
- Information to provide a basis for specifying performance or acceptance criteria
- Information on the performance of appropriate sampling and analysis methods.

Evaluations of unacceptable risks to people and ecological receptors exposed to sediments and soil located between RMs 716 and 710 require metal concentration data from near-shore sediments and soil in areas adjacent to the former YAM site, the former cable crossing, and Bossburg Flat Beach downstream to Evans Campground Beach. Samples collected from these locations will refine our understanding of exposure concentrations and evaluation of human health and ecological risks.

Near-shore sediment and soil samples will be collected from within a series of decision units (DUs) using ICS and discrete sampling approaches. A total of 16 DUs will be sampled, including 10 DUs for sediment and 6 DUs for soil. When using ICS, 30 subsample increments will be collected, composited in the field to form a single sample for each DU, and sent to the analytical laboratory for sieving and subsampling using ICS methods. In three sediment DUs and one soil DU, incremental samples will be collected in triplicate to provide information regarding metal variation within a DU. In DUs subject to triplicate sampling, three independent sets of 30 subsample increments will be collected for processing into a composite sample (i.e., 3 sets of 30 increments will be collected, with each set forming one composite). In addition, a series of discrete core

samples will be collected from sediments in the area of the former cable ferry landings (F-1 and F-2) and also from each soil DU. Handheld XRF field methods will be used to determine lead concentrations to support evaluation of the spatial extent of contamination within each sediment and soil DU. Graphical displays of locations and proposed ICS stations for each sediment DU are presented in Figures A7-2 through A7-4. Graphical displays of locations and proposed ICS stations for each soil DU are presented in Figures A7-5 and A7-6. Locations for core samples will be determined at the time of sample collection or as part of field reconnaissance. Graphical displays of locations and proposed XRF sampling stations for each sediment and soil DU are presented in Figures A7-7 through A7-9.

As demonstrated by previous sampling experiences conducted within the UCR, the percentage of proposed locations from which samples can be successfully collected cannot be determined *a priori* because of unforeseeable challenges such as, but not limited to, coarse substrates (i.e., sediments or soils generally having particle diameters greater than 2 mm) and areas of high slope that present unsafe sampling conditions. As a result, and in consideration of potentially culturally sensitive areas, reserve stations have also been identified to mitigate such potential challenges. A tabular summary of primary and reserve (alternate) sampling stations are listed in Tables A7-1a through A7-1d and illustrated within Figures A7-2 through A7-9.

At each ICS station, whole samples from the top 6 in. (15 cm) will be collected in the field and retained for laboratory analyses. ICS samples will be collected with a coring device (see USEPA 2004). At sediment and soil coring stations, the vertical extent of samples will be determined in consultation with EPA at the time of sample collection. To characterize exposure conditions, the following analytical measurements will be conducted on composited ICS and all individual core samples:

- Grain size distribution for whole sediment and whole soil
- pH, percent moisture, and total organic carbon (TOC) on the < 2 mm size fraction (sediment and soil)
- TAL metals[6] for < 2 mm (sediment and soil), < 250 μm (sediment), and < 150 μm (soil) size fractions
- CEC for < 2 mm (soil only)
- IVBA for lead and arsenic for < 250 μm (sediment) and < 150 μm (soil) size fraction.

[6] TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

In addition, field XRF analyses to measure lead concentrations will be performed at XRF stations. EPA methods for analyses of bulk sediment and soil chemistry are listed in Table A7-2.

A7.4 Step 4—Define the Boundaries of the Study

This step specifies the population of interest for the study, the geographical boundaries of the study, and any temporal considerations that may be required.

A7.4.1 Target Populations for Risk Evaluation

Consistent with the level-of-effort (USEPA 2012b), populations of interest for this study include people and ecological receptors that use beaches or come into contact with near-shore sediments and soil located between Bossburg Flat Beach (RM 716) and Evans Campground Beach (RM 710).

A7.4.2 Geographic Boundaries of the Site

For the purposes of this study and consistent with the level-of-effort (USEPA 2012b), geographic boundaries are limited to near-shore sediments and soil extending from RM 716 to RM 710.

A7.4.3 Temporal Considerations

As noted in Section A7.1.2, access to sediment sampling area is influenced by changing water levels in the Lake Roosevelt reservoir (refer to Figure A7-1). Consistent with previous near-shore sampling activities completed for the RI/FS, it is anticipated that sediment sampling would occur during periods of reservoir drawdown. Site access for soil sampling is not influenced by reservoir water levels. It is TAI's understanding that EPA would like sediment and soil samples to be collected in a single sampling event conducted during a timeframe coinciding with spring drawdown (e.g., late April to early May).

A7.5 Step 5—Define the Statistics and Types of Inferences

Step 5 of the DQO process provides data analysis approaches that will be used to evaluate the data and draw conclusions regarding unacceptable risks to people and ecological receptors. It is necessary to have a general understanding of the types of data analyses that will be conducted to ensure that required parameters are measured and that a sufficiently large data set is developed to provide the desired level of confidence in the statistics. This approach will ensure generation of a data set that will be adequate for use in evaluations of unacceptable risks to people and ecological receptors. Data from this study will be used in conjunction with data generated as part of prior

investigations to refine our understanding of exposure point concentrations to lead and other TAL metals in near-shore sediments and soil.

A7.6 Step 6—Specify Performance or Acceptance Criteria

The goal of Step 6 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 (USEPA 2006a). For this study, performance and acceptance criteria will apply to generating appropriate and acceptable data for use in risk assessments, as well as providing data to reduce uncertainty and the probability for false positive or false negative decision errors[7].

A7.6.1 Sampling Completeness

Near-shore sediments and soil will be collected using ICS and discrete sampling approaches in 16 DUs, including 10 DUs for sediment and 6 DUs for soil. Including all triplicate samples, a total of 18 composite samples for sediments and 8 composite samples for soil will be collected. Each ICS sample will be composed of 30 subsample increments. A total of 27 sediment cores and 18 soil cores will also be collected. An additional 99 samples, including 55 samples from sediment DUs and 44 samples from soil DUs, will be collected for handheld XRF analysis. As demonstrated by previous sampling experiences conducted within the UCR and consistent with the level-of-effort (USEPA 2012b), the percentage of stations where sediments and soil can be successfully collected cannot be determined *a priori.* Unforeseeable challenges such as, but not limited to, occurrence of coarse substrates (i.e., sediments and soil generally having particle diameters greater than 2 mm) and areas with high slope have been recorded within the study area. As a result, to mitigate such potential challenges and in consideration of culturally sensitive areas, a series of reserve (alternate) stations have also been specified as part of the sampling design; refer to Tables A7-1a through A7-1d and Figures A7-2 through A7-9. Because numerous reserve stations are available, the overall goal is to collect 100 percent of the targeted number of samples. If unforeseeable challenges prevent successful sample collection at any primary or reserve station, the field sampling team will consult with EPA or their designee to determine if sampling actions should be relocated to a nearby reserve station or other appropriate location.

[7] Because of variability in collected data, statistical analysis can lead to varying decision outcomes. A false negative decision error (Type II), for example, is when examination of the data leads to a conclusion of no risk, when there is a true potential risk, while a false positive decision error (Type I) indicates a potential risk, when the true risk is negligible (USEPA 2006a).

Sampling and analysis of sediment and soils will be conducted using standard EPA-approved methods. All composite samples will be submitted to the analytical chemistry laboratory for ICS processing and subsampling according to the Interstate Technology and Regulatory Council (ITRC) guidance and the laboratory SOP (ALS SOP No. GEN-SUBS and ITRC 2012) followed by analysis. The metals analysis is non-standard as it is a slightly scaled-up 2 gram digestion volume. No additional subsampling will be done once the laboratory subsample (i.e., 2 grams of the <150 μm soil fraction) 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 grams of soil will be placed in each jar. Two grams is the minimum mass required to control fundamental error at five percent for the <150 μm grain size fraction. Two grams is also the minimum mass required to collect a representative subsample using incremental subsampling methods (Crumbling 2014).

A7.6.2 Data Quality

DQOs are developed using EPA's DQO process (USEPA 2006a) to describe data and data quality needs. Data quality indicators (DQIs) such as precision, accuracy or bias, representativeness, completeness, and comparability (PARCC) parameters and analytical sensitivity will be used to assess conformance of data with QC criteria (USEPA 2002a). Precision will be determined by repeatability of chemical measures in duplicate samples (see below).

Incremental composite sample collection techniques will provide sufficient volume from the surface depth interval (i.e., 0 to 6 in. [0 to 15 cm]) to allow measurements for the full set of analyses that will be performed for this study (e.g., grain size distribution, TAL metals, IVBA etc.); refer to Table A7-2. Similarly, coring techniques will provide sufficient volume from surface and subsurface depth intervals to allow measurements for the full set of planned analyses. The overall volume of material to be collected at each station sampled will be sufficient to allow planned analytical measurements to be performed, including QA/QC samples. XRF samples will be processed and analyzed in the field for lead. Confirmatory analytical laboratory analyses will be performed on 20 percent of XRF samples. Field QC samples will include trip blanks, equipment rinsate blanks, field duplicate samples, and certified reference materials. These QC samples will be collected or prepared by sampling personnel in the field and submitted to the laboratory as natural samples. Minimum sample volume (mass) requirements are detailed in Table B3-1 and in Appendix A.

Equipment rinsate blanks will be used to identify possible contamination from the sampling environment or from sampling equipment. These blanks will be collected by

pouring deionized or distilled water over (or through) decontaminated sampling equipment and into a sample jar. Equipment rinsate blanks during the sampling event will be collected at an interval of one per day and will be analyzed for TAL metals.

Field triplicate samples will be collected to assess the precision of the sampling process. Field triplicate samples will be collected as identified in Section A7.2 above from sediment and soil DUs identified by EPA (USEPA 2013).

Experimental blanks will be used to identify possible contamination from the laboratory and will be collected according to laboratory protocols. Experimental blanks will be generated for equipment used in the sieving process and will be collected once per incremental sampling event in the laboratory.

A matrix spike/matrix spike duplicate (MS/MSD) will be performed in the laboratory to assess the accuracy of the analyses. The MS/MSD will be performed according to the laboratory protocols and will occur at a frequency of once every 20 samples.

Method detection limits (MDLs) and MRLs for sediment and soil samples are summarized in Table A7-2, and were selected to ensure consistency with EPA's sediment and soil detection limit evaluation process (USEPA 2008).

A7.7 Step 7—Develop the Plan for Collecting Data

Detailed discussions of study components are presented in Section B1 of this QAPP. Because field sampling methods associated with this study involves sediment and soil collection or 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 (Appendix B) has been prepared to provide relevant background information about cultural resources related to the project site, 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.

A8 SPECIAL TRAINING/CERTIFICATES

TAI has assembled a technical team with the requisite experience and technical skills to successfully complete the study. Minimum training and certification requirements for laboratory personnel are provided in the laboratory QA plan (Appendix C).

The analytical laboratory must demonstrate experience with the conduct of the IVBA to be used in this study. Accreditation from the National Environmental Laboratory

Accreditation Conference (NELAC) is required in accordance with EPA's Forum on Environmental Measurement (FEM).

Sampling personnel will be familiar with the cultural resources coordination plan (Appendix B). Sampling personnel will report any materials that might be considered a cultural resource to cultural resource observers participating in the field sampling program.

A9 DOCUMENTATION AND RECORDS

This section identifies on-site and laboratory records to be maintained for this study, information to be included in project reports, data reporting format for data report packages, and document control procedures to be used. Critical records required for this study are identified below with descriptive or supporting information as appropriate. Records will include documents and electronic deliverables related to field sampling (field notebook, sample logs, COC, etc.), IVBA testing, and chemistry laboratory documentation (laboratory records, data packages, project reports, electronic deliverables, etc.), data validation, and data reports. Data reports will be made available through integration into the project web tool. Briefly, this will be an electronic data management system that is accessible via an external web site. The QAPP, FSP (Appendix A), Site Health and Safety Plan (SHSP) (TCAI 2007), and the general SHSP addendum (Attachment A1 to Appendix A) will be provided to each person listed in Section A3 and the Field Team Leader. Any revisions or amendments to any of the documents that comprise the FSP will also be provided to these individuals.

A9.1 Field Documentation

The TAI technical team field supervisor will ensure that the field team receives the final approved version of the QAPP prior to the initiation of field activities. Minimum field records that will be maintained include the following:

- Field logbooks
- Photo documentation
- Field data forms
- Sample tracking/COC forms.

Additional content, information, and use of the above-listed documents are further described in the FSP (Appendix A).

A9.2 Laboratory Documentation

Full laboratory data reports will be provided in electronic format to the task QA coordinator or designee, 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.

Documentation requirements for the analytical laboratory (i.e., ALS) are detailed on page 59 of the ALS QA manual (Appendix C) and will, at a minimum, include the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered
- Sample receipt and analysis dates
- Final analyte concentration including reporting limit, laboratory qualifiers, and reanalysis
- Interference checks
- Serial dilutions
- Internal standards
- Calibration results
- Instrument raw data
- Percent recovery of each compound in the matrix spike sample
- Matrix spike recovery control limits
- Relative percent difference (RPD) for all MS/MSD and/or laboratory control sample (LCS)/LCS duplicate (LCSD) results
- RPD control limits for MS/MSD and/or LCS/LCSD reports
- LCS results when analyzed
- Recovery control limits for LCS or standard reference material recoveries and relative standard deviation
- Blank results for method blanks, experimental blanks, and equipment blanks
- Method blank summary indicating associated samples
- Case narrative.

The task chemistry laboratory coordinator will oversee data verification and validation, and the data validator will be automatically notified via the web tool database (http://teck-ucr.exponent.com) that the data set is available and ready for review. Further details of data validation and usability are in Section D.

A9.3 Data Quality Documentation

Data verification (i.e., confirming the accuracy and completeness of field and laboratory data) will be performed by the TAI technical team for data generated in the field, and by the analytical laboratory for the analytical data that it generates. Data validation and data quality assessment for this task will be completed by the task QA coordinator and their staff.

Accuracy of laboratory EDDs will be verified by, or under the direction of, the database administrator. All changes to data stored in the database will be recorded in the database history log. Any data tables prepared from the database for data users will include all qualifiers that are applied by the laboratories and during data validation.

Data validation reports will be prepared and provided to the laboratory analytical chemistry coordinator. Any limitation to the usability of the data will be discussed in this report. Completed data validation checklists will also be provided by the QA coordinator.

SECTION B: DATA GENERATION AND ACQUISITION

B1 SAMPLING PROCESS DESIGN AND RATIONALE

Sediment and soil sampling in the area of the Young America Mill Site, Bossburg Flat Beach, and Evans Campground Beach is focused on a relatively small portion of the Upper Columbia River site. This section presents design details and rationale for this study, which will generate data to refine characterization of exposures to metals in near-shore sediments and soil from targeted areas of the UCR site located between RM 716 and 710. Elevated lead concentrations were identified at Bossburg Flat Beach and Evans Campground Beach during the beach sediment study (TAI 2009, 2010, 2011). At some locations, total lead concentrations exceeded EPA's human health screening level of 400 mg/kg (refer to Figures A7-2 through A7-9). Subsequent investigations conducted by EPA under the START program also identified elevated metal (i.e., lead) concentrations in soils of adjacent sites associated with historic mining and milling activities, including the former YAM site (WDNR 2008; Emerson 2012; TechLaw 2012a,b; and USEPA 2012a[8]). As a result, further refinement of near-shore sediment and soil metal concentrations is needed in areas adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (RM 716) to Evans Campground Beach (RM 710) to determine the concentration of contaminants and determine, to the extent practicable, the source(s) of contamination. Consistent with the initial level-of-effort (USEPA 2012b) and the revised approach outlined by EPA in comments on the initial draft of this QAPP (USEPA 2013), near-shore sediment and soil sampling is needed to characterize metal concentrations (particularly lead) and relative bioaccessibility (of lead and arsenic) in these media. In addition, further characterization within the Bossburg Flat Beach and Evans Campground Beach will refine spatial extents of locations where lead concentrations may exceed EPA's 400 mg/kg human health screening level. Surface sediment and surface soil samples will be collected from these areas to refine exposure estimates and support risk evaluations for both human health and ecological receptors.

B1.1 Design and Rationale for Selecting Sampling Locations

The study design considered the following factors: 1) approximate locations of targeted sampling areas (i.e., DUs for near-shore sediments and soil adjacent to the former

[8]Final documentation (including analytical data) associated with removal actions remain in preparation. Site profile information can be accessed at the following web sites: Young America Mine @ http://www.epaosc.org/site/site_profile.aspx?site_id=7048 and Hahnlen Property @ http://www.epaosc.org/site/site_profile.aspx?site_id=8194.

YAM site, the former cable ferry landings, Bossburg Flat Beach, and Evans Campground Beach, etc.); 2) reservoir water level management; 3) site elevations and geography (e.g., proximity to former cable ferry landings, public beaches, the YAM site, etc.), and 4) previous site measurements (e.g., lead concentrations measured in the laboratory and by field XRF). These site-specific factors, in conjunction with design constraints driven by use of an incremental composite sampling approach, were used to define the extent of targeted sampling areas (e.g., DUs), numbers of sampling stations, and locations of proposed stations. Approximate locations of targeted sampling areas were guided by objectives specified in EPA's level-of-effort (USEPA 2012b) and comments on the initial draft of this QAPP (USEPA 2013). Spatial extents of targeted areas were determined by evaluating typical water levels during anticipated sampling periods (e.g., spring drawdown) in conjunction with site elevations (e.g., 1280 to 1290 ft), and proximity to locations of interest such as the former cable ferry landings.

Water surface elevation ranges of sediment DU areas targeted for sampling were identified in EPA's July 3, 2013 letter to TAI with comments and a revised Level of Effort (LOE) for the Study. The lowest elevation specified in the revised LOE for any sediment DU was 1,250 feet (see Table 1 of the revised LOE). Based on EPA's specifications in the revised LOE, the sediment sampling approach for the Bossburg study, and the types of samples to be collected (e.g., ICS and XRF) from each DU, was designed to be a shore-based effort where sediment temporarily exposed above the water line would be sampled. Ultimately, the ability of field crews to access any predetermined sediment sampling location will be influenced by water surface elevations at the time of sampling. The exposed sediment area noted on all figures in this QAPP is based on a typical reservoir drawdown of 40 feet, which corresponds to a water surface elevation of 1,250 feet (USBR Datum of 1937).

The extent and timing of drawdown cannot be accurately determined this far in advance of the proposed sampling period. If a below average snowpack condition occurs, reservoir drawdown levels may be less than typical and water surface elevations could be greater than 1,250 feet. In this context, it is not reasonable to specify that sampling will occur for a reservoir drawdown case where water surface elevations would be between 1,250 and 1,225 feet. If a larger than typical drawdown occurs, a portion of the ICS and XRF samples could be relocated to new positions based on field conditions. If a larger than typical drawdown occurs, a portion of the ICS and XRF samples could be relocated to new positions based on field conditions.

The overall sampling program was developed using a hybrid approach that reflects regular grid, random, and judgment-based design elements. Locations of proposed ICS stations for sediment and soil were established using an approach consistent with incremental sampling methodology (ITRC 2012). ICS locations for sediments and soil were randomly selected subject to both maximum and minimum spacing constraints so that proposed ICS stations were situated throughout each DU. XRF sampling locations were based on consideration of regular grid design factors. In larger DUs (e.g., sediment DUs 1 and 2, soil DUs 1 through 4), distances between proposed XRF stations was determined using a statistical approach described by Gilbert (1987). Except for areas of steep slope, soil DUs 1 through 4 are relatively open and distances between stations are roughly 36 m (120 ft). Given geographic constraints associated with soil DU 5, where roughly 70 percent of the DU has areas with steep slope that may limit where samples can be collected, distances between XRF stations are approximately 23 m (75 ft); use of a finer grid in soil DU 5 is intended to provide enough locations to support evaluation of contaminant extent even in the event that slope constraints preclude sample collection and at all XRF stations as intended. In narrow sediment DUs (e.g., sediment DUs 4 and 8), XRF sampling stations were placed at regular distances in an upstream to downstream orientation to support evaluation of potential spatial trends and extents. Locations for sediment and soil core samples are judgment-based and will be determined in the field in consultation with EPA oversight crews; results of field XRF measurements may be used to guide the location of sediment and soil core samples.

In addition, to account for uncertainties such as culturally sensitive areas, and/or sediments/soil that cannot be tested due to large grain sizes (e.g., gravels and cobbles); reserve/alternate sampling locations were also identified. In total, 18 sediment ICS samples (with 540 increments, including DUs sampled in triplicate), 8 soil ICS samples (with 240 increments, including DUs sampled in triplicate), 27 sediment cores, 18 soil cores, 55 sediment XRF samples, and 44 soil XRF samples, are proposed for this study. Confirmatory analytical laboratory analyses will be performed on 20 percent of XRF samples. Proposed sampling stations (primary and reserve), along with DU boundaries, are presented in Figure A7-2 to A7-9.

B1.2 Design and Rationale for Field Sampling and Analytical Program

The proposed field sampling and analytical program is designed to generate data to refine exposure estimates and further inform risk evaluations for both human health and ecological receptors. The proposed sampling program includes ICS, and XRF sampling in 10 sediment and 6 soil DUs. Additionally, core samples will be collected from sediments near the former cable ferry landings (F-1 and F-2) as well as from each soil

and sediment DU with the exception of sediment DU 10. ICS samples will be collected from the surface (15 cm; 0 to 6 in) of sediment and soil and are intended to provide more reliable estimates of mean concentrations of TAL metals (particularly lead) in each DU to support risk evaluations. Sediment and soil cores will include intervals from surface (15 cm) and one or more subsurface layers (e.g., 15 to 45 cm and 45 to 75 cm) to support evaluation of the vertical extent of contamination. XRF samples will be collected from surface sediment and soil (0 to 15 cm) to support evaluation of the areal extent of lead contamination and spatial trends and to also support evaluation of potential source(s), to the degree practicable.

Increments for ICS sediment and soil samples will be collected, composited in the field, and submitted to the analytical laboratory for further sieving and analyses. Whole ICS samples will be analyzed for grain size distribution and will be sieved into two size fractions, depending on media. Whole sediment samples will be sieved into < 2 mm and < 250 μm size fractions. Whole soil samples will be sieved into < 2 mm and < 150 μm size fractions. The size fractions needed to assess unacceptable risks to people exposed to sediments and soils are < 250 μm and < 150 μm, respectively. The < 2 mm size fraction is required for ecological receptors.

For each composited ICS sample, TAL metals, pH, percent moisture, and TOC will be determined on the < 2 mm size fraction. These data will be used with other existing site metals data to better refine exposure point concentrations. Parameters such as pH and TOC (for both sediment and soil) and CEC (for soil) will be analyzed to help interpret total metal concentrations in terms of potential bioavailability for ecological receptors. TAL metals analyses and IVBA for lead and arsenic will also be performed on the < 250 μm size fraction (for sediment) and the < 150 μm size fraction (for soil). The need for TAL metals analyses in the finer size fractions is driven by the occurrence of elevated lead concentrations in samples from previous near-shore sampling events. IVBA data will provide a measure of the relative bioaccessibility of lead and arsenic for use in the human health risk assessment.

Surface and subsurface sediment and soil core samples will be collected and submitted to the analytical laboratory for processing and analysis in the same manner that ICS samples are handled (except for compositing). Whole sediment and soil core samples will be analyzed for grain size distribution. For sediment and soil cores, TAL metals, pH, percent moisture, and TOC will be determined on the < 2 mm size fraction. For soil cores, CEC will also be determined on the < 2 mm size fraction. TAL metals analyses and IVBA for lead and arsenic will also be performed on the < 250 μm size fraction for

sediment and the < 150 μm size fraction for soil. These analyses will be performed on all core intervals collected.

XRF samples will be processed and analyzed in the field. Samples will be air dried, sieved through a No. 10 (2 mm) stainless steel sieve, and then analyzed for lead using a hand-held portable XRF unit. Confirmatory analytical laboratory analyses of lead concentrations will be performed on 20 percent of field-sieved XRF samples (i.e., 11 sediment and 9 soil samples).

B2 SAMPLING METHODS

Field sampling methods for collection of near-shore sediment and soil samples to be analyzed for grain size, TAL metals, IVBA and all other parameters are described in the FSP (Appendix A). The FSP includes the following topics:

- Station positioning (Section 2.2)
- Field equipment and supplies (Section 2.3.1)
- Sampling methods (Section 2.3.2)
- Sample containers and labels (sample labels, sample identifier custody seals, sample custody/tracking procedures) (Section 2.9)
- Field documentation and procedures (field logbooks, photo documentation, COC forms) (Section 3).

SOPs for each sampling method are provided in Attachment 2 of the FSP. Field QC samples are described in Section 2.5 of the FSP.

In the event that unanticipated or changed circumstances occur in the field, the field supervisor will institute necessary corrective actions in consultation with EPA field oversight crews, complete a corrective action record, and ensure that appropriate procedures are followed. If corrective actions require a departure from the FSP, those changes will be documented on a field change request form (refer to Appendix A for examples of these and other forms) and submitted to EPA. In other circumstances where sampling conditions are unexpected, appropriate sampling actions consistent with study objectives will be conducted. Changes will be noted by the field supervisor in the field log, and a change request form will be completed for the project files and submitted to EPA. Any problems that cannot be easily resolved or that affect the final quality of the work product will be brought to the attention of the TAI technical team coordinator, TAI project coordinator, and EPA. EPA will be notified of any problems

that may affect the final outcome of this task. Additional information regarding corrective actions and related documentation is provided in Section C1.

B3 SAMPLE HANDLING AND CUSTODY

Principal documents used to identify samples and to document possession will be field logbooks and COC records. Custody will be documented for all samples at all stages of the analytical or transfer process. COC procedures for sample handling prior to delivery to the laboratories are outlined in Sections 2.2, 2.3, and 3.2 of the FSP (Appendix A).

Samples will be shipped from the field to the analytical chemistry laboratory for processing and analyses. Requirements for sample containers, sample preservation, storage temperature, and holding times are summarized in Table B3-1 and detailed in the FSP (Appendix A).

Upon receipt of samples, the laboratory will check the physical integrity of containers and custody seals, and samples will be inventoried by comparing sample labels to those on the COC forms. The laboratory will submit a confirmation of sample receipt form to the field supervisor and the analytical chemistry laboratory coordinator for review and approval prior to initiating analyses. The laboratory will include COC and shipping container receipt forms in the data package. Any breaks in the COC or non-conformances will be noted and reported in writing to the analytical chemistry laboratory coordinator within 24 hours of receipt of samples. Specific analytical laboratory QA plans are provided in Appendix C. Laboratory project managers will ensure that a sample-tracking record is maintained that follows each sample through all stages of sample processing at the laboratory.

Samples will be stored in accordance with specifications detailed in Table B3-1. The laboratory will maintain COC documentation and documentation of proper storage conditions for the entire time that the samples are in their possession. The laboratory will not dispose of the samples for this study until EPA has given permission to the analytical chemistry laboratory coordinator to instruct the laboratory to do so. After authorization is obtained, the laboratory will dispose of samples, as appropriate, based on matrix, analytical results, and information received from the client.

B4 SAMPLE COLLECTION AND PROCESSING AND ANALYTICAL METHODS

Samples will be collected into 2-gallon buckets; preservation and holding times are provided in Table B3-1. Field analysis for lead with handheld XRF will be performed for samples collected at XRF station. All other samples from all areas will be processed and analyzed in the laboratory.

B4.1 Field Measurements and Observations

A hand-held XRF unit (e.g., Innov-X Alpha model a-4000s, or comparable) will be used in the field to measure concentrations of lead in soils according to EPA Method 6200. Prior to XRF measurements, soils will be air dried and sieved (see Appendix A for methodology details). This method will increase the precision of the XRF measurements and enable lower detection limits (see Table A7-2 for the range of detection limits for the example XRF unit).

In upland areas, field operations will include observing the types of vegetation surrounding the soil sample locations (e.g., common and/or scientific names of trees and shrubs, an estimate of their abundance around the sampling location, percent groundcover, and percent canopy cover). Weather (temperature and precipitation) will be noted at all station types (i.e., ICS increment, core, and XRF for sediment and soil). These observations will be documented in the field notebook or on field forms, along with corresponding digital photographs.

B4.2 Laboratory Methods

All composited ICS samples and cores samples will be analyzed for grain size distribution, then sieved into two fractions: <2 mm and <250 μm (*sediment),* and <2 mm and <150 μm (*soils*). For sediments the <2 mm fraction will be analyzed for pH, TOC and percent moisture, both size fractions (<2 mm and <250 μm) will be analyzed for TAL metals and the <250 μm fraction will be analyzed for lead and arsenic bioaccessibility using an in vitro extraction method (USEPA 2012c). Similarly, for soils the <2 mm fraction will be analyzed for pH, CEC, TOC and percent moisture, both size fractions (<2 mm and <150 μm) will be analyzed for TAL metals, and the <150 μm fraction will be analyzed for lead and arsenic bioaccessibility using an in vitro extraction method (USEPA 2012c). Samples collected for this study will be analyzed according to standard EPA-approved analytical and preperation/digestion methods detailed in Table A7-2. Quality control specification tables for these methods are included in Tables B4-1 through B4-4.

All composite samples will be submitted to the analytical chemistry laboratory for ICS processing and subsampling according to the ITRC guidance and the laboratory SOP (ALS SOP No. GEN-SUBS and ITRC 2012) followed by analysis.

The sediment ICS samples will be dried, homogenized, and subsampled to provide an aliquot for determining grain size. The remaining sample will be sieved through a No. 10 (2 mm) stainless steel sieve and then subsampled for analysis; these results will be used in the ecological risk assessment. Another subsample will be sieved through a No. 60 (0.250 mm) stainless steel sieve to collect material to analyze for use in the HHRA (Ruby and Lowney 2012). A 1 gram portion of the sieved human health composite fraction (<250 μm) subsample will be used for testing lead and arsenic bioaccessibility.

The soil ICS samples will be dried, homogenized, and subsampled to provide an aliquot for determining grain size. The remaining sample will be sieved through a No. 10 (2 mm) stainless steel sieve and then subsampled for analysis; these results will be used in the ecological risk assessment. Another subsample will be sieved through a No. 100 (0.149 mm) stainless steel sieve to collect material to analyze for use in the HHRA (Ruby and Lowney 2012). The metals analysis is non-standard as it is a slightly scaled-up 2 gram digestion volume. No additional subsampling will be done once the laboratory subsample (i.e., 2 grams of the <150 μm soil fraction) 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 grams of soil will be placed in each jar. Two grams is the minimum mass required to control fundamental error at five percent for the <150 μm grain size fraction. Two grams is also the minimum mass required to collect a representative subsample using incremental subsampling methods (Crumbling 2014). A 1 gram portion of the sieved human health composite fraction (<150 μm) subsample will be used for testing lead and arsenic bioaccessibility.

B5 QUALITY CONTROL

Laboratory QC procedures are described below.

B5.1 Analytical Laboratory Quality Control

Extensive and detailed requirements for laboratory QC procedures are provided in the EPA methods that will be used for this study. Every method protocol includes descriptions of QC procedures, and many incorporate additional QC requirements by reference to separate QC sections. QC requirements include control limits and requirements for corrective action in many cases. QC procedures will be completed by

the laboratory, as required in each protocol and their internal SOPs, and as indicated in this QAPP.

The frequency of analysis for LCSs, MS/MSD samples or laboratory duplicates, and method blanks will be one for every 20 samples or one per extraction or analysis batch, whichever is more frequent. Calibration procedures will be completed at the frequency specified in each method description. Equipment rinse blanks will be subjected to the same processes as the corresponding sediment and soil preparations.

As required for EPA SW-846 methods (USEPA 2008), performance-based control limits have been established by the laboratory. These and all other control limits specified in the method descriptions will be used by the laboratory to establish the acceptability of the data or the need for reanalysis of the samples. Laboratory control limits for recovery of internal standards (including certified reference material), matrix spikes, and LCSs, and for relative percent difference of laboratory duplicates, are provided in the analytical laboratory's QA manual (Appendix C).

B5.2 Data Quality Indicators for Laboratory

The overall quality objective for this task is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality. QA procedures and measurements that will be used for this study are based on EPA guidance. Data quality indicators such as the PARCC parameters and analytical sensitivity will be used to assess conformance of data with QC criteria (USEPA 2002b). Measurement quality objectives (MQOs) for the quantitative PARCC parameters are provided in Table B5-1. Data quality indicators and QC objectives are described in this section.

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of laboratory duplicates and field splits. Precision is expressed in terms of the RPD for two measurements. The following equation is used to calculate the RPD between measurements:

$$RPD = \frac{\left|C_1 - C_2\right|}{(C_1 + C_2)/2} \times 100$$

Where: RPD = relative percent difference

C_1 = first measurement

C_2 = second measurement

For three or more measurements, the relative standard deviation (RSD) is used to evaluate precision. The RSD is calculated as the ratio of the standard deviation of three or more measurements to the average of the measurements, expressed as a percentage.

Accuracy and bias represent the degree to which a measured concentration conforms to a reference value. Results for matrix spikes, LCSs, field blanks, and method blanks will be reviewed to evaluate accuracy and bias of the data. The following calculation is used to determine percent recovery for a matrix spike sample:

$$\%R = \frac{M - U}{C} \times 100$$

Where: %R = percent recovery

M = measured concentration in spiked sample

U = measured concentration in unspiked sample

C = concentration of added spike

Percent recovery for an LCS or reference material is calculated as follows:

$$\%R = \frac{M}{C} \times 100$$

Where: %R = percent recovery

M = measured concentration in reference sample

C = established reference concentration

Results for field and method blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Detection of any target analytes in field or method blanks will be evaluated as potential indicators of bias.

QC sample and procedures are specified in each method protocol (analytical methods are presented in Table A7-2). All QC requirements will be completed by the analytical laboratories as described in the protocols, including the following (as applicable to each analysis):

- Initial calibration
- Initial calibration verification
- Continuing calibration
- Calibration or instrument blanks
- Method blanks
- Equipment rinse blanks

- Laboratory control samples
- Internal standards (including certified reference material)
- Serial dilutions
- Matrix spikes
- Laboratory duplicates.

To alert data users of possible bias or imprecision, data qualifiers will be applied to reported analyte concentrations when associated QC samples or procedures do not meet laboratory internal control limits (Appendix C).

Analytical concentration goals (ACGs) provide the target concentration required for the chemical analysis. Methods selected for this study are expected to provide sufficient sensitivity to yield ACGs that are below the lowest reference value for this study and are consistent with other RI/FS studies.

The laboratory will determine a MDL for each analyte, as required by EPA (USEPA 2004). MDLs are statistically derived and reflect the concentration at which an analyte can be detected in a clean matrix with 99 percent confidence that a false positive result has not been reported. The analytical laboratory will have established MRLs at levels above the MDLs for the task analytes. These values are based on the laboratory's experience analyzing environmental samples and reflect the typical sensitivity obtained by the analytical system; they represent the level of analyte above which concentrations are accurately quantified.

The laboratory will quantify analytes at concentrations above the MRL. Analytes detected at concentrations between the MDL and MRL will be flagged with a "J" qualifier to indicate that the value is an estimate (i.e., the analyte concentration is greater than or equal to the MDL and less than the MRL). Analytes that are not detected will be reported as the MRL and will be flagged with a "U" qualifier. MDLs will be adjusted by the laboratory as necessary to reflect sample dilution or matrix interference.

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, representativeness will be addressed primarily in the sampling design by the selection of sampling sites and sample collection procedures. In the laboratory, representativeness will be ensured by the proper handling and storage of samples, the use of standard performance-based methods, and initiation of analyses within holding times.

Comparability is the qualitative similarity of one data set to another (i.e., the extent to which different data sets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are consistent with methods and procedures recommended by EPA.

Completeness is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The target completeness objective will be 90 percent; the actual completeness may vary depending on the intrinsic nature of the samples. Completeness of the data will be assessed during QC reviews.

Completeness is defined as follows for all measurements:

$$\%C = \frac{V}{T} \times 100$$

Where: %C = percent completeness

V = number of measurements judged valid

T = total number of measurements

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

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

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Before beginning each analysis, laboratory instruments will be properly calibrated, and the calibration will be verified with appropriate check standards and calibration blanks for each parameter. Instrument calibration procedures and schedules will conform to analytical protocol requirements and descriptions provided in the laboratories' QA plans.

Calibration standards will be obtained from either the EPA repository or a commercial vendor, and the laboratories will maintain traceability back to the National Institute of Standards and Technology (NIST). Stock standards will be used to establish

intermediate standards and calibration standards. Special attention will be given to expiration dating, proper labeling, proper refrigeration, and prevention of contamination. Documentation relating to the receipt, mixing, and use of standards will be recorded in a laboratory logbook. All calibration and spiking standards will be checked against standards from another source, as specified in the methods and the laboratory QA manual.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

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

The quality of laboratory water used will be documented at the laboratory. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

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

B9 DATA MANAGEMENT

Data for this study will be generated both in the field and at the analytical laboratory. The final repository for sample information will be the relational database housed at http://teck-ucr.exponent.com. Procedures used to transfer data from the point of generation to the database are described in this section.

The draft data management plan (DMP) establishes standard procedures for the management of all documents and environmental data (field and laboratory) generated during the RI/FS. The DMP describes data management procedures relating to the creation, acquisition, handling, storage, and distribution of task-related data. Data management systems and procedures described below are intended to establish and

maintain an efficient organization of large volumes of complex environmental information for a diverse combination of data types. To accomplish this task, the following four management systems will be used to provide organized and efficient data management and retrieval:

- **Project database**. Stores environmental sampling and analysis data, information pertaining to geographic information system (GIS) files, and citations of documents related to collection, analysis, or interpretation of environmental data stored in the database. Both current and historical data will be stored in the project database.
- **Geographic information system**. Stores spatial data and enables the cartographic presentation of data trends and patterns.
- **Hard copy files**. Maintains a record and archive of documents from field studies and resulting reports.
- **Web site (http://www.ucr-rifs.com)**. Makes available draft documents and other project information via this secure project web site. Users with appropriate privileges will be able to download documents.

The sediment and soil activities will use spatial data sets and analyses for planning, data interpretation, decision support, and data presentation. Links between sediment and soil data in the project database and GIS files will be established via common identifiers for sampling locations and other geographic features.

B9.1 Field Data

Data that are generated during sample collection and preparation will be manually entered into the field logbook, field data forms, and COC forms. Data from these sources will be entered into a spreadsheet by the field supervisor and transferred to the database manager. The database manager will import data into the database and coordinate with the field supervisor to ensure all data are complete and delivered in the correct format. These data include sample collection coordinates, station names, sampling dates, sample identifiers and numbers, and additional station and sample information. All entries will be reviewed for accuracy and completeness by a second individual, and any errors will be corrected before the data are approved for release to data users.

B9.2 Analytical Laboratory Data

A variety of manually entered and electronic instrument data will be generated at the laboratory. Data will be manually entered into the following:

- Standard logbooks
- Storage temperature logs
- Balance calibration logs
- Instrument logs
- Sample preparation and analysis worksheets
- Maintenance logs
- Individual laboratory notebooks.

All manual data entry into the laboratory information management system will be proofed at the analytical laboratories. Data collected from each laboratory instrument, either manually or electronically, will be reviewed and confirmed by analysts before reporting. A detailed description of procedures for laboratory data management and data review and verification is provided in the laboratory QA plan (Appendix C).

Analytical data packages will be comprehensive Tier 4 CLP data packages that will allow for a full Stage 4 (S4VM) data validation (reference section D.2 below for data verification and validation methods for this study).

SECTION C: ASSESSMENT AND OVERSIGHT

This study will rely on the knowledge and expertise of the TAI technical team. The field team and laboratory will stay in close verbal contact with the senior technical advisor and the task QA coordinator during all phases of this study. This communication will include regular calls and meetings. This level of communication will serve to keep the management team apprised of activities and events, and will allow for informal but continuous task oversight.

C1 ASSESSMENTS AND RESPONSE ACTIONS

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

Readiness reviews are typically conducted to ensure that all necessary preparations have been made for efficient and effective completion of each critical phase of work. 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 site. The field supervisor will also verify that the field team and subcontractor(s), as required, have been scheduled and briefed and that the contract for the subcontractor has been signed by both parties. Any deficiencies noted during this readiness review will be corrected prior to initiation of sampling activities.

The second readiness review will be completed 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. Any deficiencies noted during this review will be corrected by the database administrator, the task QA coordinator, or their designee. Data will not be released for final use until all data have been verified and validated. No report will be prepared in conjunction with the readiness reviews.

Technical review of intermediate and final work products generated for this task will be completed throughout the course of all sampling and laboratory activities, data validation, data management, and data interpretation to ensure that every phase of work is accurate and complete and follows the QA procedures outlined in this QAPP. Any problems that are encountered will be resolved between the reviewer and the person completing the work. Any problems that cannot be easily resolved or that affect

the final quality of the work product will be brought to the attention of the TAI technical team coordinator and TAI project coordinator. EPA will be notified of any problems that may affect the final outcome of this task, according to the Agreement.

The laboratory will be required to have implemented a review system that serves as a formal surveillance mechanism for all laboratory activities. Each phase of work will be reviewed by a supervisor before it is approved for release. Details are provided in the laboratory QA plan (Appendix C).

Technical system audits may be conducted if serious problems are encountered during sampling or analysis operations. Any task team member who discovers or suspects a non-conformance is responsible for reporting the non-conformance to the senior technical advisor, the task QA coordinator, or the laboratory project or QA manager, as applicable. The task QA coordinator will ensure that no additional work dependent on the non-conforming activity is performed until a confirmed non-conformance is corrected. Any confirmed non-conformance issues will be relayed to the TAI technical team coordinator. In addition, during corrective actions, communication between the field personnel and the laboratory relative to the accuracy and completeness of the COC documents will follow corrective-action procedures.

C2 REPORTS TO MANAGEMENT

The laboratory will keep the appropriate technical team laboratory coordinator(s) and QA manager(s) apprised of their progress on a regular basis. The laboratory will provide the following information:

- Inventory and status of samples held at the laboratory in spreadsheet format by sample delivery group
- Summaries of out-of-control laboratory QC data that resulted in a requirement for corrective action and a description of the corrective actions implemented
- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

The technical team laboratory coordinator and QA manager will provide this information to the task QA coordinator who, in turn, will provide this information to the TAI technical team coordinator.

The laboratory will be required to have implemented routine systems of reporting non-conformance issues and their resolution. These procedures are described in the

laboratory QA manual. Laboratory non-conformance issues will also be described in the field sampling report if they affect the quality of the data.

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

Validated data will be provided electronically to EPA within 90 days after completion of field sampling activities as required by Section V.13.c of the Agreement. These data will also be provided with the data summary report containing an overview of the field event, a sampling location map, sample collection methods, and rationale for any deviations from the FSP and QAPP within 150 days of completion of field activities as required by Section V.13.c.ii of the Agreement.

SECTION D: DATA VALIDATION AND USABILITY

Data generated in the field and at the laboratory will be verified and validated according to criteria and procedures described in this section. Data quality and usability will be evaluated, and a discussion will be included in the data validation report. In the following sections, the term "laboratory" refers to the analytical laboratory.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

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

Data verification and validation will be completed according to methods described in the following EPA guidance documents for data validation:

- Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 540-R-08-005, January 2009)
- US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 540-R-04-004, October 2004)

Data will be qualified as estimated, as applicable, if results for surrogates, LCSs, MS/MSD samples, or laboratory duplicates do not meet method-specified control limits, including performance-based control limits. Results for other QC procedures will be qualified if they do not meet control limits outlined in EPA's functional guidelines and SOPs for data validation (USEPA 1995, 1996, 1999, 2004). Data will be qualified as undetected based on concentrations of target analytes detected in laboratory or field blanks, according to EPA's functional guidelines and SOPs for data validation.

Performance-based control limits are established periodically by the laboratory as required for the selected methods. Current values will be provided in the laboratory QA plans, as applicable.

No guidelines are available for validation of data for TOC. These data will be validated using procedures described in the functional guidelines for inorganic data review (USEPA 2004), as applicable. Data will be qualified as estimated, as necessary, if results for QC samples do not meet performance-based control limits.

Results for field duplicate samples will be evaluated using control limits of 35 percent. Data will not be qualified as estimated if the MQOs are exceeded, but RPD results will be tabulated and any exceedances will be discussed in the data summary report.

Equipment rinse blanks will be evaluated and data qualifiers applied in the same manner as method blanks, described in the functional guidelines for data review (USEPA 1995, 1996, 1999, 2004). Data will be rejected if control limits for acceptance of data are not met, as described in USEPA (1995, 1996, 1999, 2004).

D2 VERIFICATION AND VALIDATION METHODS

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

Approximately 10 percent of the chemistry data will undergo Stage 4 (S4VM) validation, including the first two data packages generated for each chemical analysis type. Approximately 90 percent of the chemistry data will undergo Stage 2B (S2BVM) validation with the understanding that more detailed validation will be performed on the S2BVM data if issues are identified in the S4VM validation. If problems or questions are encountered during validation, the laboratory will be contacted for resolution. An additional full validation will be completed, if required, to fully assess the quality of the data or to verify that laboratory errors have been addressed.

Procedures for verification and validation of laboratory data and field QC samples will be completed as described in the functional guidelines and SOPs for data validation (USEPA 1995, 1996, 1999, 2004) and summarized in Section D1 above. Accuracy and completeness of each data set will be verified at the laboratory when EDDs are prepared and again as part of data validation. Ten percent of entries to the database from the laboratory EDDs will be checked against the hard copy data packages. Data validation will be completed by ESI, the Task QA Manager.

In addition to verification of field and laboratory data and information, data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use.

Method reporting limits for non-detects will be compared to the analytical concentrations goals to evaluate method sensitivity for each sample. Any exceedance of actual MRLs over the analytical concentrations goal will be discussed in the data validation report.

D3 RECONCILIATION WITH USER REQUIREMENTS

The goal of data validation is to determine the quality of each data result and to identify those that do not meet the task MQOs. Non-conforming data may be qualified as estimated (i.e., a "J" qualifier will be applied to the result) or rejected as unusable (i.e., an "R" qualifier will be applied to the result) during data validation if criteria for data quality are not met. Data may also be qualified as undetected during validation based on laboratory and field blank results. Rejected data will not be used for any purpose. A summary of the qualified data and the reasons for qualification will be included in the data validation report.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the project database. However, these data are less precise or less accurate than unqualified data. Data users are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on statistical procedures and other data uses. Data quality discussion in the data validation report will include information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability. Data validation reports will also include a discussion of data limitations and their effect on data interpretation activities.

SECTION E: REFERENCES

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FIGURES

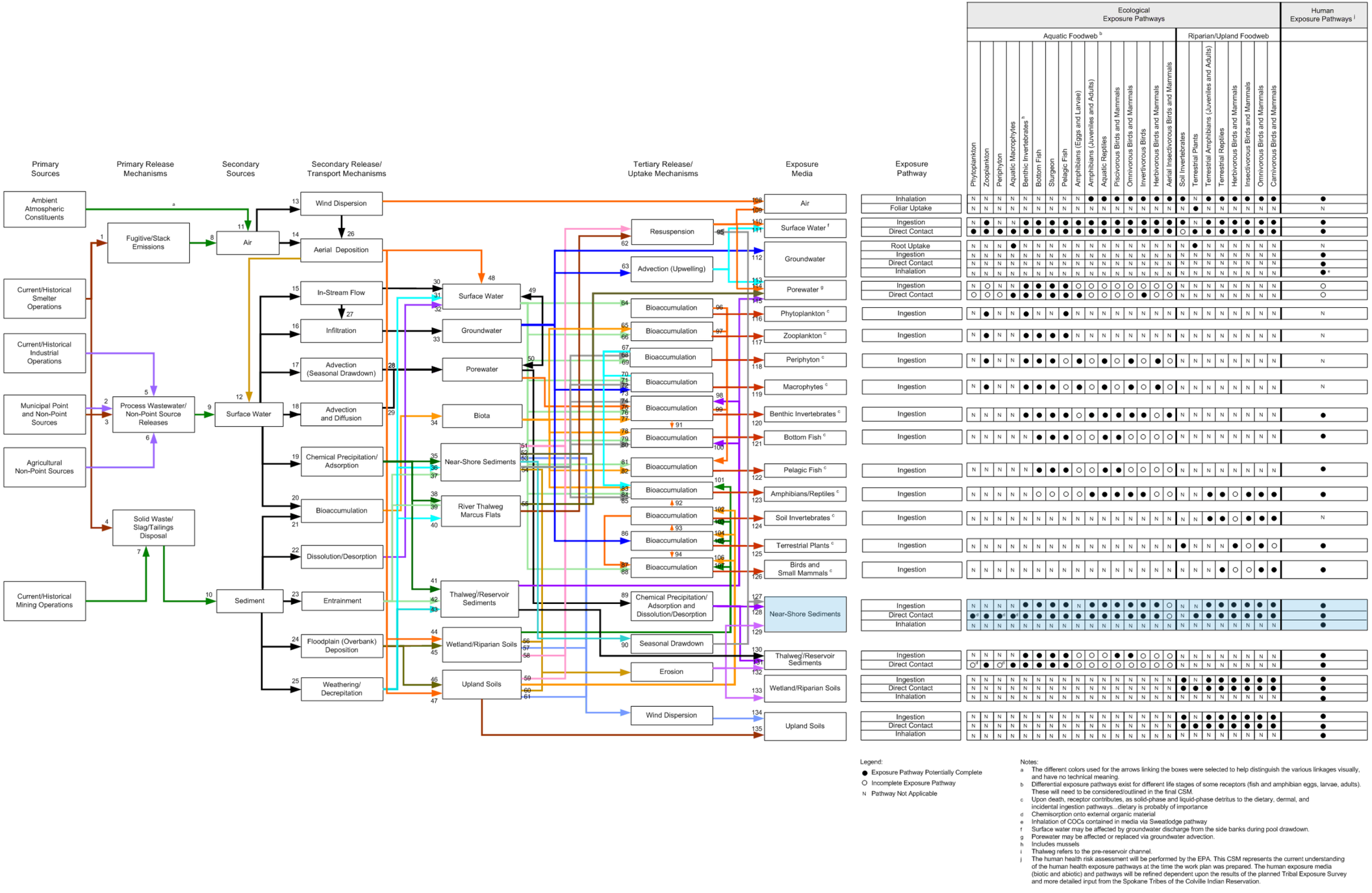

Figure A6-1. Sitewide Conceptual Site Model

Note: Data collected during this study will refine exposure point concentrations between river miles 710 and 716 for receptors shaded in blue

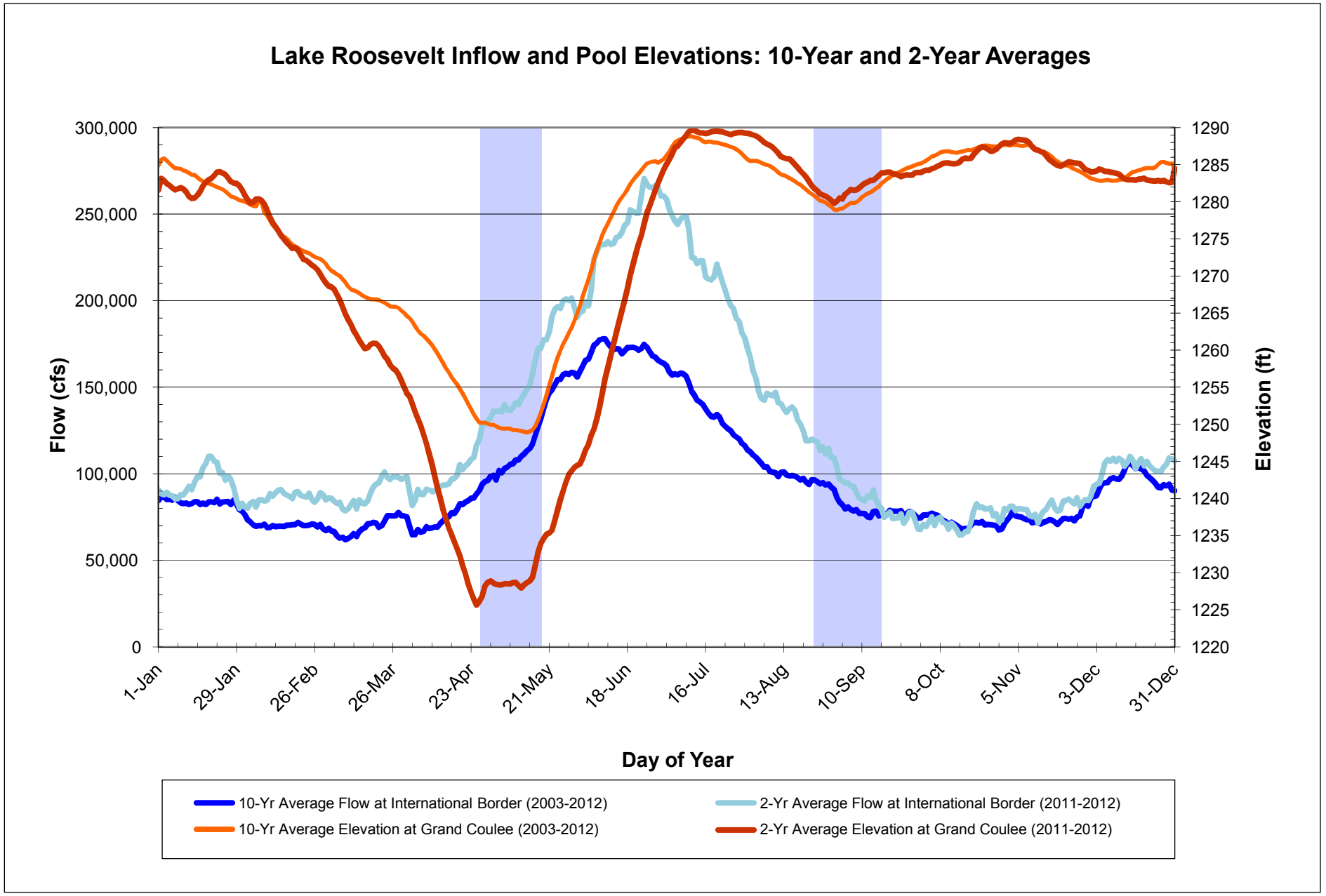

Figure A7-1. Sampling Windows of Opportunity to Collect Near-shore Sediments Between River Miles 710 and 716

Note: Sampling windows are shaded in blue

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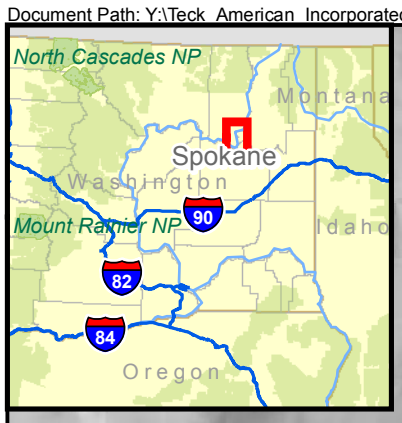

Ferry Landing Area

Hackley Parcel

SDU-8

SDU-1

716

YAM Area

SDU-2

Tailings Pond Outlet

Young America Mill Site

UDU-5

SDU-3

Young America Mine Site

SDU-9

F-1

UDU-6

F-2

UDU-1-4

Historic Ferry Site

SDU-10

715

SDU-4

Bossburg Area

Bossburg

714

713

25

712

Bear

Evans

Left Bank River Mile 711

Powell

SDU-5

711

Evans Campground Beach

SDU-6

Evans Campground Beach

710

SDU-7

Left Bank River Mile 710

709

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure A7-2. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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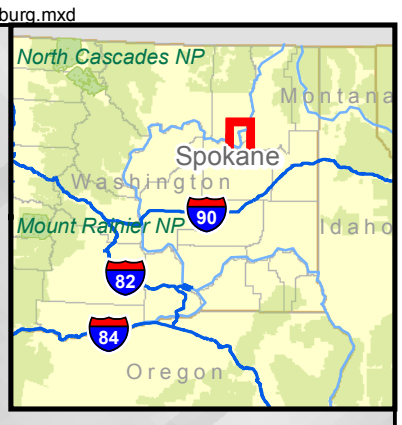

SDU-1
SDU-8
SDU-2
716
YAM Area
Young America Mill Site
Tailings Pond Outlet
(location uncertain)
UDU-5
Young America Mine Site
SDU-3
715
UDU-1
F-1
UDU-4
Historic
Ferry Site
1 inch = 175 feet
1 inch = 53 meters
Bossburg
Area
SDU-3
UDU- 1
UDU-3
Historic
Ferry Site
F-1
UDU-4
UDU-2
Bossburg
Flat
Beach
SDU-9
715
SDU-4
Hackley
Parcel
F-2
Ferry
Landing
Area
UDU-6
SDU-10

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 200 400 600 Feet

0 50 100 150 Meters

Figure A7-3. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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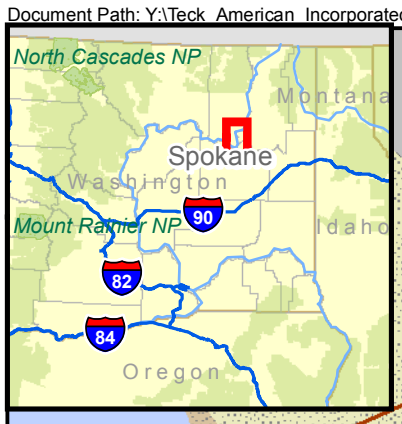


Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 350 700 1,050 Feet

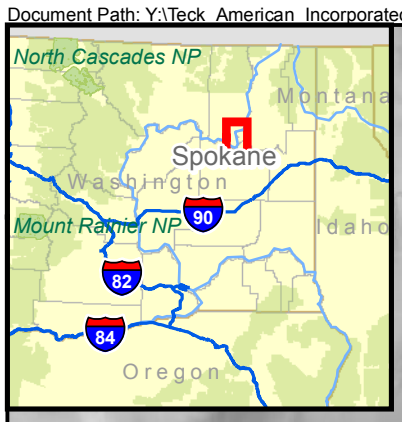
0 100 200 300 Meters

N

Figure A7-4. Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d5_Bossburg-Beach_Targets_Historic-Pb_ICS_Decision Units_Soil_Cover.mxd



YAM Area

SDU-8

716

SDU-1

SDU-2

UDU-5

Tailings Pond Outlet

Young America Mill Site

Young America Mine Site

Hackley Parcel

SDU-9

SDU-3

UDU-1

UDU-6

UDU-4

Historic Ferry Site

Ferry Landing Area

SDU-4

UDU-3

UDU-2

SDU-10

715

Bossburg Area

Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714

713

25

712

Bear

Evans

Left Bank River Mile 711

SDU-5

Powell

711

Evans Campground Beach

SDU-6

SDU-7

710

Left Bank River Mile 710

709

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see ICS detail figure)
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure A7-5. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations

Upper Columbia River, WA

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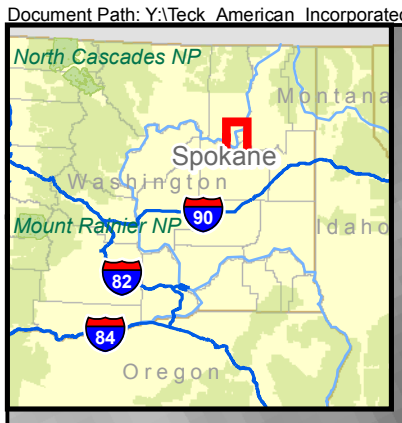

SDU-8
SDU-1
SDU-2
SDU-3
SDU-9
SDU-10
YAM Area
Young America Mill Site
UDU-5
Tailings Pond Outlet
(location uncertain)
716
715
Bossburg Area
UDU-1
UDU-2
UDU-3
UDU-4
UDU-6
F-1
F-2
Historic Ferry Site
Hackley Parcel
Ferry Landing Area

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30%
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

HDR

0 200 400 600 Feet
0 50 100 150 Meters

N

1 inch = 164 feet
1 inch = 50 meters

Figure A7-6. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations

Upper Columbia River, WA

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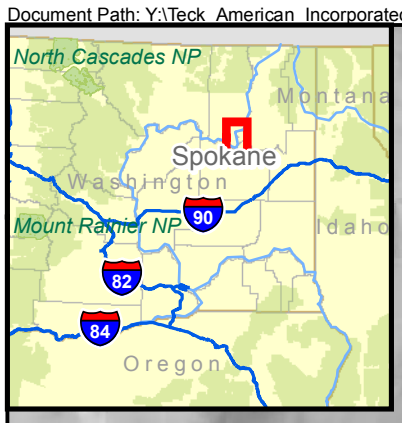


SDU-8
716
SDU-1
YAM Area
Tailings Pond Outlet
Young America Mill Site
SDU-2
UDU-5
Young America Mine Site
Hackley Parcel
SDU-9
F-1
SDU-3
UDU-6
F-2
Historic Ferry Site
UDU-1 - 4
Ferry Landing Area
SDU-10
715
SDU-4
Bossburg Area
Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714
713
25
Evans
Bear
712
Left Bank River Mile 711
SDU-5
Powell
711
Evans Campground Beach
SDU-6
710
SDU-7
Left Bank River Mile 710
709

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see XRF detail figure)
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure A7-7. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d8_Bossburg-Beach_XRF_Decision Units_Boss.mxd

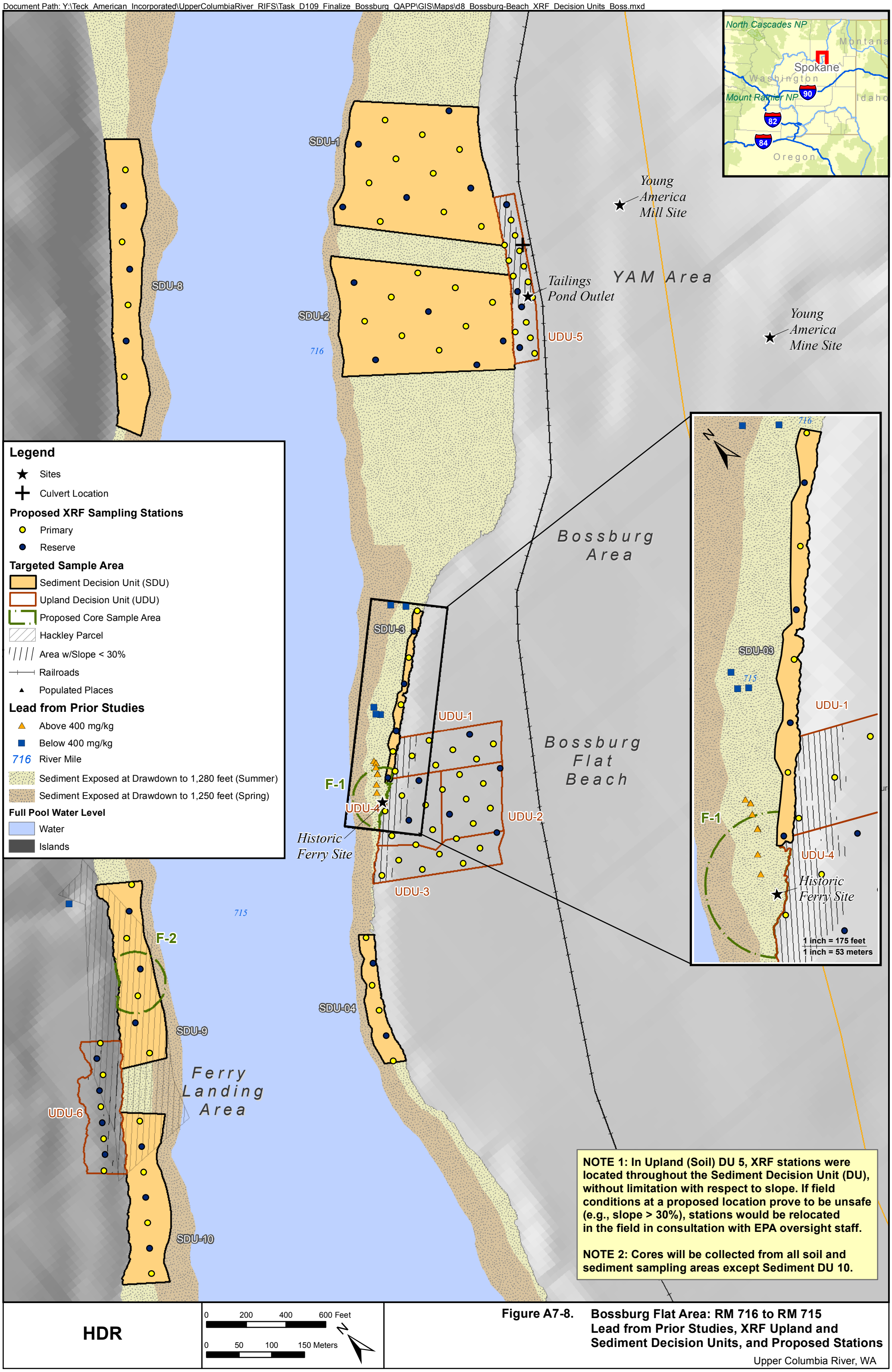
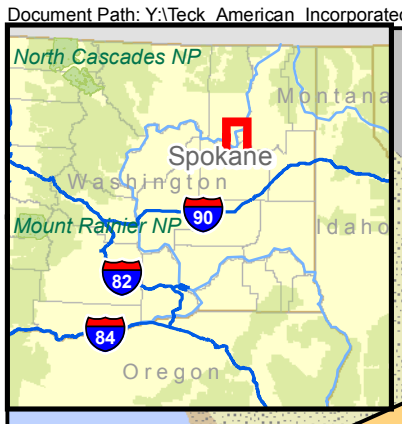


Figure A7-8. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d9_Bossburg-Beach_XRF_Decision Units_Evans.mxd



Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 350 700 1,050 Feet

0 100 200 300 Meters

N

Figure A7-9. Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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Table A4-1. Technical Team Task Member Information

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Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-01	423630.84	5401600.76	48.7627	-118.0392	Primary
SDU-01-02	423639.10	5401572.94	48.7625	-118.0391	Primary
SDU-01-03	423561.09	5401621.46	48.7629	-118.0401	Primary
SDU-01-04	423487.54	5401630.90	48.7630	-118.0411	Primary
SDU-01-05	423606.19	5401524.37	48.7620	-118.0395	Primary
SDU-01-06	423467.76	5401598.51	48.7627	-118.0414	Primary
SDU-01-07	423546.63	5401564.98	48.7624	-118.0403	Primary
SDU-01-08	423470.32	5401675.20	48.7634	-118.0414	Primary
SDU-01-09	423483.19	5401602.38	48.7627	-118.0412	Primary
SDU-01-10	423618.44	5401607.41	48.7628	-118.0394	Primary
SDU-01-11	423578.57	5401478.54	48.7616	-118.0399	Primary
SDU-01-12	423591.34	5401567.34	48.7624	-118.0397	Primary
SDU-01-13	423500.83	5401536.39	48.7621	-118.0410	Primary
SDU-01-14	423446.28	5401580.60	48.7625	-118.0417	Primary
SDU-01-15	423497.63	5401547.32	48.7622	-118.0410	Primary
SDU-01-16	423546.64	5401622.76	48.7629	-118.0403	Primary
SDU-01-17	423474.37	5401652.35	48.7632	-118.0413	Primary
SDU-01-18	423554.86	5401525.29	48.7620	-118.0402	Primary
SDU-01-19	423574.63	5401659.35	48.7632	-118.0400	Primary
SDU-01-20	423539.40	5401588.88	48.7626	-118.0404	Primary
SDU-01-21	423504.09	5401608.43	48.7628	-118.0409	Primary
SDU-01-22	423556.23	5401551.04	48.7623	-118.0402	Primary
SDU-01-23	423547.92	5401690.13	48.7635	-118.0403	Primary
SDU-01-24	423588.63	5401546.53	48.7622	-118.0398	Primary
SDU-01-25	423563.43	5401574.67	48.7625	-118.0401	Primary
SDU-01-26	423483.66	5401615.73	48.7628	-118.0412	Primary
SDU-01-27	423592.55	5401520.85	48.7620	-118.0397	Primary
SDU-01-28	423529.44	5401541.81	48.7622	-118.0406	Primary
SDU-01-29	423577.03	5401458.95	48.7614	-118.0399	Primary
SDU-01-30	423450.75	5401658.18	48.7632	-118.0417	Primary
SDU-01-R01	423544.63	5401479.69	48.7616	-118.0403	Reserve
SDU-01-R02	423608.25	5401595.82	48.7627	-118.0395	Reserve
SDU-01-R03	423620.19	5401632.54	48.7630	-118.0393	Reserve
SDU-01-R04	423497.83	5401690.92	48.7635	-118.0410	Reserve
SDU-01-R05	423520.31	5401721.62	48.7638	-118.0407	Reserve
SDU-01-R06	423563.06	5401500.20	48.7618	-118.0401	Reserve
Sediment Decision Unit 2					
SDU-02A-01	423365.94	5401507.17	48.7619	-118.0428	Primary
SDU-02A-02	423475.31	5401421.06	48.7611	-118.0413	Primary
SDU-02A-03	423440.99	5401312.01	48.7601	-118.0417	Primary
SDU-02A-04	423329.14	5401424.80	48.7611	-118.0433	Primary
SDU-02A-05	423413.96	5401404.55	48.7609	-118.0421	Primary
SDU-02A-06	423457.30	5401408.51	48.7610	-118.0415	Primary
SDU-02A-07	423306.22	5401432.62	48.7612	-118.0436	Primary
SDU-02A-08	423319.02	5401437.62	48.7612	-118.0434	Primary
SDU-02A-09	423363.13	5401531.17	48.7621	-118.0428	Primary
SDU-02A-10	423325.42	5401502.85	48.7618	-118.0433	Primary
SDU-02A-11	423355.87	5401381.48	48.7607	-118.0429	Primary
SDU-02A-12	423439.20	5401459.26	48.7614	-118.0418	Primary
SDU-02A-13	423357.78	5401431.33	48.7612	-118.0429	Primary
SDU-02A-14	423299.76	5401506.93	48.7618	-118.0437	Primary
SDU-02A-15	423282.13	5401438.13	48.7612	-118.0439	Primary
SDU-02A-16	423371.31	5401377.48	48.7607	-118.0427	Primary
SDU-02A-17	423369.97	5401426.20	48.7611	-118.0427	Primary
SDU-02A-18	423461.29	5401323.65	48.7602	-118.0414	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02A-19	423331.38	5401445.01	48.7613	-118.0432	Primary
SDU-02A-20	423325.13	5401475.38	48.7616	-118.0433	Primary
SDU-02A-21	423524.50	5401394.79	48.7609	-118.0406	Primary
SDU-02A-22	423376.85	5401528.78	48.7620	-118.0426	Primary
SDU-02A-23	423445.76	5401480.31	48.7616	-118.0417	Primary
SDU-02A-24	423311.87	5401476.04	48.7616	-118.0435	Primary
SDU-02A-25	423304.27	5401486.04	48.7617	-118.0436	Primary
SDU-02A-26	423459.10	5401368.29	48.7606	-118.0415	Primary
SDU-02A-27	423423.30	5401421.21	48.7611	-118.0420	Primary
SDU-02A-28	423377.53	5401505.95	48.7618	-118.0426	Primary
SDU-02A-29	423448.50	5401285.48	48.7599	-118.0416	Primary
SDU-02A-30	423359.02	5401571.04	48.7624	-118.0429	Primary
SDU-02B-01	423323.59	5401524.36	48.7620	-118.0434	Primary
SDU-02B-02	423413.07	5401381.78	48.7607	-118.0421	Primary
SDU-02B-03	423439.73	5401460.96	48.7614	-118.0418	Primary
SDU-02B-04	423413.88	5401430.31	48.7612	-118.0421	Primary
SDU-02B-05	423456.45	5401393.37	48.7608	-118.0415	Primary
SDU-02B-06	423466.72	5401430.14	48.7612	-118.0414	Primary
SDU-02B-07	423347.04	5401550.69	48.7622	-118.0430	Primary
SDU-02B-08	423374.44	5401419.78	48.7611	-118.0426	Primary
SDU-02B-09	423386.57	5401403.06	48.7609	-118.0425	Primary
SDU-02B-10	423353.11	5401440.82	48.7613	-118.0429	Primary
SDU-02B-11	423357.31	5401352.98	48.7605	-118.0429	Primary
SDU-02B-12	423362.70	5401521.73	48.7620	-118.0428	Primary
SDU-02B-13	423394.21	5401419.01	48.7611	-118.0424	Primary
SDU-02B-14	423396.68	5401453.70	48.7614	-118.0424	Primary
SDU-02B-15	423450.07	5401358.94	48.7605	-118.0416	Primary
SDU-02B-16	423337.37	5401373.60	48.7606	-118.0431	Primary
SDU-02B-17	423380.44	5401449.89	48.7613	-118.0426	Primary
SDU-02B-18	423457.99	5401377.57	48.7607	-118.0415	Primary
SDU-02B-19	423462.29	5401418.77	48.7611	-118.0415	Primary
SDU-02B-20	423382.92	5401364.71	48.7606	-118.0425	Primary
SDU-02B-21	423413.29	5401367.63	48.7606	-118.0421	Primary
SDU-02B-22	423344.28	5401361.70	48.7605	-118.0430	Primary
SDU-02B-23	423422.26	5401514.36	48.7619	-118.0420	Primary
SDU-02B-24	423281.10	5401417.25	48.7610	-118.0439	Primary
SDU-02B-25	423369.61	5401562.31	48.7624	-118.0427	Primary
SDU-02B-26	423331.75	5401451.68	48.7614	-118.0432	Primary
SDU-02B-27	423423.41	5401395.22	48.7609	-118.0420	Primary
SDU-02B-28	423425.99	5401353.00	48.7605	-118.0419	Primary
SDU-02B-29	423306.62	5401407.49	48.7609	-118.0436	Primary
SDU-02B-30	423497.47	5401354.65	48.7605	-118.0410	Primary
SDU-02C-01	423496.55	5401381.42	48.7607	-118.0410	Primary
SDU-02C-02	423437.23	5401489.51	48.7617	-118.0418	Primary
SDU-02C-03	423408.38	5401337.72	48.7603	-118.0422	Primary
SDU-02C-04	423426.25	5401301.17	48.7600	-118.0419	Primary
SDU-02C-05	423473.39	5401444.37	48.7613	-118.0413	Primary
SDU-02C-06	423279.65	5401482.77	48.7616	-118.0440	Primary
SDU-02C-07	423343.15	5401404.70	48.7609	-118.0431	Primary
SDU-02C-08	423406.67	5401497.62	48.7618	-118.0422	Primary
SDU-02C-09	423358.81	5401463.19	48.7615	-118.0429	Primary
SDU-02C-10	423398.72	5401528.36	48.7620	-118.0423	Primary
SDU-02C-11	423362.77	5401481.91	48.7616	-118.0428	Primary
SDU-02C-12	423386.12	5401505.30	48.7618	-118.0425	Primary
SDU-02C-13	423380.70	5401380.75	48.7607	-118.0426	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02C-14	423397.73	5401391.88	48.7608	-118.0423	Primary
SDU-02C-15	423429.17	5401362.27	48.7606	-118.0419	Primary
SDU-02C-16	423463.59	5401464.10	48.7615	-118.0414	Primary
SDU-02C-17	423409.76	5401478.77	48.7616	-118.0422	Primary
SDU-02C-18	423445.55	5401465.20	48.7615	-118.0417	Primary
SDU-02C-19	423514.50	5401376.57	48.7607	-118.0407	Primary
SDU-02C-20	423391.13	5401347.70	48.7604	-118.0424	Primary
SDU-02C-21	423516.19	5401396.67	48.7609	-118.0407	Primary
SDU-02C-22	423375.89	5401518.96	48.7620	-118.0426	Primary
SDU-02C-23	423290.97	5401500.76	48.7618	-118.0438	Primary
SDU-02C-24	423327.71	5401534.89	48.7621	-118.0433	Primary
SDU-02C-25	423274.81	5401428.67	48.7611	-118.0440	Primary
SDU-02C-26	423345.92	5401390.29	48.7608	-118.0430	Primary
SDU-02C-27	423471.62	5401356.39	48.7605	-118.0413	Primary
SDU-02C-28	423485.43	5401413.10	48.7610	-118.0411	Primary
SDU-02C-29	423453.30	5401373.60	48.7607	-118.0416	Primary
SDU-02C-30	423425.35	5401335.23	48.7603	-118.0419	Primary
SDU-02A-R01	423374.93	5401429.92	48.7612	-118.0426	Reserve
SDU-02A-R02	423486.85	5401335.36	48.7603	-118.0411	Reserve
SDU-02A-R03	423476.84	5401346.80	48.7604	-118.0412	Reserve
SDU-02A-R04	423503.11	5401380.10	48.7607	-118.0409	Reserve
SDU-02A-R05	423424.54	5401316.00	48.7601	-118.0419	Reserve
SDU-02A-R06	423397.51	5401464.10	48.7615	-118.0423	Reserve
SDU-02B-R01	423496.79	5401362.83	48.7606	-118.0410	Reserve
SDU-02B-R02	423406.71	5401433.83	48.7612	-118.0422	Reserve
SDU-02B-R03	423408.76	5401364.48	48.7606	-118.0422	Reserve
SDU-02B-R04	423484.81	5401381.81	48.7607	-118.0411	Reserve
SDU-02B-R05	423374.79	5401420.33	48.7611	-118.0426	Reserve
SDU-02B-R06	423318.66	5401424.85	48.7611	-118.0434	Reserve
SDU-02C-R01	423438.64	5401417.08	48.7611	-118.0418	Reserve
SDU-02C-R02	423497.63	5401423.54	48.7611	-118.0410	Reserve
SDU-02C-R03	423341.29	5401564.27	48.7624	-118.0431	Reserve
SDU-02C-R04	423374.17	5401370.09	48.7606	-118.0426	Reserve
SDU-02C-R05	423438.02	5401318.49	48.7602	-118.0418	Reserve
SDU-02C-R06	423443.37	5401298.27	48.7600	-118.0417	Reserve
Sediment Decision Unit 3					
SDU-03A-01	423075.43	5401081.95	48.7580	-118.0467	Primary
SDU-03A-02	423046.12	5401075.30	48.7579	-118.0471	Primary
SDU-03A-03	422893.02	5400942.44	48.7567	-118.0491	Primary
SDU-03A-04	422977.57	5401017.64	48.7574	-118.0480	Primary
SDU-03A-05	422953.98	5400993.74	48.7572	-118.0483	Primary
SDU-03A-06	423083.50	5401091.50	48.7581	-118.0465	Primary
SDU-03A-07	422881.53	5400934.65	48.7566	-118.0493	Primary
SDU-03A-08	422965.42	5401004.46	48.7573	-118.0481	Primary
SDU-03A-09	422930.98	5400977.64	48.7570	-118.0486	Primary
SDU-03A-10	422948.57	5400993.52	48.7572	-118.0484	Primary
SDU-03A-11	422960.74	5401013.46	48.7574	-118.0482	Primary
SDU-03A-12	422938.71	5400982.31	48.7571	-118.0485	Primary
SDU-03A-13	423025.31	5401056.61	48.7578	-118.0473	Primary
SDU-03A-14	422886.41	5400944.45	48.7567	-118.0492	Primary
SDU-03A-15	423025.66	5401050.24	48.7577	-118.0473	Primary
SDU-03A-16	422911.29	5400957.94	48.7569	-118.0489	Primary
SDU-03A-17	422925.42	5400985.25	48.7571	-118.0487	Primary
SDU-03A-18	422902.56	5400957.13	48.7568	-118.0490	Primary
SDU-03A-19	422984.99	5401015.02	48.7574	-118.0479	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03A-20	423001.20	5401035.84	48.7576	-118.0477	Primary
SDU-03A-21	422889.97	5400951.48	48.7568	-118.0492	Primary
SDU-03A-22	422927.40	5400971.82	48.7570	-118.0486	Primary
SDU-03A-23	423078.13	5401090.09	48.7581	-118.0466	Primary
SDU-03A-24	422876.63	5400940.09	48.7567	-118.0493	Primary
SDU-03A-25	423070.75	5401093.52	48.7581	-118.0467	Primary
SDU-03A-26	423067.38	5401085.69	48.7580	-118.0468	Primary
SDU-03A-27	423001.95	5401028.31	48.7575	-118.0476	Primary
SDU-03A-28	422990.07	5401023.10	48.7575	-118.0478	Primary
SDU-03A-29	423091.79	5401096.58	48.7581	-118.0464	Primary
SDU-03A-30	423036.86	5401056.28	48.7578	-118.0472	Primary
SDU-03B-01	422980.84	5401019.31	48.7574	-118.0479	Primary
SDU-03B-02	422986.69	5401023.93	48.7575	-118.0479	Primary
SDU-03B-03	423021.41	5401046.16	48.7577	-118.0474	Primary
SDU-03B-04	423028.20	5401060.50	48.7578	-118.0473	Primary
SDU-03B-05	423010.08	5401036.69	48.7576	-118.0475	Primary
SDU-03B-06	423044.95	5401075.95	48.7579	-118.0471	Primary
SDU-03B-07	422892.87	5400942.88	48.7567	-118.0491	Primary
SDU-03B-08	422920.20	5400964.51	48.7569	-118.0487	Primary
SDU-03B-09	423022.73	5401051.03	48.7577	-118.0474	Primary
SDU-03B-10	422875.01	5400940.13	48.7567	-118.0494	Primary
SDU-03B-11	423033.15	5401055.81	48.7578	-118.0472	Primary
SDU-03B-12	423040.98	5401066.34	48.7578	-118.0471	Primary
SDU-03B-13	423036.73	5401059.31	48.7578	-118.0472	Primary
SDU-03B-14	422934.26	5400982.52	48.7571	-118.0486	Primary
SDU-03B-15	422963.54	5401012.84	48.7574	-118.0482	Primary
SDU-03B-16	422921.44	5400975.30	48.7570	-118.0487	Primary
SDU-03B-17	422895.74	5400952.35	48.7568	-118.0491	Primary
SDU-03B-18	423049.97	5401077.13	48.7579	-118.0470	Primary
SDU-03B-19	422939.29	5400979.13	48.7571	-118.0485	Primary
SDU-03B-20	423085.85	5401098.64	48.7581	-118.0465	Primary
SDU-03B-21	422904.97	5400959.70	48.7569	-118.0490	Primary
SDU-03B-22	423013.70	5401048.80	48.7577	-118.0475	Primary
SDU-03B-23	422960.67	5401006.12	48.7573	-118.0482	Primary
SDU-03B-24	422993.20	5401021.39	48.7574	-118.0478	Primary
SDU-03B-25	423084.30	5401089.64	48.7581	-118.0465	Primary
SDU-03B-26	422926.24	5400982.51	48.7571	-118.0487	Primary
SDU-03B-27	422967.08	5401001.65	48.7573	-118.0481	Primary
SDU-03B-28	422898.58	5400958.01	48.7569	-118.0490	Primary
SDU-03B-29	422976.05	5401012.38	48.7574	-118.0480	Primary
SDU-03B-30	422948.63	5400999.49	48.7572	-118.0484	Primary
SDU-03C-01	423036.26	5401060.71	48.7578	-118.0472	Primary
SDU-03C-02	422986.55	5401024.92	48.7575	-118.0479	Primary
SDU-03C-03	422972.23	5401015.58	48.7574	-118.0480	Primary
SDU-03C-04	423036.74	5401066.10	48.7578	-118.0472	Primary
SDU-03C-05	422885.36	5400945.57	48.7567	-118.0492	Primary
SDU-03C-06	423019.90	5401042.05	48.7576	-118.0474	Primary
SDU-03C-07	423067.91	5401079.04	48.7580	-118.0468	Primary
SDU-03C-08	423008.31	5401036.05	48.7576	-118.0476	Primary
SDU-03C-09	423050.36	5401069.60	48.7579	-118.0470	Primary
SDU-03C-10	423087.50	5401096.02	48.7581	-118.0465	Primary
SDU-03C-11	422949.80	5400997.88	48.7572	-118.0483	Primary
SDU-03C-12	422924.52	5400976.81	48.7570	-118.0487	Primary
SDU-03C-13	423050.22	5401075.12	48.7579	-118.0470	Primary
SDU-03C-14	422954.65	5401009.87	48.7573	-118.0483	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03C-15	423010.72	5401042.77	48.7576	-118.0475	Primary
SDU-03C-16	423023.40	5401056.87	48.7578	-118.0474	Primary
SDU-03C-17	423063.68	5401084.22	48.7580	-118.0468	Primary
SDU-03C-18	422899.61	5400958.32	48.7569	-118.0490	Primary
SDU-03C-19	422957.60	5401001.92	48.7573	-118.0482	Primary
SDU-03C-20	423078.03	5401099.88	48.7582	-118.0466	Primary
SDU-03C-21	422906.54	5400959.69	48.7569	-118.0489	Primary
SDU-03C-22	423079.92	5401093.28	48.7581	-118.0466	Primary
SDU-03C-23	422978.65	5401010.81	48.7573	-118.0480	Primary
SDU-03C-24	422917.15	5400964.56	48.7569	-118.0488	Primary
SDU-03C-25	423070.91	5401086.41	48.7580	-118.0467	Primary
SDU-03C-26	422935.28	5400985.60	48.7571	-118.0485	Primary
SDU-03C-27	422887.12	5400939.38	48.7567	-118.0492	Primary
SDU-03C-28	423055.82	5401077.23	48.7579	-118.0469	Primary
SDU-03C-29	423031.02	5401063.65	48.7578	-118.0473	Primary
SDU-03C-30	422962.43	5401012.22	48.7574	-118.0482	Primary
SDU-03A-R01	423003.03	5401040.73	48.7576	-118.0476	Reserve
SDU-03A-R02	422978.85	5401022.65	48.7574	-118.0480	Reserve
SDU-03A-R03	423035.59	5401059.68	48.7578	-118.0472	Reserve
SDU-03A-R04	422889.18	5400947.17	48.7568	-118.0492	Reserve
SDU-03A-R05	422916.93	5400972.62	48.7570	-118.0488	Reserve
SDU-03A-R06	422987.08	5401027.19	48.7575	-118.0478	Reserve
SDU-03B-R01	422962.46	5401001.83	48.7573	-118.0482	Reserve
SDU-03B-R02	422994.03	5401028.52	48.7575	-118.0478	Reserve
SDU-03B-R03	423072.83	5401083.40	48.7580	-118.0467	Reserve
SDU-03B-R04	422896.05	5400947.54	48.7568	-118.0491	Reserve
SDU-03B-R05	422936.79	5400975.25	48.7570	-118.0485	Reserve
SDU-03B-R06	423062.05	5401082.13	48.7580	-118.0468	Reserve
SDU-03C-R01	422896.00	5400951.21	48.7568	-118.0491	Reserve
SDU-03C-R02	423048.80	5401077.52	48.7580	-118.0470	Reserve
SDU-03C-R03	422907.49	5400955.91	48.7568	-118.0489	Reserve
SDU-03C-R04	422954.83	5400996.30	48.7572	-118.0483	Reserve
SDU-03C-R05	422981.92	5401019.90	48.7574	-118.0479	Reserve
SDU-03C-R06	422958.40	5401003.23	48.7573	-118.0482	Reserve
Sediment Decision Unit 4					
SDU-04-01	422603.47	5400657.78	48.7541	-118.0530	Primary
SDU-04-02	422672.21	5400762.34	48.7551	-118.0521	Primary
SDU-04-03	422678.61	5400778.72	48.7552	-118.0520	Primary
SDU-04-04	422626.54	5400658.95	48.7541	-118.0527	Primary
SDU-04-05	422630.71	5400680.62	48.7543	-118.0526	Primary
SDU-04-06	422620.95	5400688.83	48.7544	-118.0528	Primary
SDU-04-07	422669.67	5400744.43	48.7549	-118.0521	Primary
SDU-04-08	422609.61	5400644.67	48.7540	-118.0529	Primary
SDU-04-09	422658.77	5400732.51	48.7548	-118.0523	Primary
SDU-04-10	422656.04	5400748.44	48.7549	-118.0523	Primary
SDU-04-11	422679.08	5400749.70	48.7550	-118.0520	Primary
SDU-04-12	422682.58	5400762.14	48.7551	-118.0519	Primary
SDU-04-13	422652.93	5400723.17	48.7547	-118.0523	Primary
SDU-04-14	422639.31	5400711.80	48.7546	-118.0525	Primary
SDU-04-15	422596.57	5400622.09	48.7538	-118.0531	Primary
SDU-04-16	422616.68	5400628.55	48.7539	-118.0528	Primary
SDU-04-17	422632.22	5400700.46	48.7545	-118.0526	Primary
SDU-04-18	422615.51	5400613.02	48.7537	-118.0528	Primary
SDU-04-19	422617.81	5400676.91	48.7543	-118.0528	Primary
SDU-04-20	422608.85	5400682.01	48.7543	-118.0529	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 4 (continued)					
SDU-04-21	422641.10	5400689.90	48.7544	-118.0525	Primary
SDU-04-22	422668.91	5400730.41	48.7548	-118.0521	Primary
SDU-04-23	422585.81	5400626.22	48.7538	-118.0532	Primary
SDU-04-24	422696.57	5400771.48	48.7552	-118.0517	Primary
SDU-04-25	422606.88	5400670.63	48.7542	-118.0530	Primary
SDU-04-26	422590.00	5400640.17	48.7540	-118.0532	Primary
SDU-04-27	422619.44	5400651.33	48.7541	-118.0528	Primary
SDU-04-28	422595.71	5400650.41	48.7541	-118.0531	Primary
SDU-04-29	422607.79	5400622.30	48.7538	-118.0529	Primary
SDU-04-30	422618.06	5400666.60	48.7542	-118.0528	Primary
SDU-04-R01	422631.97	5400705.38	48.7546	-118.0526	Reserve
SDU-04-R02	422680.35	5400762.15	48.7551	-118.0520	Reserve
SDU-04-R03	422684.79	5400788.72	48.7553	-118.0519	Reserve
SDU-04-R04	422595.15	5400640.26	48.7540	-118.0531	Reserve
SDU-04-R05	422600.39	5400652.06	48.7541	-118.0530	Reserve
SDU-04-R06	422609.92	5400643.39	48.7540	-118.0529	Reserve
Sediment Decision Unit 5					
SDU-05-01	424472.26	5395156.32	48.7049	-118.0266	Primary
SDU-05-02	424399.92	5395020.87	48.7036	-118.0275	Primary
SDU-05-03	424464.46	5395247.37	48.7057	-118.0267	Primary
SDU-05-04	424423.78	5394887.57	48.7024	-118.0272	Primary
SDU-05-05	424366.56	5395269.89	48.7059	-118.0280	Primary
SDU-05-06	424405.11	5395202.62	48.7053	-118.0275	Primary
SDU-05-07	424749.82	5395036.86	48.7038	-118.0228	Primary
SDU-05-08	424647.43	5395143.85	48.7048	-118.0242	Primary
SDU-05-09	424415.33	5395097.09	48.7043	-118.0273	Primary
SDU-05-10	424335.38	5395243.99	48.7056	-118.0284	Primary
SDU-05-11	424501.84	5395031.62	48.7037	-118.0261	Primary
SDU-05-12	424386.76	5395194.71	48.7052	-118.0277	Primary
SDU-05-13	424449.75	5395051.43	48.7039	-118.0269	Primary
SDU-05-14	424420.63	5395085.72	48.7042	-118.0273	Primary
SDU-05-15	424621.07	5395155.26	48.7049	-118.0245	Primary
SDU-05-16	424308.62	5395258.43	48.7058	-118.0288	Primary
SDU-05-17	424339.88	5395210.75	48.7053	-118.0284	Primary
SDU-05-18	424700.88	5395037.45	48.7038	-118.0234	Primary
SDU-05-19	424508.57	5395400.73	48.7071	-118.0261	Primary
SDU-05-20	424326.13	5395031.86	48.7037	-118.0285	Primary
SDU-05-21	424485.03	5395041.34	48.7038	-118.0264	Primary
SDU-05-22	424414.23	5394867.40	48.7023	-118.0273	Primary
SDU-05-23	424408.72	5395150.39	48.7048	-118.0274	Primary
SDU-05-24	424636.47	5395017.45	48.7036	-118.0243	Primary
SDU-05-25	424443.82	5395267.29	48.7059	-118.0270	Primary
SDU-05-26	424441.21	5394892.32	48.7025	-118.0269	Primary
SDU-05-27	424469.89	5395323.25	48.7064	-118.0266	Primary
SDU-05-28	424563.41	5394993.91	48.7034	-118.0253	Primary
SDU-05-29	424541.10	5394951.78	48.7030	-118.0256	Primary
SDU-05-30	424244.37	5395132.02	48.7046	-118.0297	Primary
SDU-05-R01	424362.83	5395131.72	48.7046	-118.0280	Reserve
SDU-05-R02	424569.42	5395348.39	48.7066	-118.0253	Reserve
SDU-05-R03	424293.31	5395212.92	48.7054	-118.0290	Reserve
SDU-05-R04	424699.09	5395181.36	48.7051	-118.0235	Reserve
SDU-05-R05	424717.13	5395166.72	48.7050	-118.0232	Reserve
SDU-05-R06	424431.62	5395109.47	48.7044	-118.0271	Reserve

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6					
SDU-06A-01	425237.10	5393946.60	48.6941	-118.0160	Primary
SDU-06A-02	425260.79	5393962.50	48.6942	-118.0156	Primary
SDU-06A-03	425306.90	5393826.09	48.6930	-118.0150	Primary
SDU-06A-04	425212.58	5394072.57	48.6952	-118.0163	Primary
SDU-06A-05	425302.20	5393747.94	48.6923	-118.0150	Primary
SDU-06A-06	425241.84	5393997.48	48.6945	-118.0159	Primary
SDU-06A-07	425240.79	5394049.61	48.6950	-118.0159	Primary
SDU-06A-08	425301.44	5393654.36	48.6915	-118.0150	Primary
SDU-06A-09	425235.94	5394038.05	48.6949	-118.0160	Primary
SDU-06A-10	425308.23	5393728.40	48.6921	-118.0149	Primary
SDU-06A-11	425155.57	5394142.98	48.6958	-118.0171	Primary
SDU-06A-12	425241.44	5393964.60	48.6942	-118.0159	Primary
SDU-06A-13	425285.11	5393850.98	48.6932	-118.0153	Primary
SDU-06A-14	425254.96	5393984.99	48.6944	-118.0157	Primary
SDU-06A-15	425304.43	5393763.16	48.6924	-118.0150	Primary
SDU-06A-16	425265.24	5393952.89	48.6941	-118.0156	Primary
SDU-06A-17	425285.91	5393728.64	48.6921	-118.0153	Primary
SDU-06A-18	425227.67	5394008.93	48.6946	-118.0161	Primary
SDU-06A-19	425260.46	5393887.43	48.6935	-118.0156	Primary
SDU-06A-20	425219.56	5394025.89	48.6948	-118.0162	Primary
SDU-06A-21	425164.40	5394137.83	48.6958	-118.0170	Primary
SDU-06A-22	425314.92	5393749.94	48.6923	-118.0149	Primary
SDU-06A-23	425282.19	5393883.95	48.6935	-118.0153	Primary
SDU-06A-24	425298.79	5393737.84	48.6922	-118.0151	Primary
SDU-06A-25	425140.07	5394162.97	48.6960	-118.0173	Primary
SDU-06A-26	425283.25	5393830.25	48.6930	-118.0153	Primary
SDU-06A-27	425190.68	5394114.67	48.6956	-118.0166	Primary
SDU-06A-28	425230.13	5394052.57	48.6950	-118.0161	Primary
SDU-06A-29	425302.40	5393816.28	48.6929	-118.0150	Primary
SDU-06A-30	425314.38	5393791.67	48.6927	-118.0149	Primary
SDU-06B-01	425304.62	5393706.64	48.6919	-118.0150	Primary
SDU-06B-02	425268.86	5393883.04	48.6935	-118.0155	Primary
SDU-06B-03	425303.49	5393734.42	48.6922	-118.0150	Primary
SDU-06B-04	425129.61	5394178.10	48.6961	-118.0175	Primary
SDU-06B-05	425299.29	5393658.80	48.6915	-118.0151	Primary
SDU-06B-06	425233.42	5394055.71	48.6951	-118.0160	Primary
SDU-06B-07	425283.67	5393741.30	48.6922	-118.0153	Primary
SDU-06B-08	425280.23	5393697.19	48.6918	-118.0153	Primary
SDU-06B-09	425189.41	5394112.80	48.6956	-118.0166	Primary
SDU-06B-10	425281.00	5393877.57	48.6935	-118.0153	Primary
SDU-06B-11	425247.28	5393905.12	48.6937	-118.0158	Primary
SDU-06B-12	425146.94	5394155.76	48.6959	-118.0172	Primary
SDU-06B-13	425233.43	5394008.61	48.6946	-118.0160	Primary
SDU-06B-14	425307.64	5393819.14	48.6929	-118.0150	Primary
SDU-06B-15	425278.77	5393850.64	48.6932	-118.0154	Primary
SDU-06B-16	425306.09	5393746.44	48.6923	-118.0150	Primary
SDU-06B-17	425119.17	5394180.12	48.6962	-118.0176	Primary
SDU-06B-18	425248.74	5393997.16	48.6945	-118.0158	Primary
SDU-06B-19	425257.04	5394003.81	48.6946	-118.0157	Primary
SDU-06B-20	425208.21	5394095.44	48.6954	-118.0164	Primary
SDU-06B-21	425128.37	5394167.15	48.6960	-118.0175	Primary
SDU-06B-22	425205.78	5394080.26	48.6953	-118.0164	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6 (continued)					
SDU-06B-23	425264.51	5393902.69	48.6937	-118.0156	Primary
SDU-06B-24	425181.28	5394119.78	48.6956	-118.0167	Primary
SDU-06B-25	425177.10	5394109.13	48.6955	-118.0168	Primary
SDU-06B-26	425242.88	5394049.36	48.6950	-118.0159	Primary
SDU-06B-27	425291.01	5393687.28	48.6918	-118.0152	Primary
SDU-06B-28	425232.92	5394036.92	48.6949	-118.0160	Primary
SDU-06B-29	425250.89	5393972.82	48.6943	-118.0158	Primary
SDU-06B-30	425296.41	5393674.08	48.6916	-118.0151	Primary
SDU-06C-01	425179.08	5394130.63	48.6957	-118.0168	Primary
SDU-06C-02	425248.90	5393985.52	48.6944	-118.0158	Primary
SDU-06C-03	425222.01	5394019.88	48.6947	-118.0162	Primary
SDU-06C-04	425298.36	5393857.65	48.6933	-118.0151	Primary
SDU-06C-05	425305.17	5393823.03	48.6930	-118.0150	Primary
SDU-06C-06	425284.21	5393859.37	48.6933	-118.0153	Primary
SDU-06C-07	425308.08	5393770.28	48.6925	-118.0150	Primary
SDU-06C-08	425200.47	5394087.32	48.6953	-118.0165	Primary
SDU-06C-09	425286.97	5393834.38	48.6931	-118.0153	Primary
SDU-06C-10	425236.99	5393923.04	48.6939	-118.0160	Primary
SDU-06C-11	425238.97	5394048.14	48.6950	-118.0159	Primary
SDU-06C-12	425271.97	5393861.58	48.6933	-118.0155	Primary
SDU-06C-13	425257.58	5393912.89	48.6938	-118.0157	Primary
SDU-06C-14	425300.88	5393758.94	48.6924	-118.0151	Primary
SDU-06C-15	425245.67	5393960.28	48.6942	-118.0158	Primary
SDU-06C-16	425226.60	5394048.28	48.6950	-118.0161	Primary
SDU-06C-17	425296.62	5393694.12	48.6918	-118.0151	Primary
SDU-06C-18	425132.36	5394167.39	48.6961	-118.0174	Primary
SDU-06C-19	425254.84	5393938.91	48.6940	-118.0157	Primary
SDU-06C-20	425316.94	5393778.98	48.6926	-118.0148	Primary
SDU-06C-21	425285.57	5393684.21	48.6917	-118.0152	Primary
SDU-06C-22	425144.99	5394157.40	48.6960	-118.0172	Primary
SDU-06C-23	425240.17	5393972.44	48.6943	-118.0159	Primary
SDU-06C-24	425302.51	5393680.03	48.6917	-118.0150	Primary
SDU-06C-25	425270.69	5393904.41	48.6937	-118.0155	Primary
SDU-06C-26	425221.76	5394067.60	48.6952	-118.0162	Primary
SDU-06C-27	425281.64	5393716.23	48.6920	-118.0153	Primary
SDU-06C-28	425247.81	5393907.84	48.6937	-118.0158	Primary
SDU-06C-29	425260.74	5393901.19	48.6937	-118.0156	Primary
SDU-06C-30	425304.38	5393669.32	48.6916	-118.0150	Primary
SDU-06A-R01	425297.78	5393780.57	48.6926	-118.0151	Reserve
SDU-06A-R02	425287.93	5393841.90	48.6931	-118.0152	Reserve
SDU-06A-R03	425231.23	5393992.52	48.6945	-118.0160	Reserve
SDU-06A-R04	425222.32	5394046.74	48.6950	-118.0162	Reserve
SDU-06A-R05	425241.90	5394041.02	48.6949	-118.0159	Reserve
SDU-06A-R06	425261.90	5393897.51	48.6936	-118.0156	Reserve
SDU-06B-R01	425231.53	5394017.61	48.6947	-118.0160	Reserve
SDU-06B-R02	425253.58	5393908.84	48.6937	-118.0157	Reserve
SDU-06B-R03	425239.13	5393930.63	48.6939	-118.0159	Reserve
SDU-06B-R04	425296.03	5393776.17	48.6926	-118.0151	Reserve
SDU-06B-R05	425286.98	5393715.15	48.6920	-118.0152	Reserve
SDU-06B-R06	425253.86	5393989.99	48.6945	-118.0157	Reserve
SDU-06C-R01	425130.93	5394169.67	48.6961	-118.0174	Reserve
SDU-06C-R02	425244.17	5393926.48	48.6939	-118.0159	Reserve

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6 (continued)					
SDU-06C-R03	425221.45	5394018.80	48.6947	-118.0162	Reserve
SDU-06C-R04	425286.78	5393869.34	48.6934	-118.0153	Reserve
SDU-06C-R05	425278.37	5393893.31	48.6936	-118.0154	Reserve
SDU-06C-R06	425305.67	5393775.93	48.6925	-118.0150	Reserve
Sediment Decision Unit 7					
SDU-07-01	425077.64	5392770.80	48.6835	-118.0179	Primary
SDU-07-02	425210.03	5392999.75	48.6856	-118.0161	Primary
SDU-07-03	425030.99	5392686.86	48.6827	-118.0185	Primary
SDU-07-04	425181.35	5392975.27	48.6853	-118.0165	Primary
SDU-07-05	425236.70	5393072.85	48.6862	-118.0158	Primary
SDU-07-06	425164.23	5392836.20	48.6841	-118.0167	Primary
SDU-07-07	425202.40	5392890.15	48.6846	-118.0162	Primary
SDU-07-08	425264.42	5392991.46	48.6855	-118.0154	Primary
SDU-07-09	425284.81	5393065.24	48.6862	-118.0151	Primary
SDU-07-10	425164.80	5392929.98	48.6849	-118.0168	Primary
SDU-07-11	425088.97	5392862.42	48.6843	-118.0178	Primary
SDU-07-12	425087.51	5392605.44	48.6820	-118.0177	Primary
SDU-07-13	425209.07	5393035.23	48.6859	-118.0162	Primary
SDU-07-14	425034.15	5392787.04	48.6836	-118.0185	Primary
SDU-07-15	425178.39	5392894.00	48.6846	-118.0166	Primary
SDU-07-16	425114.58	5392712.44	48.6830	-118.0174	Primary
SDU-07-17	425086.99	5392660.43	48.6825	-118.0178	Primary
SDU-07-18	425170.58	5392885.44	48.6845	-118.0167	Primary
SDU-07-19	425106.88	5392865.95	48.6843	-118.0175	Primary
SDU-07-20	424992.39	5392677.63	48.6826	-118.0190	Primary
SDU-07-21	425113.22	5392881.56	48.6845	-118.0174	Primary
SDU-07-22	425132.89	5392775.78	48.6835	-118.0172	Primary
SDU-07-23	425161.15	5392963.30	48.6852	-118.0168	Primary
SDU-07-24	425174.55	5392936.93	48.6850	-118.0166	Primary
SDU-07-25	425174.08	5392968.19	48.6853	-118.0166	Primary
SDU-07-26	425224.75	5392888.06	48.6846	-118.0159	Primary
SDU-07-27	425191.76	5392845.42	48.6842	-118.0164	Primary
SDU-07-28	424999.21	5392703.30	48.6829	-118.0190	Primary
SDU-07-29	425272.38	5393065.08	48.6862	-118.0153	Primary
SDU-07-30	425185.91	5393055.14	48.6861	-118.0165	Primary
SDU-07-R01	425196.60	5392975.83	48.6853	-118.0163	Reserve
SDU-07-R02	425172.43	5392993.92	48.6855	-118.0167	Reserve
SDU-07-R03	425227.45	5392964.95	48.6852	-118.0159	Reserve
SDU-07-R04	425196.50	5392781.77	48.6836	-118.0163	Reserve
SDU-07-R05	425062.81	5392712.29	48.6830	-118.0181	Reserve
SDU-07-R06	425026.79	5392713.56	48.6830	-118.0186	Reserve

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 8					
SDU-08-01	423137.23	5401825.68	48.7647	-118.0460	Primary
SDU-08-02	423122.43	5401770.43	48.7642	-118.0461	Primary
SDU-08-03	423096.57	5401801.20	48.7645	-118.0465	Primary
SDU-08-04	422964.72	5401616.42	48.7628	-118.0483	Primary
SDU-08-05	423181.79	5401905.36	48.7654	-118.0454	Primary
SDU-08-06	423175.50	5401868.59	48.7651	-118.0454	Primary
SDU-08-07	423021.23	5401655.32	48.7631	-118.0475	Primary
SDU-08-08	423083.58	5401787.43	48.7643	-118.0467	Primary
SDU-08-09	423038.21	5401677.32	48.7633	-118.0473	Primary
SDU-08-10	423004.77	5401681.57	48.7634	-118.0477	Primary
SDU-08-11	423051.14	5401715.43	48.7637	-118.0471	Primary
SDU-08-12	422961.54	5401635.13	48.7630	-118.0483	Primary
SDU-08-13	423093.90	5401742.45	48.7639	-118.0465	Primary
SDU-08-14	423072.56	5401725.41	48.7638	-118.0468	Primary
SDU-08-15	423220.95	5401956.02	48.7659	-118.0448	Primary
SDU-08-16	423204.67	5401900.27	48.7654	-118.0450	Primary
SDU-08-17	423202.82	5401851.71	48.7649	-118.0451	Primary
SDU-08-18	423184.71	5401844.72	48.7649	-118.0453	Primary
SDU-08-19	423082.90	5401771.82	48.7642	-118.0467	Primary
SDU-08-20	422985.97	5401651.68	48.7631	-118.0480	Primary
SDU-08-21	422998.70	5401666.89	48.7632	-118.0478	Primary
SDU-08-22	422983.81	5401633.63	48.7629	-118.0480	Primary
SDU-08-23	422995.59	5401639.76	48.7630	-118.0478	Primary
SDU-08-24	423064.95	5401770.25	48.7642	-118.0469	Primary
SDU-08-25	423187.20	5401832.73	48.7648	-118.0453	Primary
SDU-08-26	423126.09	5401823.44	48.7647	-118.0461	Primary
SDU-08-27	423009.37	5401655.00	48.7631	-118.0477	Primary
SDU-08-28	423082.57	5401745.40	48.7640	-118.0467	Primary
SDU-08-29	423149.46	5401809.79	48.7645	-118.0458	Primary
SDU-08-30	423021.35	5401666.76	48.7632	-118.0475	Primary
SDU-08-R01	422976.97	5401609.49	48.7627	-118.0481	Reserve
SDU-08-R02	423057.06	5401756.68	48.7641	-118.0470	Reserve
SDU-08-R03	423176.33	5401834.68	48.7648	-118.0454	Reserve
SDU-08-R04	423065.18	5401767.58	48.7642	-118.0469	Reserve
SDU-08-R05	423145.88	5401833.85	48.7648	-118.0458	Reserve
SDU-08-R06	422981.75	5401645.70	48.7631	-118.0480	Reserve
Sediment Decision Unit 9					
SDU-09A-01	422438.53	5401031.99	48.7575	-118.0550	Primary
SDU-09A-02	422435.61	5401082.55	48.7579	-118.0550	Primary
SDU-09A-03	422359.09	5400890.04	48.7562	-118.0560	Primary
SDU-09A-04	422459.44	5401040.60	48.7575	-118.0550	Primary
SDU-09A-05	422294.12	5400879.79	48.7561	-118.0570	Primary
SDU-09A-06	422360.19	5400968.44	48.7569	-118.0560	Primary
SDU-09A-07	422458.27	5401072.98	48.7578	-118.0550	Primary
SDU-09A-08	422409.52	5401039.95	48.7575	-118.0560	Primary
SDU-09A-09	422341.44	5400925.96	48.7565	-118.0570	Primary
SDU-09A-10	422362.03	5400928.07	48.7565	-118.0560	Primary
SDU-09A-11	422443.05	5401115.47	48.7582	-118.0550	Primary
SDU-09A-12	422348.84	5400915.49	48.7564	-118.0570	Primary
SDU-09A-13	422337.51	5400903.97	48.7563	-118.0570	Primary
SDU-09A-14	422344.59	5400889.35	48.7562	-118.0570	Primary
SDU-09A-15	422487.93	5401080.46	48.7579	-118.0550	Primary
SDU-09A-16	422440.11	5401010.42	48.7573	-118.0550	Primary
SDU-09A-17	422342.37	5400864.29	48.7559	-118.0570	Primary
SDU-09A-18	422321.97	5400863.90	48.7559	-118.0570	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09A-19	422375.45	5400953.30	48.7567	-118.0560	Primary
SDU-09A-20	422417.33	5401057.80	48.7577	-118.0560	Primary
SDU-09A-21	422445.59	5401065.74	48.7578	-118.0550	Primary
SDU-09A-22	422401.03	5400997.91	48.7572	-118.0560	Primary
SDU-09A-23	422359.64	5400939.42	48.7566	-118.0560	Primary
SDU-09A-24	422450.74	5401108.37	48.7582	-118.0550	Primary
SDU-09A-25	422393.67	5401022.95	48.7574	-118.0560	Primary
SDU-09A-26	422377.37	5400902.52	48.7563	-118.0560	Primary
SDU-09A-27	422431.15	5401041.07	48.7575	-118.0550	Primary
SDU-09A-28	422382.92	5400982.83	48.7570	-118.0560	Primary
SDU-09A-29	422391.52	5400933.20	48.7566	-118.0560	Primary
SDU-09A-30	422466.63	5401084.77	48.7579	-118.0550	Primary
SDU-09B-01	422320.10	5400924.13	48.7565	-118.0570	Primary
SDU-09B-02	422308.02	5400885.43	48.7561	-118.0570	Primary
SDU-09B-03	422437.38	5401072.65	48.7578	-118.0550	Primary
SDU-09B-04	422320.73	5400935.45	48.7566	-118.0570	Primary
SDU-09B-05	422413.76	5400989.91	48.7571	-118.0560	Primary
SDU-09B-06	422357.80	5400910.63	48.7564	-118.0560	Primary
SDU-09B-07	422462.23	5401069.10	48.7578	-118.0550	Primary
SDU-09B-08	422400.99	5400973.01	48.7569	-118.0560	Primary
SDU-09B-09	422431.53	5401081.29	48.7579	-118.0550	Primary
SDU-09B-10	422329.21	5400896.69	48.7562	-118.0570	Primary
SDU-09B-11	422323.32	5400874.28	48.7560	-118.0570	Primary
SDU-09B-12	422366.94	5400964.34	48.7568	-118.0560	Primary
SDU-09B-13	422324.64	5400885.39	48.7561	-118.0570	Primary
SDU-09B-14	422451.48	5401044.15	48.7576	-118.0550	Primary
SDU-09B-15	422345.08	5400961.08	48.7568	-118.0570	Primary
SDU-09B-16	422424.15	5401034.93	48.7575	-118.0560	Primary
SDU-09B-17	422348.50	5400942.34	48.7566	-118.0570	Primary
SDU-09B-18	422339.95	5400913.09	48.7564	-118.0570	Primary
SDU-09B-19	422383.49	5400936.87	48.7566	-118.0560	Primary
SDU-09B-20	422341.52	5400899.74	48.7563	-118.0570	Primary
SDU-09B-21	422396.25	5401000.31	48.7572	-118.0560	Primary
SDU-09B-22	422401.36	5401032.24	48.7575	-118.0560	Primary
SDU-09B-23	422373.90	5400945.55	48.7567	-118.0560	Primary
SDU-09B-24	422309.09	5400900.00	48.7563	-118.0570	Primary
SDU-09B-25	422299.01	5400907.77	48.7563	-118.0570	Primary
SDU-09B-26	422429.03	5401059.76	48.7577	-118.0550	Primary
SDU-09B-27	422373.08	5400934.64	48.7566	-118.0560	Primary
SDU-09B-28	422356.37	5400966.52	48.7569	-118.0560	Primary
SDU-09B-29	422381.12	5400995.76	48.7571	-118.0560	Primary
SDU-09B-30	422385.48	5400918.26	48.7564	-118.0560	Primary
SDU-09C-01	422349.71	5400897.78	48.7562	-118.0560	Primary
SDU-09C-02	422490.96	5401078.82	48.7579	-118.0550	Primary
SDU-09C-03	422374.27	5400897.82	48.7563	-118.0560	Primary
SDU-09C-04	422394.93	5400966.39	48.7569	-118.0560	Primary
SDU-09C-05	422358.47	5400883.12	48.7561	-118.0560	Primary
SDU-09C-06	422420.57	5401037.18	48.7575	-118.0560	Primary
SDU-09C-07	422434.49	5401092.46	48.7580	-118.0550	Primary
SDU-09C-08	422377.57	5400915.02	48.7564	-118.0560	Primary
SDU-09C-09	422321.96	5400904.98	48.7563	-118.0570	Primary
SDU-09C-10	422341.91	5400939.09	48.7566	-118.0570	Primary
SDU-09C-11	422453.61	5401076.71	48.7579	-118.0550	Primary
SDU-09C-12	422422.20	5401050.20	48.7576	-118.0560	Primary
SDU-09C-13	422439.88	5401032.04	48.7575	-118.0550	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09C-14	422325.50	5400926.00	48.7565	-118.0570	Primary
SDU-09C-15	422371.04	5400978.88	48.7570	-118.0560	Primary
SDU-09C-16	422405.05	5400955.57	48.7568	-118.0560	Primary
SDU-09C-17	422439.53	5401113.76	48.7582	-118.0550	Primary
SDU-09C-18	422364.18	5400959.89	48.7568	-118.0560	Primary
SDU-09C-19	422299.31	5400907.67	48.7563	-118.0570	Primary
SDU-09C-20	422341.83	5400911.94	48.7564	-118.0570	Primary
SDU-09C-21	422472.29	5401056.88	48.7577	-118.0550	Primary
SDU-09C-22	422388.56	5400915.08	48.7564	-118.0560	Primary
SDU-09C-23	422371.78	5400925.60	48.7565	-118.0560	Primary
SDU-09C-24	422352.34	5400917.24	48.7564	-118.0560	Primary
SDU-09C-25	422393.03	5401018.85	48.7573	-118.0560	Primary
SDU-09C-26	422384.28	5400984.19	48.7570	-118.0560	Primary
SDU-09C-27	422435.43	5401016.37	48.7573	-118.0550	Primary
SDU-09C-28	422362.12	5400898.09	48.7563	-118.0560	Primary
SDU-09C-29	422318.41	5400876.13	48.7560	-118.0570	Primary
SDU-09C-30	422362.09	5400933.78	48.7566	-118.0560	Primary
SDU-09A-R01	422404.48	5400989.88	48.7571	-118.0560	Reserve
SDU-09A-R02	422321.41	5400886.16	48.7561	-118.0570	Reserve
SDU-09A-R03	422343.19	5400892.22	48.7562	-118.0570	Reserve
SDU-09A-R04	422354.02	5400936.84	48.7566	-118.0560	Reserve
SDU-09A-R05	422411.28	5400970.01	48.7569	-118.0560	Reserve
SDU-09A-R06	422446.78	5401103.33	48.7581	-118.0550	Reserve
SDU-09B-R01	422396.84	5401011.27	48.7573	-118.0560	Reserve
SDU-09B-R02	422434.43	5401080.58	48.7579	-118.0550	Reserve
SDU-09B-R03	422313.79	5400879.69	48.7561	-118.0570	Reserve
SDU-09B-R04	422318.50	5400925.12	48.7565	-118.0570	Reserve
SDU-09B-R05	422366.08	5400894.94	48.7562	-118.0560	Reserve
SDU-09B-R06	422362.47	5400919.53	48.7564	-118.0560	Reserve
SDU-09C-R01	422383.59	5400961.60	48.7568	-118.0560	Reserve
SDU-09C-R02	422319.09	5400866.51	48.7560	-118.0570	Reserve
SDU-09C-R03	422326.39	5400887.55	48.7562	-118.0570	Reserve
SDU-09C-R04	422408.36	5401032.90	48.7575	-118.0560	Reserve
SDU-09C-R05	422401.70	5400969.92	48.7569	-118.0560	Reserve
SDU-09C-R06	422462.22	5401094.58	48.7580	-118.0550	Reserve
Sediment Decision Unit 10					
SDU-10-01	422121.36	5400672.62	48.7542	-118.0596	Primary
SDU-10-02	422238.00	5400804.41	48.7554	-118.0580	Primary
SDU-10-03	422100.04	5400634.56	48.7538	-118.0598	Primary
SDU-10-04	422139.78	5400663.87	48.7541	-118.0593	Primary
SDU-10-05	422130.00	5400651.00	48.7540	-118.0594	Primary
SDU-10-06	422266.05	5400779.23	48.7552	-118.0576	Primary
SDU-10-07	422226.71	5400755.86	48.7550	-118.0581	Primary
SDU-10-08	422113.35	5400595.63	48.7535	-118.0597	Primary
SDU-10-09	422165.15	5400677.78	48.7542	-118.0590	Primary
SDU-10-10	422104.99	5400659.23	48.7541	-118.0598	Primary
SDU-10-11	422165.70	5400721.01	48.7546	-118.0590	Primary
SDU-10-12	422165.60	5400702.18	48.7545	-118.0590	Primary
SDU-10-13	422182.00	5400720.14	48.7546	-118.0587	Primary
SDU-10-14	422208.57	5400755.72	48.7550	-118.0584	Primary
SDU-10-15	422216.02	5400767.96	48.7551	-118.0583	Primary
SDU-10-16	422184.58	5400743.91	48.7548	-118.0587	Primary
SDU-10-17	422090.19	5400640.86	48.7539	-118.0600	Primary
SDU-10-18	422152.81	5400657.01	48.7541	-118.0591	Primary
SDU-10-19	422121.40	5400621.25	48.7537	-118.0595	Primary

Table A7-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 10 (continued)					
SDU-10-20	422191.34	5400715.34	48.7546	-118.0586	Primary
SDU-10-21	422132.41	5400626.67	48.7538	-118.0594	Primary
SDU-10-22	422180.66	5400755.08	48.7549	-118.0588	Primary
SDU-10-23	422148.21	5400712.80	48.7546	-118.0592	Primary
SDU-10-24	422255.98	5400794.06	48.7553	-118.0577	Primary
SDU-10-25	422180.22	5400730.27	48.7547	-118.0588	Primary
SDU-10-26	422202.82	5400718.57	48.7546	-118.0585	Primary
SDU-10-27	422162.81	5400650.63	48.7540	-118.0590	Primary
SDU-10-28	422220.23	5400740.72	48.7548	-118.0582	Primary
SDU-10-29	422238.06	5400791.04	48.7553	-118.0580	Primary
SDU-10-30	422193.58	5400691.80	48.7544	-118.0586	Primary
SDU-10-R01	422113.36	5400613.03	48.7537	-118.0597	Reserve
SDU-10-R02	422245.19	5400815.12	48.7555	-118.0579	Reserve
SDU-10-R03	422136.24	5400710.38	48.7545	-118.0594	Reserve
SDU-10-R04	422077.60	5400642.89	48.7539	-118.0601	Reserve
SDU-10-R05	422222.90	5400761.89	48.7550	-118.0582	Reserve
SDU-10-R06	422163.66	5400653.81	48.7540	-118.0590	Reserve

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-01	422967.34	5400915.40	48.7565	-118.0481	Primary
UDU-01-02	422955.26	5400946.77	48.7568	-118.0483	Primary
UDU-01-03	422945.62	5400955.22	48.7568	-118.0484	Primary
UDU-01-04	422943.96	5400925.29	48.7566	-118.0484	Primary
UDU-01-05	422895.35	5400941.05	48.7567	-118.0491	Primary
UDU-01-06	423017.29	5400912.54	48.7565	-118.0474	Primary
UDU-01-07	422984.73	5400905.79	48.7564	-118.0479	Primary
UDU-01-08	422963.84	5400902.64	48.7564	-118.0481	Primary
UDU-01-09	422925.69	5400930.53	48.7566	-118.0487	Primary
UDU-01-10	422927.83	5400966.67	48.7569	-118.0486	Primary
UDU-01-11	423035.90	5400903.59	48.7564	-118.0472	Primary
UDU-01-12	422974.13	5400894.28	48.7563	-118.0480	Primary
UDU-01-13	422915.94	5400935.29	48.7567	-118.0488	Primary
UDU-01-14	422992.44	5400900.71	48.7564	-118.0477	Primary
UDU-01-15	423051.29	5400883.99	48.7562	-118.0469	Primary
UDU-01-16	422966.32	5400886.82	48.7562	-118.0481	Primary
UDU-01-17	422989.13	5400934.05	48.7567	-118.0478	Primary
UDU-01-18	422932.72	5400942.02	48.7567	-118.0486	Primary
UDU-01-19	422966.59	5400930.13	48.7566	-118.0481	Primary
UDU-01-20	422908.95	5400950.70	48.7568	-118.0489	Primary
UDU-01-21	422927.93	5400945.48	48.7567	-118.0486	Primary
UDU-01-22	423045.32	5400902.67	48.7564	-118.0470	Primary
UDU-01-23	422906.92	5400935.89	48.7567	-118.0489	Primary
UDU-01-24	423058.08	5400890.19	48.7563	-118.0469	Primary
UDU-01-25	423032.94	5400860.12	48.7560	-118.0472	Primary
UDU-01-26	422954.63	5400929.51	48.7566	-118.0483	Primary
UDU-01-27	422996.30	5400925.16	48.7566	-118.0477	Primary
UDU-01-28	422960.38	5400933.13	48.7566	-118.0482	Primary
UDU-01-29	422942.22	5400970.97	48.7570	-118.0484	Primary
UDU-01-30	423032.78	5400892.90	48.7563	-118.0472	Primary
UDU-01-R01	422965.88	5400899.88	48.7563	-118.0481	Reserve
UDU-01-R02	423005.70	5400897.64	48.7563	-118.0476	Reserve
UDU-01-R03	422958.12	5400943.42	48.7567	-118.0482	Reserve
UDU-01-R04	422930.55	5400907.93	48.7564	-118.0486	Reserve
UDU-01-R05	423025.23	5400888.39	48.7562	-118.0473	Reserve
UDU-01-R06	422993.08	5400876.69	48.7561	-118.0477	Reserve
UDU-01-R07	423014.27	5400874.52	48.7561	-118.0474	Reserve
UDU-01-R08	423043.48	5400897.61	48.7563	-118.0471	Reserve
UDU-01-R09	422969.07	5400905.07	48.7564	-118.0481	Reserve
Soil Decision Unit 2					
UDU-02-01	422911.81	5400849.36	48.7559	-118.0488	Primary
UDU-02-02	422949.09	5400833.24	48.7557	-118.0483	Primary
UDU-02-03	422938.06	5400852.22	48.7559	-118.0485	Primary
UDU-02-04	422912.11	5400839.41	48.7558	-118.0488	Primary
UDU-02-05	422927.78	5400787.13	48.7553	-118.0486	Primary
UDU-02-06	422930.40	5400841.87	48.7558	-118.0486	Primary
UDU-02-07	422950.39	5400812.33	48.7556	-118.0483	Primary
UDU-02-08	422968.00	5400803.33	48.7555	-118.0481	Primary
UDU-02-09	422886.32	5400822.88	48.7556	-118.0492	Primary
UDU-02-10	422939.01	5400792.12	48.7554	-118.0485	Primary
UDU-02-11	422969.93	5400841.56	48.7558	-118.0480	Primary
UDU-02-12	422939.33	5400822.38	48.7556	-118.0485	Primary
UDU-02-13	422921.34	5400860.71	48.7560	-118.0487	Primary
UDU-02-14	422963.46	5400883.55	48.7562	-118.0481	Primary
UDU-02-15	422968.14	5400866.15	48.7560	-118.0481	Primary

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 2 (continued)					
UDU-02-16	422964.12	5400859.33	48.7560	-118.0481	Primary
UDU-02-17	422947.68	5400797.36	48.7554	-118.0483	Primary
UDU-02-18	422945.11	5400871.44	48.7561	-118.0484	Primary
UDU-02-19	422926.00	5400807.27	48.7555	-118.0486	Primary
UDU-02-20	423004.22	5400844.00	48.7558	-118.0476	Primary
UDU-02-21	422913.14	5400819.74	48.7556	-118.0488	Primary
UDU-02-22	422974.44	5400855.24	48.7559	-118.0480	Primary
UDU-02-23	422964.86	5400828.39	48.7557	-118.0481	Primary
UDU-02-24	422949.58	5400824.71	48.7557	-118.0483	Primary
UDU-02-25	422899.16	5400830.06	48.7557	-118.0490	Primary
UDU-02-26	422921.44	5400803.64	48.7555	-118.0487	Primary
UDU-02-27	422966.51	5400798.08	48.7554	-118.0481	Primary
UDU-02-28	423020.27	5400841.39	48.7558	-118.0474	Primary
UDU-02-29	422928.01	5400854.85	48.7559	-118.0486	Primary
UDU-02-30	422935.44	5400804.26	48.7555	-118.0485	Primary
Soil Decision Unit 3					
UDU-03-01	422892.25	5400764.18	48.7551	-118.0491	Primary
UDU-03-02	422854.90	5400796.94	48.7554	-118.0496	Primary
UDU-03-03	422852.40	5400816.50	48.7556	-118.0496	Primary
UDU-03-04	422911.52	5400792.37	48.7554	-118.0488	Primary
UDU-03-05	422790.75	5400866.19	48.7560	-118.0505	Primary
UDU-03-06	422802.50	5400821.16	48.7556	-118.0503	Primary
UDU-03-07	422937.20	5400762.24	48.7551	-118.0485	Primary
UDU-03-08	422915.29	5400768.98	48.7552	-118.0488	Primary
UDU-03-09	422901.24	5400748.33	48.7550	-118.0490	Primary
UDU-03-10	422806.34	5400858.57	48.7560	-118.0503	Primary
UDU-03-11	422830.28	5400806.13	48.7555	-118.0499	Primary
UDU-03-12	422838.87	5400807.38	48.7555	-118.0498	Primary
UDU-03-13	422913.69	5400738.38	48.7549	-118.0488	Primary
UDU-03-14	422901.66	5400784.75	48.7553	-118.0490	Primary
UDU-03-15	422898.88	5400795.71	48.7554	-118.0490	Primary
UDU-03-16	422888.59	5400779.57	48.7553	-118.0491	Primary
UDU-03-17	422788.37	5400817.94	48.7556	-118.0505	Primary
UDU-03-18	422894.04	5400777.49	48.7552	-118.0491	Primary
UDU-03-19	422769.70	5400835.32	48.7557	-118.0508	Primary
UDU-03-20	422761.02	5400835.05	48.7557	-118.0509	Primary
UDU-03-21	422871.39	5400787.09	48.7553	-118.0494	Primary
UDU-03-22	422847.35	5400802.20	48.7554	-118.0497	Primary
UDU-03-23	422778.84	5400826.71	48.7557	-118.0506	Primary
UDU-03-24	422859.20	5400779.26	48.7552	-118.0495	Primary
UDU-03-25	422786.43	5400823.02	48.7556	-118.0505	Primary
UDU-03-26	422863.15	5400800.89	48.7554	-118.0495	Primary
UDU-03-27	422906.27	5400778.41	48.7552	-118.0489	Primary
UDU-03-28	422776.67	5400848.69	48.7559	-118.0507	Primary
UDU-03-29	422871.61	5400801.14	48.7554	-118.0494	Primary
UDU-03-30	422914.23	5400756.47	48.7550	-118.0488	Primary
UDU-03-R01	422833.37	5400797.67	48.7554	-118.0499	Reserve
UDU-03-R02	422926.86	5400776.22	48.7552	-118.0486	Reserve
UDU-03-R03	422817.82	5400827.18	48.7557	-118.0501	Reserve
UDU-03-R04	422814.07	5400812.37	48.7555	-118.0502	Reserve
UDU-03-R05	422890.39	5400762.84	48.7551	-118.0491	Reserve

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4					
UDU-04A-01	422878.64	5400824.23	48.7557	-118.0493	Primary
UDU-04A-02	422898.34	5400906.71	48.7564	-118.0490	Primary
UDU-04A-03	422823.69	5400875.82	48.7561	-118.0500	Primary
UDU-04A-04	422872.16	5400903.81	48.7564	-118.0494	Primary
UDU-04A-05	422862.76	5400857.90	48.7560	-118.0495	Primary
UDU-04A-06	422875.06	5400863.05	48.7560	-118.0493	Primary
UDU-04A-07	422868.28	5400921.33	48.7565	-118.0494	Primary
UDU-04A-08	422838.11	5400872.40	48.7561	-118.0498	Primary
UDU-04A-09	422885.87	5400846.83	48.7559	-118.0492	Primary
UDU-04A-10	422910.53	5400904.91	48.7564	-118.0489	Primary
UDU-04A-11	422883.05	5400833.88	48.7557	-118.0492	Primary
UDU-04A-12	422858.62	5400846.89	48.7559	-118.0496	Primary
UDU-04A-13	422862.40	5400879.60	48.7561	-118.0495	Primary
UDU-04A-14	422862.71	5400825.41	48.7557	-118.0495	Primary
UDU-04A-15	422903.05	5400847.05	48.7559	-118.0490	Primary
UDU-04A-16	422869.79	5400820.65	48.7556	-118.0494	Primary
UDU-04A-17	422810.06	5400867.22	48.7560	-118.0502	Primary
UDU-04A-18	422876.86	5400852.17	48.7559	-118.0493	Primary
UDU-04A-19	422871.87	5400835.55	48.7558	-118.0494	Primary
UDU-04A-20	422904.92	5400900.17	48.7563	-118.0489	Primary
UDU-04A-21	422872.16	5400868.44	48.7560	-118.0494	Primary
UDU-04A-22	422883.35	5400860.28	48.7560	-118.0492	Primary
UDU-04A-23	422864.18	5400834.67	48.7557	-118.0495	Primary
UDU-04A-24	422846.05	5400859.90	48.7560	-118.0497	Primary
UDU-04A-25	422883.25	5400931.67	48.7566	-118.0492	Primary
UDU-04A-26	422837.15	5400863.00	48.7560	-118.0499	Primary
UDU-04A-27	422913.84	5400887.55	48.7562	-118.0488	Primary
UDU-04A-28	422902.24	5400889.33	48.7562	-118.0490	Primary
UDU-04A-29	422905.23	5400855.55	48.7559	-118.0489	Primary
UDU-04A-30	422944.70	5400893.69	48.7563	-118.0484	Primary
UDU-04B-01	422878.76	5400925.21	48.7566	-118.0493	Primary
UDU-04B-02	422874.71	5400860.00	48.7560	-118.0493	Primary
UDU-04B-03	422837.21	5400862.35	48.7560	-118.0499	Primary
UDU-04B-04	422876.36	5400840.19	48.7558	-118.0493	Primary
UDU-04B-05	422841.72	5400874.93	48.7561	-118.0498	Primary
UDU-04B-06	422864.33	5400831.46	48.7557	-118.0495	Primary
UDU-04B-07	422897.74	5400850.65	48.7559	-118.0490	Primary
UDU-04B-08	422895.51	5400868.13	48.7560	-118.0491	Primary
UDU-04B-09	422850.13	5400835.97	48.7558	-118.0497	Primary
UDU-04B-10	422836.48	5400849.59	48.7559	-118.0499	Primary
UDU-04B-11	422847.57	5400909.96	48.7564	-118.0497	Primary
UDU-04B-12	422916.35	5400897.61	48.7563	-118.0488	Primary
UDU-04B-13	422833.90	5400891.38	48.7562	-118.0499	Primary
UDU-04B-14	422827.67	5400855.53	48.7559	-118.0500	Primary
UDU-04B-15	422873.32	5400897.43	48.7563	-118.0494	Primary
UDU-04B-16	422825.94	5400892.72	48.7563	-118.0500	Primary
UDU-04B-17	422868.38	5400851.78	48.7559	-118.0494	Primary
UDU-04B-18	422921.22	5400899.70	48.7563	-118.0487	Primary
UDU-04B-19	422813.08	5400875.39	48.7561	-118.0502	Primary
UDU-04B-20	422829.27	5400884.78	48.7562	-118.0500	Primary
UDU-04B-21	422933.24	5400885.71	48.7562	-118.0486	Primary
UDU-04B-22	422924.24	5400869.45	48.7561	-118.0487	Primary
UDU-04B-23	422879.93	5400892.91	48.7563	-118.0493	Primary
UDU-04B-24	422852.64	5400868.10	48.7560	-118.0496	Primary
UDU-04B-25	422857.32	5400844.02	48.7558	-118.0496	Primary

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04B-26	422880.70	5400931.37	48.7566	-118.0493	Primary
UDU-04B-27	422907.44	5400908.77	48.7564	-118.0489	Primary
UDU-04B-28	422875.50	5400885.56	48.7562	-118.0493	Primary
UDU-04B-29	422880.83	5400912.64	48.7564	-118.0493	Primary
UDU-04B-30	422881.51	5400886.71	48.7562	-118.0493	Primary
UDU-04C-01	422912.40	5400905.50	48.7564	-118.0488	Primary
UDU-04C-02	422851.22	5400876.76	48.7561	-118.0497	Primary
UDU-04C-03	422910.52	5400916.28	48.7565	-118.0489	Primary
UDU-04C-04	422870.17	5400874.81	48.7561	-118.0494	Primary
UDU-04C-05	422889.10	5400881.26	48.7562	-118.0492	Primary
UDU-04C-06	422806.48	5400871.79	48.7561	-118.0503	Primary
UDU-04C-07	422850.89	5400843.34	48.7558	-118.0497	Primary
UDU-04C-08	422859.01	5400826.11	48.7557	-118.0496	Primary
UDU-04C-09	422871.64	5400856.16	48.7559	-118.0494	Primary
UDU-04C-10	422867.61	5400834.83	48.7557	-118.0494	Primary
UDU-04C-11	422865.66	5400881.95	48.7562	-118.0495	Primary
UDU-04C-12	422860.29	5400836.24	48.7558	-118.0495	Primary
UDU-04C-13	422895.47	5400925.09	48.7566	-118.0491	Primary
UDU-04C-14	422835.30	5400875.73	48.7561	-118.0499	Primary
UDU-04C-15	422926.00	5400906.80	48.7564	-118.0487	Primary
UDU-04C-16	422904.10	5400921.45	48.7565	-118.0490	Primary
UDU-04C-17	422915.42	5400881.07	48.7562	-118.0488	Primary
UDU-04C-18	422872.16	5400901.36	48.7563	-118.0494	Primary
UDU-04C-19	422907.50	5400880.45	48.7562	-118.0489	Primary
UDU-04C-20	422840.44	5400864.85	48.7560	-118.0498	Primary
UDU-04C-21	422880.06	5400848.18	48.7559	-118.0493	Primary
UDU-04C-22	422924.22	5400872.64	48.7561	-118.0487	Primary
UDU-04C-23	422811.25	5400879.83	48.7561	-118.0502	Primary
UDU-04C-24	422882.13	5400867.86	48.7560	-118.0492	Primary
UDU-04C-25	422857.41	5400890.96	48.7562	-118.0496	Primary
UDU-04C-26	422815.53	5400885.95	48.7562	-118.0502	Primary
UDU-04C-27	422862.67	5400867.15	48.7560	-118.0495	Primary
UDU-04C-28	422902.78	5400849.76	48.7559	-118.0490	Primary
UDU-04C-29	422902.43	5400900.85	48.7563	-118.0490	Primary
UDU-04C-30	422826.99	5400866.97	48.7560	-118.0500	Primary
UDU-04A-R01	422897.00	5400837.28	48.7558	-118.0490	Reserve
UDU-04A-R02	422871.43	5400813.95	48.7556	-118.0494	Reserve
UDU-04A-R03	422877.75	5400858.83	48.7560	-118.0493	Reserve
UDU-04A-R04	422935.65	5400901.18	48.7564	-118.0485	Reserve
UDU-04A-R05	422892.90	5400901.77	48.7564	-118.0491	Reserve
UDU-04A-R06	422922.92	5400911.89	48.7564	-118.0487	Reserve
UDU-04A-R07	422884.20	5400883.67	48.7562	-118.0492	Reserve
UDU-04B-R01	422883.10	5400894.57	48.7563	-118.0492	Reserve
UDU-04B-R02	422847.26	5400842.06	48.7558	-118.0497	Reserve
UDU-04B-R03	422857.63	5400820.76	48.7556	-118.0496	Reserve
UDU-04B-R04	422890.48	5400925.93	48.7566	-118.0491	Reserve
UDU-04B-R05	422931.06	5400878.29	48.7561	-118.0486	Reserve
UDU-04B-R06	422882.95	5400825.30	48.7557	-118.0492	Reserve
UDU-04B-R07	422895.48	5400868.84	48.7561	-118.0491	Reserve
UDU-04B-R08	422904.04	5400912.12	48.7564	-118.0490	Reserve
UDU-04B-R09	422890.13	5400886.67	48.7562	-118.0491	Reserve
UDU-04B-R10	422890.89	5400852.63	48.7559	-118.0491	Reserve
UDU-04B-R11	422889.98	5400915.22	48.7565	-118.0491	Reserve
UDU-04C-R01	422893.42	5400903.23	48.7564	-118.0491	Reserve
UDU-04C-R02	422883.83	5400865.41	48.7560	-118.0492	Reserve

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04C-R03	422912.54	5400880.27	48.7562	-118.0488	Reserve
UDU-04C-R04	422831.85	5400868.62	48.7560	-118.0499	Reserve
UDU-04C-R05	422904.54	5400892.94	48.7563	-118.0489	Reserve
UDU-04C-R06	422889.47	5400881.65	48.7562	-118.0491	Reserve
UDU-04C-R07	422933.73	5400877.36	48.7561	-118.0485	Reserve
UDU-04C-R08	422875.23	5400842.69	48.7558	-118.0493	Reserve
Soil Decision Unit 5					
UDU-05-01	423463.26	5401280.87	48.7598	-118.0414	Primary
UDU-05-02	423525.67	5401328.97	48.7603	-118.0406	Primary
UDU-05-03	423510.63	5401339.05	48.7604	-118.0408	Primary
UDU-05-04	423475.46	5401305.23	48.7601	-118.0413	Primary
UDU-05-05	423525.17	5401320.54	48.7602	-118.0406	Primary
UDU-05-06	423500.09	5401337.34	48.7603	-118.0409	Primary
UDU-05-07	423615.60	5401470.38	48.7616	-118.0394	Primary
UDU-05-08	423586.69	5401433.79	48.7612	-118.0398	Primary
UDU-05-09	423575.27	5401403.66	48.7609	-118.0399	Primary
UDU-05-10	423496.16	5401313.37	48.7601	-118.0410	Primary
UDU-05-11	423565.65	5401433.61	48.7612	-118.0401	Primary
UDU-05-12	423522.21	5401335.27	48.7603	-118.0406	Primary
UDU-05-13	423550.70	5401380.42	48.7607	-118.0402	Primary
UDU-05-14	423568.33	5401383.52	48.7608	-118.0400	Primary
UDU-05-15	423486.88	5401320.83	48.7602	-118.0411	Primary
UDU-05-16	423540.07	5401372.72	48.7607	-118.0404	Primary
UDU-05-17	423584.79	5401415.64	48.7611	-118.0398	Primary
UDU-05-18	423519.73	5401320.92	48.7602	-118.0407	Primary
UDU-05-19	423570.79	5401397.62	48.7609	-118.0400	Primary
UDU-05-20	423572.33	5401425.68	48.7611	-118.0400	Primary
UDU-05-21	423506.13	5401294.12	48.7600	-118.0408	Primary
UDU-05-22	423545.65	5401344.77	48.7604	-118.0403	Primary
UDU-05-23	423515.72	5401325.87	48.7602	-118.0407	Primary
UDU-05-24	423522.61	5401362.14	48.7606	-118.0406	Primary
UDU-05-25	423548.58	5401357.54	48.7605	-118.0403	Primary
UDU-05-26	423596.43	5401464.28	48.7615	-118.0396	Primary
UDU-05-27	423518.96	5401330.85	48.7603	-118.0407	Primary
UDU-05-28	423573.14	5401420.46	48.7611	-118.0399	Primary
UDU-05-29	423548.48	5401399.48	48.7609	-118.0403	Primary
UDU-05-30	423580.11	5401410.54	48.7610	-118.0398	Primary
UDU-05-R01	423506.01	5401303.30	48.7600	-118.0408	Reserve
UDU-05-R02	423486.11	5401295.23	48.7600	-118.0411	Reserve
UDU-05-R03	423586.71	5401419.31	48.7611	-118.0398	Reserve
UDU-05-R04	423498.72	5401297.55	48.7600	-118.0409	Reserve
UDU-05-R05	423496.70	5401277.82	48.7598	-118.0410	Reserve
UDU-05-R06	423521.10	5401327.20	48.7603	-118.0406	Reserve
UDU-05-R07	423495.67	5401289.29	48.7599	-118.0410	Reserve
UDU-05-R08	423517.03	5401307.16	48.7601	-118.0407	Reserve
UDU-05-R09	423567.99	5401433.86	48.7612	-118.0400	Reserve
UDU-05-R10	423482.40	5401287.26	48.7599	-118.0412	Reserve
UDU-05-R11	423609.73	5401449.79	48.7614	-118.0395	Reserve
UDU-05-R12	423516.08	5401316.63	48.7602	-118.0407	Reserve
UDU-05-R13	423545.81	5401354.89	48.7605	-118.0403	Reserve
UDU-05-R14	423580.96	5401412.31	48.7610	-118.0398	Reserve
UDU-05-R15	423524.69	5401323.40	48.7602	-118.0406	Reserve
UDU-05-R16	423499.34	5401285.49	48.7599	-118.0409	Reserve
UDU-05-R17	423620.17	5401479.74	48.7616	-118.0393	Reserve
UDU-05-R18	423612.30	5401465.85	48.7615	-118.0394	Reserve

Table A7-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-R19	423508.42	5401311.18	48.7601	-118.0408	Reserve
UDU-05-R20	423565.05	5401384.35	48.7608	-118.0400	Reserve
UDU-05-R21	423472.76	5401274.12	48.7598	-118.0413	Reserve
UDU-05-R22	423506.73	5401296.89	48.7600	-118.0408	Reserve
UDU-05-R23	423486.96	5401301.70	48.7600	-118.0411	Reserve
Soil Decision Unit 6					
UDU-06-01	422184.22	5400810.96	48.7554	-118.0587	Primary
UDU-06-02	422240.14	5400910.05	48.7563	-118.0580	Primary
UDU-06-03	422238.46	5400870.89	48.7560	-118.0580	Primary
UDU-06-04	422212.12	5400905.85	48.7563	-118.0584	Primary
UDU-06-05	422207.91	5400880.79	48.7561	-118.0584	Primary
UDU-06-06	422176.13	5400805.14	48.7554	-118.0588	Primary
UDU-06-07	422189.41	5400789.71	48.7553	-118.0587	Primary
UDU-06-08	422165.00	5400811.30	48.7554	-118.0590	Primary
UDU-06-09	422208.53	5400865.41	48.7559	-118.0584	Primary
UDU-06-10	422226.83	5400870.44	48.7560	-118.0582	Primary
UDU-06-11	422220.48	5400897.54	48.7562	-118.0583	Primary
UDU-06-12	422194.45	5400828.32	48.7556	-118.0586	Primary
UDU-06-13	422238.77	5400845.55	48.7558	-118.0580	Primary
UDU-06-14	422204.71	5400795.15	48.7553	-118.0584	Primary
UDU-06-15	422218.37	5400882.67	48.7561	-118.0583	Primary
UDU-06-16	422198.57	5400838.07	48.7557	-118.0585	Primary
UDU-06-17	422276.25	5400930.53	48.7565	-118.0575	Primary
UDU-06-18	422166.79	5400825.57	48.7556	-118.0590	Primary
UDU-06-19	422223.27	5400880.21	48.7561	-118.0582	Primary
UDU-06-20	422207.41	5400822.84	48.7556	-118.0584	Primary
UDU-06-21	422274.31	5400900.49	48.7563	-118.0575	Primary
UDU-06-22	422184.72	5400842.82	48.7557	-118.0587	Primary
UDU-06-23	422248.91	5400859.62	48.7559	-118.0579	Primary
UDU-06-24	422224.06	5400839.33	48.7557	-118.0582	Primary
UDU-06-25	422154.02	5400783.74	48.7552	-118.0591	Primary
UDU-06-26	422186.26	5400799.10	48.7553	-118.0587	Primary
UDU-06-27	422221.62	5400828.80	48.7556	-118.0582	Primary
UDU-06-28	422193.69	5400855.42	48.7558	-118.0586	Primary
UDU-06-29	422280.89	5400898.44	48.7562	-118.0574	Primary
UDU-06-30	422207.52	5400845.08	48.7558	-118.0584	Primary
UDU-06-R01	422260.55	5400883.36	48.7561	-118.0577	Reserve
UDU-06-R02	422202.16	5400852.63	48.7558	-118.0585	Reserve
UDU-06-R03	422274.17	5400916.47	48.7564	-118.0575	Reserve
UDU-06-R04	422206.47	5400885.39	48.7561	-118.0584	Reserve
UDU-06-R05	422224.21	5400875.78	48.7560	-118.0582	Reserve
UDU-06-R06	422216.76	5400846.91	48.7558	-118.0583	Reserve

Table A7-1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-XRF-01	423555.56	5401691.38	48.7635	-118.0402	Primary
SDU-01-XRF-02	423473.06	5401636.38	48.7630	-118.0413	Primary
SDU-01-XRF-03	423528.06	5401636.38	48.7630	-118.0406	Primary
SDU-01-XRF-04	423583.06	5401636.38	48.7630	-118.0399	Primary
SDU-01-XRF-05	423445.56	5401581.38	48.7625	-118.0417	Primary
SDU-01-XRF-06	423555.56	5401581.38	48.7625	-118.0402	Primary
SDU-01-XRF-07	423610.56	5401581.38	48.7626	-118.0395	Primary
SDU-01-XRF-08	423528.06	5401526.38	48.7620	-118.0406	Primary
SDU-01-XRF-09	423555.56	5401471.38	48.7616	-118.0402	Primary
SDU-01-XRF-R01	423500.56	5401691.38	48.7635	-118.0410	Reserve
SDU-01-XRF-R02	423418.06	5401636.38	48.7630	-118.0421	Reserve
SDU-01-XRF-R03	423638.06	5401636.38	48.7630	-118.0391	Reserve
SDU-01-XRF-R04	423500.56	5401581.38	48.7625	-118.0410	Reserve
SDU-01-XRF-R05	423583.06	5401526.38	48.7621	-118.0398	Reserve
Sediment Decision Unit 2					
SDU-02-XRF-01	423325.30	5401483.86	48.7616	-118.0433	Primary
SDU-02-XRF-02	423380.30	5401483.86	48.7616	-118.0426	Primary
SDU-02-XRF-03	423435.30	5401483.86	48.7617	-118.0418	Primary
SDU-02-XRF-04	423352.80	5401428.86	48.7611	-118.0429	Primary
SDU-02-XRF-05	423462.80	5401428.86	48.7612	-118.0414	Primary
SDU-02-XRF-06	423380.30	5401373.86	48.7607	-118.0426	Primary
SDU-02-XRF-07	423435.30	5401373.86	48.7607	-118.0418	Primary
SDU-02-XRF-08	423490.30	5401373.86	48.7607	-118.0411	Primary
SDU-02-XRF-R01	423352.80	5401538.86	48.7621	-118.0430	Reserve
SDU-02-XRF-R02	423297.80	5401428.86	48.7611	-118.0437	Reserve
SDU-02-XRF-R03	423407.80	5401428.86	48.7612	-118.0422	Reserve
SDU-02-XRF-R04	423407.80	5401318.86	48.7602	-118.0422	Reserve
SDU-02-XRF-R05	423462.80	5401318.86	48.7602	-118.0414	Reserve
Sediment Decision Unit 3					
SDU-03-XRF-01	423086.79	5401100.46	48.7582	-118.0465	Primary
SDU-03-XRF-02	423029.29	5401055.46	48.7577	-118.0473	Primary
SDU-03-XRF-03	422971.79	5401010.46	48.7573	-118.0481	Primary
SDU-03-XRF-04	422914.29	5400965.46	48.7569	-118.0488	Primary
SDU-03-XRF-R01	423061.79	5401080.46	48.7580	-118.0468	Reserve
SDU-03-XRF-R02	422996.79	5401030.46	48.7575	-118.0477	Reserve
SDU-03-XRF-R03	422939.29	5400985.46	48.7571	-118.0485	Reserve
SDU-03-XRF-R04	422881.79	5400940.46	48.7567	-118.0493	Reserve
Sediment Decision Unit 4					
SDU-04-XRF-01	422692.19	5400781.16	48.7552	-118.0518	Primary
SDU-04-XRF-02	422650.19	5400721.16	48.7547	-118.0524	Primary
SDU-04-XRF-03	422632.19	5400685.16	48.7544	-118.0526	Primary
SDU-04-XRF-04	422596.19	5400613.16	48.7537	-118.0531	Primary
SDU-04-XRF-R01	422674.19	5400745.16	48.7549	-118.0520	Reserve
SDU-04-XRF-R02	422614.19	5400649.16	48.7540	-118.0528	Reserve
Sediment Decision Unit 5					
SDU-05-XRF-01	424294.01	5395316.60	48.7063	-118.0290	Primary
SDU-05-XRF-02	424544.01	5395316.60	48.7063	-118.0256	Primary
SDU-05-XRF-03	424356.51	5395191.60	48.7052	-118.0281	Primary
SDU-05-XRF-04	424606.51	5395191.60	48.7052	-118.0247	Primary
SDU-05-XRF-05	424419.01	5395066.60	48.7041	-118.0273	Primary
SDU-05-XRF-06	424544.01	5395066.60	48.7041	-118.0256	Primary
SDU-05-XRF-07	424669.01	5395066.60	48.7041	-118.0239	Primary

Table A7-1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 5 (continued)					
SDU-05-XRF-08	424356.51	5394941.60	48.7029	-118.0281	Primary
SDU-05-XRF-09	424606.51	5394941.60	48.7030	-118.0247	Primary
SDU-05-XRF-R01	424419.01	5395316.60	48.7063	-118.0273	Reserve
SDU-05-XRF-R02	424231.51	5395191.60	48.7052	-118.0298	Reserve
SDU-05-XRF-R03	424481.51	5395191.60	48.7052	-118.0264	Reserve
SDU-05-XRF-R04	424294.01	5395066.60	48.7040	-118.0290	Reserve
SDU-05-XRF-R05	424481.51	5394941.60	48.7029	-118.0264	Reserve
Sediment Decision Unit 6					
SDU-06-XRF-01	425126.24	5394173.90	48.6961	-118.0175	Primary
SDU-06-XRF-02	425223.74	5394068.90	48.6952	-118.0162	Primary
SDU-06-XRF-03	425246.24	5393933.90	48.6940	-118.0158	Primary
SDU-06-XRF-04	425306.24	5393813.90	48.6929	-118.0150	Primary
SDU-06-XRF-05	425298.74	5393678.90	48.6917	-118.0151	Primary
SDU-06-XRF-R01	425178.74	5394128.90	48.6957	-118.0168	Reserve
SDU-06-XRF-R02	425238.74	5394008.90	48.6946	-118.0159	Reserve
SDU-06-XRF-R03	425276.24	5393873.90	48.6934	-118.0154	Reserve
SDU-06-XRF-R04	425298.74	5393738.90	48.6922	-118.0151	Reserve
Sediment Decision Unit 7					
SDU-07-XRF-01	425254.78	5393031.17	48.6858	-118.0155	Primary
SDU-07-XRF-02	425194.78	5392911.17	48.6848	-118.0163	Primary
SDU-07-XRF-03	425134.78	5392791.17	48.6837	-118.0171	Primary
SDU-07-XRF-04	425074.78	5392671.17	48.6826	-118.0179	Primary
SDU-07-XRF-R01	425224.78	5392971.17	48.6853	-118.0159	Reserve
SDU-07-XRF-R02	425164.78	5392851.17	48.6842	-118.0167	Reserve
SDU-07-XRF-R03	425104.78	5392731.17	48.6831	-118.0175	Reserve
Sediment Decision Unit 8					
SDU-08-XRF-01	423209.27	5401902.00	48.7654	-118.0450	Primary
SDU-08-XRF-02	423131.27	5401824.00	48.7647	-118.0460	Primary
SDU-08-XRF-03	423072.77	5401746.00	48.7640	-118.0468	Primary
SDU-08-XRF-04	422994.77	5401668.00	48.7633	-118.0479	Primary
SDU-08-XRF-R01	423170.27	5401863.00	48.7650	-118.0455	Reserve
SDU-08-XRF-R02	423111.77	5401785.00	48.7643	-118.0463	Reserve
SDU-08-XRF-R03	423033.77	5401707.00	48.7636	-118.0473	Reserve
Sediment Decision Unit 9					
SDU-09-XRF-01	422480.15	5401083.34	48.7579	-118.0548	Primary
SDU-09-XRF-02	422419.13	5401027.18	48.7574	-118.0556	Primary
SDU-09-XRF-03	422373.05	5400950.09	48.7567	-118.0562	Primary
SDU-09-XRF-04	422326.96	5400873.00	48.7560	-118.0568	Primary
SDU-09-XRF-R01	422449.64	5401055.26	48.7577	-118.0552	Reserve
SDU-09-XRF-R02	422403.56	5400978.17	48.7570	-118.0558	Reserve
SDU-09-XRF-R03	422342.54	5400922.01	48.7565	-118.0566	Reserve
Sediment Decision Unit 10					
SDU-10-XRF-01	422246.13	5400805.54	48.7554	-118.0579	Primary
SDU-10-XRF-02	422198.11	5400743.74	48.7548	-118.0585	Primary
SDU-10-XRF-03	422150.09	5400681.94	48.7543	-118.0592	Primary
SDU-10-XRF-04	422102.07	5400620.14	48.7537	-118.0598	Primary
SDU-10-XRF-R01	422222.12	5400774.64	48.7551	-118.0582	Reserve
SDU-10-XRF-R02	422174.10	5400712.84	48.7546	-118.0588	Reserve
SDU-10-XRF-R03	422126.08	5400651.04	48.7540	-118.0595	Reserve

Table A7-1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-XRF-01	422896.73	5400940.79	48.7567	-118.0491	Primary
UDU-01-XRF-02	422931.73	5400940.79	48.7567	-118.0486	Primary
UDU-01-XRF-03	422966.73	5400940.79	48.7567	-118.0481	Primary
UDU-01-XRF-04	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-01-XRF-05	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-01-XRF-06	422914.23	5400905.79	48.7564	-118.0488	Primary
UDU-01-XRF-07	422949.23	5400905.79	48.7564	-118.0483	Primary
UDU-01-XRF-R01	422984.23	5400905.79	48.7564	-118.0479	Reserve
Soil Decision Unit 2					
UDU-02-XRF-01	422931.73	5400870.79	48.7561	-118.0486	Primary
UDU-02-XRF-02	422966.73	5400870.79	48.7561	-118.0481	Primary
UDU-02-XRF-03	422949.23	5400835.79	48.7558	-118.0483	Primary
UDU-02-XRF-04	422984.23	5400835.79	48.7558	-118.0478	Primary
UDU-02-XRF-05	422931.73	5400800.79	48.7554	-118.0486	Primary
UDU-02-XRF-06	422966.73	5400800.79	48.7555	-118.0481	Primary
UDU-02-XRF-R01	422914.23	5400835.79	48.7558	-118.0488	Reserve
UDU-02-XRF-R02	423019.23	5400835.79	48.7558	-118.0474	Reserve
Soil Decision Unit 3					
UDU-03-XRF-01	422879.23	5400765.79	48.7551	-118.0493	Primary
UDU-03-XRF-02	422774.23	5400835.79	48.7557	-118.0507	Primary
UDU-03-XRF-03	422809.23	5400835.79	48.7557	-118.0502	Primary
UDU-03-XRF-04	422844.23	5400835.79	48.7558	-118.0498	Primary
UDU-03-XRF-05	422826.73	5400800.79	48.7554	-118.0500	Primary
UDU-03-XRF-06	422861.73	5400800.79	48.7554	-118.0495	Primary
UDU-03-XRF-07	422896.73	5400800.79	48.7554	-118.0490	Primary
UDU-03-XRF-08	422914.23	5400765.79	48.7551	-118.0488	Primary
UDU-03-XRF-R01	422949.23	5400765.79	48.7551	-118.0483	Reserve
Soil Decision Unit 4					
UDU-04-XRF-01	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-04-XRF-02	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-04-XRF-03	422826.73	5400870.79	48.7561	-118.0500	Primary
UDU-04-XRF-04	422896.73	5400870.79	48.7561	-118.0490	Primary
UDU-04-XRF-05	422879.23	5400835.79	48.7558	-118.0493	Primary
UDU-04-XRF-R01	422861.73	5400870.79	48.7561	-118.0495	Reserve
UDU-04-XRF-R02	422914.23	5400905.79	48.7564	-118.0488	Reserve
Soil Decision Unit 5					
UDU-05-XRF-01	423595.75	5401448.21	48.7614	-118.0396	Primary
UDU-05-XRF-02	423562.75	5401426.21	48.7612	-118.0401	Primary
UDU-05-XRF-03	423584.75	5401426.21	48.7612	-118.0398	Primary
UDU-05-XRF-04	423551.75	5401404.21	48.7610	-118.0402	Primary
UDU-05-XRF-05	423573.75	5401404.21	48.7610	-118.0399	Primary
UDU-05-XRF-06	423540.75	5401382.21	48.7608	-118.0404	Primary
UDU-05-XRF-07	423562.75	5401382.21	48.7608	-118.0401	Primary
UDU-05-XRF-08	423551.75	5401360.21	48.7606	-118.0402	Primary
UDU-05-XRF-09	423540.75	5401338.21	48.7604	-118.0404	Primary
UDU-05-XRF-10	423485.75	5401316.21	48.7602	-118.0411	Primary
UDU-05-XRF-11	423507.75	5401316.21	48.7602	-118.0408	Primary
UDU-05-XRF-12	423496.75	5401294.21	48.7600	-118.0410	Primary
UDU-05-XRF-13	423485.75	5401272.21	48.7598	-118.0411	Primary
UDU-05-XRF-R01	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R02	423529.75	5401360.21	48.7606	-118.0405	Reserve
UDU-05-XRF-R03	423518.75	5401338.21	48.7604	-118.0407	Reserve
UDU-05-XRF-R04	423474.75	5401294.21	48.7600	-118.0413	Reserve
UDU-05-XRF-R05	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R06	423529.75	5401360.21	48.7606	-118.0405	Reserve

Table A7-1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-XRF-R07	423518.75	5401338.21	48.7604	-118.0407	Reserve
UDU-05-XRF-R08	423474.75	5401294.21	48.7600	-118.0413	Reserve
Soil Decision Unit 6					
UDU-06-XRF-01	422281.43	5400935.14	48.7566	-118.0574	Primary
UDU-06-XRF-02	422251.68	5400895.96	48.7562	-118.0578	Primary
UDU-06-XRF-03	422216.89	5400862.07	48.7559	-118.0583	Primary
UDU-06-XRF-04	422187.13	5400822.90	48.7556	-118.0587	Primary
UDU-06-XRF-05	422154.20	5400786.40	48.7552	-118.0591	Primary
UDU-06-XRF-R01	422261.53	5400920.83	48.7564	-118.0577	Reserve
UDU-06-XRF-R02	422231.77	5400881.66	48.7561	-118.0581	Reserve
UDU-06-XRF-R03	422202.01	5400842.49	48.7557	-118.0585	Reserve
UDU-06-XRF-R04	422172.25	5400803.31	48.7554	-118.0589	Reserve

Table A7-2. Analytical Methods for Sediment and Soil Samples

Analytes	Laboratory	Sample Preparation		Quantitative Analysis		Risk Based Concentrations (RBCs)			Analytical Laboratory		
		Protocol	Procedure	Protocol	Procedure	Human Soil Benchmark Value [a] (mg/kg dw)	EcoSSL Benchmark Value [b] (mg/kg dw)	1/2 Wildlife Soil Benchmark Value (mg/kg dw)	MRL (mg/kg dw)	MDL (mg/kg dw)	ACGs [c] (mg/kg dw)
Conventional Parameters (< 2 mm size fraction only except for grain size which utilizes whole samples prior to sieving soils and sediments, unless noted otherwise)											
Grain size	ALS	NA	NA	PSEP	Sieves and pipette	NA	NA	NA	NA	NA	NA
pH	ALS	NA	NA	EPA 9045D	Electrometric	NA	NA	NA	NA	0.1 unit	NA
CEC (soils only)	ALS	EPA 9080	Displacement with ammonium acetate	EPA 9080	AAS	NA	NA	NA	NA	NA	NA
TOC	ALS	SOP: GEN-ASTM	NA	ASTM D4129-05	Coulometric	NA	NA	NA	0.05	0.02	NA
Percent moisture	ALS	NA	NA	EPA 160.3	Gravimetric	NA	NA	NA	NA	NA	NA
TAL Metals/Metalloids (< 2 mm size fraction for sediments and soils; < 250 µm size fraction for sediments only; < 150 µm size for soils only)											
Calcium	ALS	EPA 3050B	Acid digestion	EPA 6010C	ICP-AES	NA	NA	NA	4	1	4
Iron	ALS	EPA 3050B	Acid digestion	EPA 6010C	ICP-AES	54,800	NA	NA	4	2	54,800
Magnesium	ALS	EPA 3050B	Acid digestion	EPA 6010C	ICP-AES	NA	NA	NA	2	0.2	2
Potassium	ALS	EPA 3050B	Acid digestion	EPA 6010C	ICP-AES	NA	NA	NA	40	10	40
Sodium	ALS	EPA 3050B	Acid digestion	EPA 6010C	ICP-AES	NA	NA	NA	40	5	40
Aluminum	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	77,400	NA	NA	2	0.6	77,400
Antimony	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	31	0.27	0.1	0.05	0.02	0.1
Arsenic	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	9	18	9	0.5	0.2	0.5
Barium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	15,300	330	165	0.05	0.02	165
Beryllim	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	156	21	10.5	0.02	0.005	10.5
Cadmium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	70	0.36	0.2	0.02	0.009	0.2
Chromium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	117,000	26	13	0.2	0.07	13
Cobalt	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	23	13	6.5	0.02	0.009	6.5
Copper	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	3,130	28	14	0.1	0.04	14
Lead	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	400	11	5.5	0.05	0.02	5.5
Manganese	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	1,830	NA	NA	0.05	0.02	1,830
Nickel	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	1,550	38	19	0.2	0.09	19
Selenium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	391	0.52	0.3	0.2	0.07	0.3
Silver	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	391	4.2	2.1	0.02	0.005	2.1
Thallium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	1	NA	NA	0.02	0.002	1
Vanadium	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	394	7.8	3.9	0.2	0.08	3.9
Zinc	ALS	EPA 3050B	Acid digestion	EPA 6020A [d]	ICP-MS	23,500	46	23	0.5	0.2	23.0
Mercury (total)	ALS	EPA 7471B	Acid digestion/oxidation	EPA 7471B	CVAA	24	NA	NA	0.02	0.002	24
IVBA Metals (< 250 µm size fraction for sediments only; < 150 µm size fraction for soils only)											
Lead	ALS	Ruby extraction	*In vitro* extraction	EPA 6020A	ICP/MS	400	11	5.5	0.05	0.005	5.5
Arsenic	ALS	Ruby extraction	*In vitro* extraction	EPA 6020A	ICP/MS	9	18	9	0.5	0.2	0.5
XRF (< 2 mm size fraction only for soils and sediments)											
Lead	Field	See XRF SOP	See XRF SOP	See XRF SOP	See XRF SOP	400	11	5.5	NA	10-100 [e]	NA

Notes:
All methods subject to change upon consultation with the selected analytical laboratory.

[a] Residential sediment screening levels from SRC (2013).

[b] Lowest Soil Screening Ecotoxicity Value in SLERA (see Appendix D of SLERA; TAI 2010).

[c] ACGs represent the lowest RBC value for human health or 1/2th wildlife RBCs. If the RBC is lower than the MRL, then the MRL will be used as the ACG.

[d] Metals may be reported by EPA Method 6010 rather than EPA Method 6020 if the analyte concentrations are sufficiently high.

[e] Detection limit guidelines supplied by Innov-X for the model alpha a-4000s for analytes currently measured by the unit with serial number 6502.

AAS - atomic absorption spectrometry
ACG - analytical concentration goals
AES - atomic emission spectrometry
ALS - ALS Environmental
ASTM - American Society for Testing and Materials
CEC - cation exchange capacity
CVAA - cold vapor atomic absorption spectrometry
EcoSSL - ecological soil screening level
EPA - U.S. Environmental Protection Agency
ICP - inductively coupled plasma
IVBA - *in vitro* bio-accessibility assay
MDL - method detection limit
MRL - method reporting limit
MS - mass spectrometry
NA - not applicable
RBC - risk-based concentration
SOP: GEN-ASTM - ALS standard operating procedure
SOP - standard operating procedure
TAL - target analyte list
TOC - total organic carbon
XRF - X-ray fluorescence

Table B3-1. Sampling Containers, Preservation, and Holding Time Requirements for Sediment and Soil Chemistry

Analysis	Container Type	Container Size	Preservation	Holding Time	Minimum Laboratory Sample Size	Total Minimum Sample Size Needed [a, b]
Whole Sediment	Plastic	2 gallon	4 ± 2ºC			
Grain size				6 months	100 g	100 g
Sediment < 2 mm size fraction						
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	51 g[f]
Percent moisture				6 months	10 g	
pH				7 days	20 g	
Total organic carbon				28 days	1 g	
Sediment < 250 µm size fraction						
TAL metals						
EPA 6020A metals [c]				6 months	10 g	22 g[g]
EPA 6010C metals [d]				6 months	10 g	
IVBA [e]				6 months	2 g	
Whole Soil	Plastic	2 gallon	4 ± 2ºC			
Grain size				6 months	100 g	100 g
Soil < 2 mm size fraction						
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	
Percent moisture				6 months	10 g	151 g[f]
pH				7 days	20 g	
Total organic carbon				28 days	1 g	
CEC				14 days	100g	
Soil < 150 µm size fraction						
TAL metals						
EPA 6020A metals [c]				6 months	10 g	22 g[h]
EPA 6010C metals [d]				6 months	10 g	
IVBA [e]				6 months	2 g	

Notes:

[a] Total sample size does not include additional sample volumes needed for laboratory quality control or field duplicate samples.

[b] Project field duplicate samples should be collected for 10 percent of all analytical sediment samples and submitted blind to the analytical laboratory.

[c] TAL metals—aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, and zinc.

[d] TAL metals—calcium, iron, magnesium, potassium, and sodium.

[e] Samples will be sieved by the analytical laboratory.

[f] Mass represents the amount of <2 mm sieved material.

[g] Mass represents the amount of <250 µm sieved material.

[h] Mass represents the amount of <150 µm sieved material.

CEC - cation exchange capacity

TAL - target analyte list

IVBA - *in vitro* bio-accessibility assay (lead and arsenic only)

Table B4-1. Summary of Calibration and QC Procedures for Method SW6010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SW6010B	ICP Metals	Initial calibration (minimum 1 standard and a blank)	Daily initial calibration prior to sample analysis	If more than one standard is used, correlation coefficient must be ≥0.995	If applicable, correct problem and repeat initial calibration
		Initial calibration verification (second source)	Daily after initial calibration	All analytes within ±10% of expected value	Correct problem then repeat initial calibration
		Calibration verification (instrument check standard)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within ±10% of expected value and RSD of replicate integrations <5%	Repeat calibration and reanalyze all samples since last successful calibration
		Calibration blank	After every calibration verification	No analytes detected ≥RL	Correct problem then analyze calibration blank and previous 10 samples
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, to be provided by lab	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
		Low level calibration check standard (at or below RL)	Once per analytical batch prior to sample analysis unless multi-point (3+) calibration with low standard at or below RL is performed	All analyte(s) with ±50% of expected value	Correct problem then reanalyze
		Linear range calibration (high) check standard	Every three months	Analyte within ±10% of expected value	Correct problem then reanalyze or reset linear range

Table B4-1. Summary of Calibration and QC Procedures for Method SW6010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SW6010B	ICP Metals	Method blank	One per analytical batch	No analytes detected ≥RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank
		ICS	At the beginning of an analytical run	Within ±20% of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples
		LCS for the analyte	One LCS per analytical batch	QC acceptance to be provided by lab criteria,	Correct problem then reanalyze If still out, re-prepare and reanalyze the LCS and all samples in the affected batch
		Dilution test	Each new sample matrix, at least once per analytical batch (only applicable for analytes with concentrations ≥50X MDL)	Fivefold (1+4) dilution must agree within ±10% of the original determination	Perform post-digestion spike addition
		Method blank	One per analytical batch	No analytes detected ≥RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank
		ICS	At the beginning of an analytical run	Within ±20% of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples

Table B4-1. Summary of Calibration and QC Procedures for Method SW6010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
		LCS for the analyte	One LCS per analytical batch	QC acceptance to be provided by lab criteria	Correct problem then reanalyze If still out, re-prepare and reanalyze the LCS and all samples in the affected batch
		Dilution test	Each new sample matrix, at least once per analytical batch (only applicable for analytes with concentrations >50X MDL)	Fivefold (1+4) dilution must agree within ±10% of the original determination	Perform post-digestion spike addition

Notes:
ICP – inductively coupled plasma
ICS – internal check solution
LCS – laboratory control sample
MDL – method detection limit
QC – quality control
RL – reporting limit
RSD – relative standard deviation

Table B4-2. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
SW6020	ICP/MS Metals	MS tuning sample	Prior to initial calibration and calibration verification	SW6020 paragraph 5.8	Retune instrument then reanalyze tuning solution
		Initial calibration (minimum 1 standard and a blank)	Daily initial calibration prior to sample analysis	If more than one standard is used, correlation coefficient must be ≥0.995	If applicable, correct problem and repeat initial calibration
		Calibration blank	Before beginning a sample run, after every 10 samples and at end of the analysis sequence	No analytes detected ≥RL	Correct problem then analyze calibration blank and previous 10 samples
		Initial calibration verification (second source standard)	After initial calibration before beginning a sample run – at a concentration other than used for calibration	All analytes within ±10% of expected value	Correct problem then repeat initial calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±10% of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration
		Low level calibration check standard (at or below RL)	Once per analytical batch prior to sample analysis unless multi-point (3+) calibration with low standard at or below RL is performed	All analyte(s) with ±50% of expected value	Correct problem then reanalyze
		Linear range calibration (high) check standard	Every three months	Analyte within ±10% of expected value	Correct problem then reanalyze or reset linear range

Table B4-2. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
		Method blank	One per analytical batch	No analytes detected ≥RL	Correct problem re-prepare and analyze method blank and all samples processed with the contaminated blank
		Interference check solutions (ICS-A and ICS-AB)	At the beginning and end of an analytical run or once during an 12 hour period, whichever is more frequent	ICS-A All non-spiked analytes < RL unless they are a verified trace impurity from one of the spiked analytes ICS-AB Within ±20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, to be provided by lab	Correct problem then reanalyze If still out, re-prepare and reanalyze the LCS and all samples in the affected batch
		Dilution test	Each matrix in an analytical batch (only applicable for analytes with concentrations >100X MDL)	Fivefold (1+4) dilution must agree within ±10% of the original determination	Perform post-digestion spike addition
		Post digestion spike addition	When dilution test fails or if an analyte's concentration for all samples in a batch is less than 100X MDL	Recovery within 75-125% of expected results	Dilute the sample; reanalyze post-digestion spike addition
		MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, to be provided by lab	None

Table B4-2. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
		IS	Every sample	IS intensity within 30-120% of intensity of the IS in the initial calibration	Perform corrective action as described in method SW6020, section 8.3
		MDL study	Every 12 months		
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, to be reported by lab	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
		Results reported between MDL and RL	None	None	None

Notes:

ICP/MS – inductively coupled plasma mass spectrometry
ICS – internal check solution
ICS-A – internal check solution A
ICS-AB – internal check solution AB
IS – internal standards
LCS – laboratory control sample
MDL – method detection limit
MS – matrix spike
MSD – matrix spike duplicate
MS – mass spectrometry
QC – quality control
RL – reporting limit

Table B4-3. Summary of Calibration and QC Procedures for Method SW9080 for Ammonia [a]

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	ICAL	Prior to sample analysis	R2 ≥0.995	Correct problem then repeat ICAL.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	ICV	After ICAL	±10%	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	CCV	Prior to sample analysis	±10%	Correct problem then repeat CCV or repeat ICAL.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	Method blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminate, unless samples contain >20x amount in blank.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	LCS	Include with each analysis batch (up to 20 samples)	90-100%	If exceeds limits, re-extract and reanalyze.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	MS	Include per 10 samples – 350.1; Per 20 samples – SM 4500-G	Water, 90-100% Soil, 55-135%	Evaluate data to determine if the there is a matrix effect or analytical error.
EPA 350.1 SM 4500-NH3 B-1997 SM 4500-NH3 G-1997	Sample duplicates	Include with each analysis batch (up to 20 samples)	RPD ≤20% , Soil RPD ≤32%	Rehomogenize and reanalyze if result is >5X the MRL.

Notes:

[a] Calibration and QC procedures are with EPA Method 350.1 as the Determinative Step (i.e., the analysis for ammonia after forcing all cationic sites to be occupied by ammonium ions and then quantitatively removing them via treatment with hydrochloric acid. The analysis of the ammonium is then performed using EPA Method 350.1).

ICAL – initial calibration

ICV – initial calibration verification

CCV – continuing calibration verification

LCS – laboratory control sample

MS – matrix spike

MRL – method reporting limit

RPD – relative percent difference

Table B4-4. Summary of Calibration and QC Procedures for Method ASTM D4129-05 for Total Organic Carbon

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
ASTM D4129-05	CCV	Verify calibration by analyzing prior to samples, after every 10 analysis and after the last sample	±10%	Reanalyze all samples affected.
ASTM D4129-05	LCS	Include with each analysis batch (up to 20 samples)	See DQO tables	Reanalyze all samples affected.
ASTM D4129-05	Method blank	Include with each analysis batch (up to 20 samples)	<0.05%	If target exceeds 0.05%, clean boats and reanalyze.
ASTM D4129-05	MS	Include with each analysis batch (up to 20 samples)	See DQO tables	Evaluate data to determine if the there is a matrix effect or analytical error
ASTM D4129-05	Sample duplicates	Include with each analysis batch (up to 20 samples)	≤20% RPD	Rehomogenize and reanalyze if result is >5X the MRL
ASTM D4129-05	Sample triplicate	Include with each analysis batch (up to 20 samples)	≤20% RSD	Rehomogenize and reanalyze if result is >5X the MRL
ASTM D4129-05	Sample duplicates	All samples in each analysis batch	≤20% RPD	Rehomogenize and reanalyze if result is >5X the MRL

Notes:

ASTM – American Society for Testing and Materials

CCV – continuing calibration verification

DQO – data quality objective

LCS – laboratory control sample

MRL – method reporting limit

QC – quality control

RPD – relative percent difference

RSD – relative standard deviation

Table B5-1. Measurement Quality Objectives for Sediment and Soil Samples

Parameter	Analytical Accuracy (% recovery)	Analytical Precision (relative % deviation)	Overall Completeness (percent)
TAL metals	75-125	20	90
TOC	70-125	20	90
CEC	85-115	20	90
pH	±0.05 pH Units	20	90
Grain size	NA	NA	NA
IVBA	NA	NA	NA

Notes:

CEC - cation exchange capacity
IVBA - *in vitro* bio-accessibility assay

NA - not applicable

TAL - target analyte list

TAL metals—aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

TOC - total organic carbon

APPENDIX A

FIELD SAMPLING PLAN FOR THE BOSSBURG FLAT BEACH REFINED SEDIMENT AND SOIL STUDY

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CEC	cation exchange capacity
CFR	Code of Federal Regulations
COC	chain-of-custody
DU	decision unit
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
GPS	global positioning system
ICS	incremental composite sampling
ID	identification number
IVBA	*in vitro* bioaccessibility assay
QA	quality assurance
QA/QC	quality assurance and quality control
QC	quality control
RI/FS	remedial investigation and feasibility study
RM	river mile
SHSP	site health and safety plan
SOP	standard operating procedure
START	Superfund Technical Assessment and Response Team
TAI	Teck American Incorporated
TAL	target analyte list
TOC	total organic carbon
UCR	Upper Columbia River
UTM	universal transverse mercator
WGS 1984	World Geodetic System of 1984
XRF	X-ray fluorescence
YAM	Young America Mill

UNITS OF MEASURE

bgs	below ground surface
cm	centimeter(s)
°C	degree(s) Celsius
dw	dry weight
g	gram(s)
g/cm^3	grams per cubic centimeter(s)
in.	inch(es)
mg/kg	milligram(s) per kilogram
mm	millimeter(s)
ppm	parts per million
µm	micrometer(s)

1 INTRODUCTION

This document presents the field sampling plan (FSP) for the Bossburg Flat Beach refined sediment and soil study (herein the 'study'), which focuses on a section of the Upper Columbia River (UCR) extending from river mile (RM) 716 to RM 710. Information collected in this study will be used to refine exposure estimates and further inform risk evaluations for both human health and ecological receptors associated with near-shore sediments and adjacent upland soils. This work is being completed as part of the remedial investigation and feasibility study (RI/FS) conducted by Teck American Incorporated (TAI) under U.S. Environmental Protection Agency (EPA) oversight.

The objective of this study is to generate data to refine exposure estimates and further inform risk evaluations for both human health and ecological receptors associated with near-shore sediments and soil adjacent to and hydrogeologically down-gradient of the Young America Mill (YAM) site. Specifically, further refinement in near-shore sediments and soil is needed in areas adjacent to the former YAM site, the former cable ferry landing, and along the east riverbank from Bossburg Flat Beach (RM 716) to Evans Campground Beach (RM 710) to determine the concentration of contaminants and determine, to the extent practicable, the sources of contamination. To meet this objective, data for target analyte list (TAL) metals and *in vitro* bio-accessibility assay (IVBA) data for lead and arsenic will be determined to support the human health risk assessment. In addition, data collected during this study will be used to inform components of the ecological risk assessment (e.g., evaluation of risk to aquatic plants, sediment-probing birds, and other receptors). This FSP describes how and where near-shore sediments and soil will be collected for chemical analyses.

1.1 OVERVIEW

Lead concentrations above a screening level of 400[1] pm[2] were identified at Bossburg Flat Beach (RM 716) and Evans Campground Beach (RM 710) during beach sediment sampling activities conducted for the RI/FS. Subsequent investigations conducted by EPA under the Superfund Technical Assessment and Response Team (START) program in adjacent sites (i.e., the Young America Mine and Mill sites) identified elevated metal (i.e., lead) concentrations associated with historic mining and milling activities (WDNR 2008; Emerson 2012; TechLaw 2012a,b; and USEPA 2012). Based on the elevated lead

[1] As defined within EPA's April 2012 fact sheet, the lead screening level of 400 ppm is considered "residential use" or safe for small children (http://yosemite.epa.gov/R10/CLEANUP.NSF/UCR/Fact+Sheets).
[2] Parts per million (ppm) are equivalent to mg/kg.

concentrations, a removal action at the YAM site was completed by EPA in 2012. At the time of writing, final documentation of work completed (including analytical data) remains in preparation. In consideration of the above-mentioned investigations, the goal of this study is to refine our understanding regarding the nature and extent of near-shore sediment contamination in areas adjacent to the former YAM site, the former cable ferry landings, and the area between Bossburg Flat Beach (RM 716) and Evans Campground Beach (RM 710). These data will then be used in the evaluation of risks in the human health and baseline ecological risk assessments. The data quality objectives to be addressed by this study are:

- Do TAL metals in near-shore sediments located between RMs 710 and 716 occur at concentrations that may present unacceptable risks to people or ecological receptors?
- What is the spatial extent of contamination in the areas identified above?

1.2 PLAN ORGANIZATION

This FSP describes field methods that will be used to collect near-shore sediments for the study. Section 2 of this FSP describes field procedures that will be followed. Section 3 describes procedures for field documentation. References cited in this document are listed in Section 4.

Attachments to this FSP include:

- **Attachment A1—General Site Health and Safety Plan (SHSP), Addendum.** Describes site-specific requirements and procedures to minimize the safety risk to personnel who carry out the field study program.
- **Attachment A2—Standard Operating Procedures (SOPs).** Detailed field procedures to be used include:
  - SOP-1 – Positioning at Sample Collection Areas
  - SOP-2 – ICS Surface Sample Collection
  - SOP-3 – Core Sample Collection
  - SOP-4 – Field Documentation
  - SOP-5 – Decontamination of Sediment and Soil Sampling Equipment
  - SOP-6 – Sample Labeling
  - SOP-7 – XRF Surface Sample Collection
  - SOP-8 – Handling and Reporting of Cultural Resources

  - SOP-9 – Sample Custody
  - SOP-10 – Sample Storage, Packing, and Shipping

- **Attachment A3—Examples of Various Field Forms.** Contains examples of various forms that will be used during field sampling, processing, and external examination forms; a chain-of-custody (COC) form; and sample labeling forms.
- **Attachment A4—Archaeological Monitoring Protocol.** Provides study-specific procedures to be followed if any archaeological objects or resources are discovered during sampling activities.

2 SAMPLE COLLECTION AND PROCESSING

The following sections describe procedures and methods that will be used during the study, including sampling procedures, record keeping, sample handling, storage, and field quality control (QC) procedures. Sampling efforts will be scheduled to coincide with reservoir drawdown. Sample collection and processing will be conducted in accordance with the SOPs, provided in Attachment A2. Depending on field conditions, procedures specified in the referenced SOPs may be modified if necessary.

2.1 TASK SCHEDULE

Access to areas where sediment samples are to be collected is influenced by changing water levels in the Lake Roosevelt reservoir. For planning purposes, and consistent with previous near-shore sediment sampling activities completed for the RI/FS, it is anticipated that this work will occur during periods of reservoir drawdown. Water levels are lower, and sediment sampling areas more accessible, during spring drawdown. Access to soil sampling sites is not affected by water level changes. Soil sampling can be conducted independent of reservoir drawdown. It is TAI's understanding that EPA would like sediment and soil samples to be collected in a single event conducted during a timeframe coinciding with spring drawdown (e.g., late April to early May). Sampling efforts are expected to take two weeks to complete. Prior to initiating field sampling activities, a detailed schedule will be prepared by the field sampling crew to facilitate planning and scheduling of EPA technical and cultural oversight.

2.2 LOCATING SAMPLING STATIONS

Field personnel will collect near-shore sediments and soil from 16 decision units (DUs) extending from RM 716 to RM 710. The location of each DU and individual sampling sites are shown graphically on Figures A1 through A8. Sampling areas will be accessed using vehicles large enough to safely transport the field sampling crew, any observers (e.g., EPA or tribal representatives), sampling equipment (e.g., backpacks, sample containers, trowels, mixing pans), and sample coolers across backcountry roads. The vehicle driver(s) will become familiar with the relevant roads prior to the sampling event to determine the most appropriate access routes to each sampling location. Vehicle access to some locations may be restricted due to conditions such as high slope or debris. Field crews will be prepared to carry equipment and supplies to access some sampling sites.

A handheld global positioning system (GPS) will be used to find each sampling location using the procedure detailed in SOP-1 (Positioning at Sample Collection Areas). The standard projection method to be used during field activities will be the horizontal datum of World Geodetic System of 1984 (WGS 1984). Sampling locations (Tables A1a through A1d) will be uploaded to GPS units prior to field sampling.

2.3 FIELD SURVEY AND SAMPLING METHODS

It is anticipated that a minimum of one sediment sampling team, one soil sampling team, and one team for sample transport and logistics support will be used to complete field sampling activities. Vehicles used for sampling activities will have sufficient capacity to accommodate a minimum of two sampling crew members, any observers (e.g., EPA oversight personnel), sampling equipment (e.g., backpacks, sample containers, trowels, mixing pans, decontamination materials), and sample coolers.

2.3.1 Field Equipment and Supplies

Field equipment and supplies are identified in each SOP and include (but are not limited to) handheld GPS unit(s), camera, stainless steel soil "punch" for sample collection, 2 mm sieve(s) (for X-ray fluorescence [XRF] samples), 5-gallon buckets, stainless steel or Lexan scoops, decontamination supplies, sample bags, coolers, wet ice or coldpacks, shipping containers, logbooks and forms, personal protection equipment, and personal gear. Protective gear (e.g., nitrile gloves) is required to minimize the possibility of cross-contamination between samples. Surface sediment and soil samples will be collected using a stainless steel soil "punch" (or equivalent), following the sampling methods provided in SOP-2.

Shipping coolers, packaging material, sample bags, buckets, and distilled/deionized water for rinsing the equipment following decontamination will be supplied by the analytical laboratory. Details on the types of sample containers are provided in Table A2. Commercially available zipper closure bags (e.g., Ziploc® or equivalent) will be used to collect soil increments for cultural observation and transfer to a plastic 1-gallon bucket. Sample containers will be clearly labeled at or prior to the time of sampling. Completing as much labeling as possible prior to the field work (especially electronic labeling) is advantageous because it reduces errors stemming from inconsistent naming, handwriting legibility, and label adhesion that may occur when labeling in field conditions. Labels will include the task name, sample location and number, samplers' initials, analyses to be

performed, and sample date and time. Sample labeling procedures are detailed in SOP-6 (Attachment A2) and an example sample label is provided in Attachment A3.

2.3.2 Sampling Methods

This section describes sampling methods that will be implemented in the field. These methods are supported by SOPs. Different methods are required for each sampling technique used in the study: incremental composite sampling (ICS), core, and XRF samples. Prior to sample collection, photographs of the general area and at each sampling station will be taken following procedures provided in SOP-4. The purpose of these photographs is to provide qualitative information on field conditions (e.g., proportion of coarse-grained [≥ 2 mm] versus fine-grained [< 2 mm] sediment) and surrounding area conditions. Sampling methods for each sample type follow.

2.3.2.1 Incremental Composite Samples

This section details the equipment and procedures that will be used to collect ICS samples. ICS increments will be composited in the field. The numbers of ICS increments to be collected and their locations are listed in Tables A1a (sediment) and A1b (soil).

The field sampling team will have the necessary knowledge and experience to perform all field activities. Such knowledge includes experience with GPS units, specified sampling gear, and sediment and soil collection. All crew members will be familiar with this FSP, and will participate in site and equipment orientation prior to initiating sample collection.

Minimum Sample Mass

Data quality objectives for this field effort can be achieved by collecting sufficient sediment or soil mass for laboratory analysis. Minimum sample sizes for the ICS samples and each increment comprising them were conservatively calculated as described in this section.

Sediments

For collection of sediment samples to be used for ecological assessment (i.e., substrates passing through a 2 mm sieve), the analytical measurements to be performed are grain size (on whole sediment), TAL metals, total organic carbon (TOC), and pH on the < 2 mm size fraction. The minimum mass for analysis of these analytes is roughly 151 g (see Table A2). This minimum mass was tripled to allow at least 5 percent of the samples to undergo laboratory quality assurance (QA) procedures, resulting in a total mass of 453 g. The tripled minimum mass was then doubled to provide excess sample for archiving, resulting

in a total mass of 906 g. Under the assumption that only 80 percent of a composited ICS sample would pass through a 2 mm sieve, the minimum mass was divided by 0.8. The final targeted mass for samples sieved to 2 mm is 1,133 g per ICS sample, or 38 g per increment.

For collection of sediment samples to be used for human health assessment (i.e., those passing through a 0.250 mm sieve), the analytical measurements to be performed are TAL metals, and lead and arsenic IVBA. The minimum mass for analysis of these analytes is 22 g (see Table A2). This minimum mass was tripled to allow at least 5 percent of the samples to undergo laboratory QA procedures, resulting in a total mass of 66 g. The tripled minimum mass was doubled to provide excess sample for archiving, resulting in a total mass of 132 g. Under the assumption that only 20 percent of a composited ICS sample would pass through a 0.150 mm sieve, the minimum mass was divided by 0.2. The final targeted mass for samples sieved to 0.150 mm is 660 g per ICS sample, or 22 g per increment.

Together, the overall targeted mass for sediment samples sent to the laboratory is 1,793 g, or 60 g per increment.

Soils

For collection of soil samples to be used for ecological assessment (i.e., substrates passing through a 2 mm sieve), the analytical measurements to be performed are grain size (on whole sediment), TAL metals, TOC, pH, and cation exchange capacity (CEC). The minimum mass for analysis of these analytes is roughly 251 g (see Table A2). This minimum mass was tripled to allow at least 5 percent of the samples to undergo laboratory QA procedures, resulting in a total mass of 753 g. The tripled minimum mass was then doubled to provide excess sample for archiving, resulting in a total mass of 1506 g. Under the assumption that only 80 percent of a composited ICS sample would pass through a 2 mm sieve, the minimum mass was divided by 0.8. The final targeted mass for samples sieved to 2 mm is 1,883 g per ICS sample, or 63 g per increment.

For collection of soil samples to be used for human health assessment (i.e., those passing through a 0.150 mm sieve), the analytical measurements to be performed are TAL metals, and lead and arsenic IVBA. The minimum mass for analysis of these analytes is 22 g (see Table A2). This minimum mass was tripled to allow at least 5 percent of the samples to undergo laboratory QA procedures, resulting in a total mass of 66 g. The tripled minimum mass was doubled to provide excess sample for archiving, resulting in a total mass of 132 g. Under the assumption that only 20 percent of a composited ICS sample would pass through a 0.150 mm sieve, the minimum mass was divided by 0.2. The final

targeted mass for samples sieved to 0.150 mm is 660 g per ICS sample, or 22 g per increment.

Together, the overall targeted mass for soil samples sent to the laboratory is 1,838 g, or 61 g per increment.

The volume of sediment or soil needed to be collected in the field to meet these requirements is dependent on the (unknown) soil densities that will be encountered in the field. However, collecting increments from 0 to 15 cm below ground surface (bgs) using a soil punch with a diameter of 4 cm should result in sufficient sample mass at soil densities equal or greater than 0.55 g/cm^3.

Field personnel can confirm that adequate mass will be collected using the soil sampling device(s) selected for use in the field. Collected sample masses can be predicted using the following equation:

$$M = \rho \times n \times D \times \pi \times (\theta/2)^2$$

Where:

M = targeted mass of sample (g)

D = sampling depth (cm)

n = number of increments

ρ = soil density (g/cm^3)

θ = diameter of soil corer (cm)

Procedures for ICS Samples

A brief overview of the soil collection procedure is provided below and described in more detail in SOP-2 (Attachment A2).

1. Transport field personnel and sampling equipment to the DU selected for ICS sampling.
2. Locate each increment location using a handheld GPS and convey sampling equipment and personnel to this location.
3. A cultural resources monitor will inspect and approve each ICS sample location.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).

5. Select a location to collect the sample within 2 m of the GPS increment location specified in Tables A1a and A1b. If a sample is inaccessible, move 2 m north of the GPS location, move 2 m west, then south and east until a sample is obtained. The actual increment location may be shifted from the planned GPS location to target available sediment or soil and avoid obstacles such as woody vegetation or rocks.
6. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
7. Collect the increment(s) from each increment location (see Tables A1a through A1b) using a decontaminated soil punch or equivalent sampling device.
    a. Increment samples for laboratory analysis will be collected using a 4-cm-diameter soil punch (or equivalent) from the 0 to 15 cm depth interval.
    b. All increments collected at an increment location should be collected as close as possible to the planned station location.
8. Place the increment into a quart-sized zipper closure plastic bag.
9. Allow the cultural resources representative to inspect the increment in the quart-sized bag(s).
    a. If the increment passes cultural resources review, continue sample collection.
    b. If the increment does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.
10. Transfer the increment for laboratory analysis from the quart-sized inspection bag into a 5-gallon bucket containing any previously collected increments from the DU.
11. Complete field documentation for this increment location.
12. Grossly decontaminate (brush off) sample collection equipment between increment locations within one DU. Fully decontaminate sampling equipment between DUs as described in Section 2.4 and SOP-5.
13. Discard DU-dedicated sampling equipment such as gloves, quart-sized inspection bags.
14. At the close of the field day, transfer ICS samples to sample coolers and store on ice at 4°C.

15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation.

Detailed descriptions of daily sampling team operations are provided in the SOPs in Attachment A2.

2.3.2.2 Core Samples

Sediment and soil cores will be collected at locations to be selected in the field in consultation with EPA oversight personnel and the cultural resource monitor in accordance with SOP-3. The depth of each core collected will also be determined in consultation with EPA oversight personnel and the cultural resource monitor. Up to three surface and subsurface intervals will be collected: 0 to 15 cm (0 to 6 in.), 15 to 45 cm (6 to 12 in.), 45 to 75 cm (12 to 18 in.). The depth to which subsurface intervals can be collected may be limited to the depth of refusal at any given coring station. If the coring device cannot sample to a depth of 18 inches, that sampling location will be marked as "refused" and an alternate sample location within 2 m will be used.

Procedures for Core Sample Collection

1. Transport field personnel and sampling equipment to a location for core sampling.
2. Determine each core location in consultation with EPA oversight personnel, convey sampling equipment and personnel to those locations, and record coordinates for each core sampling location using a handheld GPS.
3. A cultural resources monitor will inspect and approve each core sample location prior to any sediment or soil disturbance.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).
5. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
6. Collect surface and subsurface intervals from each coring location using a decontaminated auger or coring device (e.g., stainless steel bucket auger with special teeth, coring device with liner and core catcher, stainless steel hand auger, or equivalent type of equipment). A stainless steel ruler will be used to ensure that sediment from the correct interval is collected.

a. All core samples collected at a location should be collected as close as possible to the station location selected in consultation with EPA oversight personnel.

b. The target minimum sample mass to be collected for any core interval is 50 g (as determined above for ICS sample increments)

7. Sticks, twigs, rocks, and other large material will be manually removed.
8. Place each core interval into a quart-sized zipper closure plastic bag.
9. Allow the cultural resources representative to inspect the each interval in the quart-sized bag(s).

   a. If the core sample passes cultural resources review, continue sample collection.

   b. If the core sample does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.

10. Appropriately label each core interval for laboratory analysis.
11. Complete field documentation for this coring location.
12. Grossly decontaminate (brush off) sample collection equipment between coring attempts at a location. Fully decontaminate sampling equipment between coring locations as described in Section 2.4 and SOP-5.
13. Discard core sample-dedicated sampling equipment such as gloves, quart-sized inspection bags.
14. At the close of the field day, transfer core samples to sample coolers and store on ice at 4°C.
15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation.

Detailed descriptions of daily sampling team operations are provided in the SOPs in Attachment A2.

2.3.2.3 XRF Samples

Samples collected for XRF analysis will be placed into labeled zipper closure bags and transported to the field analysis area. XRF analysis methods will follow EPA method 6200 (USEPA 2007). The field-portable XRF unit will be an Innov-X alpha model a-4000s or similar. This unit currently is able to analyze lead concentrations at a detection limit range of 10 to 100 mg/kg dw.

One source of variability using XRF is analysis time (USEPA 2007). The analysis time of each XRF unit is user-selectable. Shorter times (30 seconds) are generally used for initial screening and hot spot delineation, and longer times (up to 300 seconds) are used to meet higher precision and accuracy requirements (USEPA 2007). Other research found that there was negligible increase in data quality for lead analysis times greater than 120 seconds (CLAIRE 2008). For this study, an analysis time of 120 seconds (2 minutes) will be used to achieve the lowest detection limits and most accurate measurements practical.

Procedures for XRF Samples

A brief overview of the XRF analysis procedure is provided below and described in more detail in SOP-7 (Attachment A2).

1. Transport field personnel and sampling equipment to the DU for XRF sampling.
2. Locate each XRF location using a handheld GPS and convey sampling equipment and personnel to this location.
3. A cultural resources monitor will inspect and approve each XRF sample location prior to any sediment or soil disturbance.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).
5. Select a location to collect the sample within 2 m of the GPS increment location specified in Tables A1c and A1d. If a sample is inaccessible, move 2 m north of the GPS location, move 2 m west, then south and east until a sample is obtained. The actual increment location may be shifted from the planned GPS location to target available soil and avoid obstacles such as woody vegetation or rocks.
6. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
7. Collect a sample from each XRF location (see Tables A1c and A1d) using a decontaminated soil punch or equivalent sampling device.
    a. XRF samples will be collected using a 4-cm-diameter soil punch (or equivalent) from the 0 to 15 cm depth interval.
    b. All XRF samples collected at a location should be collected as close as possible to the planned station location.

8. Allow the cultural resources representative to inspect the each interval in the quart-sized bag(s).
    a. If the XRF sample passes cultural resources review, continue sample collection.
    b. If the XRF sample does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.
9. The XRF sample will be weighed before drying and the weight (before drying) will be recorded on the sample analysis form.
10. Each XRF sample will be spread out in a decontaminated, shallow, disposable aluminum pan (or equivalent) and allowed to air dry. In accordance with EPA Method 6200 (Section 11.5), the sample will be considered dry when a constant weight is obtained.
11. The dried XRF sample will be weighed and the weight (after drying) will be recorded on the sample analysis form.
12. Sticks, twigs, rocks, and other large material will be manually removed.
13. The XRF sample will be sieved using a decontaminated 2 mm sieve.
14. Following sieving, the sample will be mixed using ASTM (2006) or a comparable method to ensure full homogenization.
15. The sieved and mixed XRF sample will be placed in a clear plastic bag on a level surface and the soil will be slightly compacted to reduce application-related error (USEPA 2007).
16. The probe window of the XRF unit will be placed directly against the plastic bag during measurement.
17. The XRF analysis will be performed for 120 seconds and the reading for lead will be recorded on the sample analysis form.
18. The bag containing the sieved XRF sample will be turned over and a second XRF reading will be conducted for 120 seconds. The resulting lead concentration will be recorded on the sample analysis form.
19. The bag containing the sieved XRF sample will be turned over again and a third XRF reading will be conducted for 120 seconds. The resulting lead concentration will be recorded on the sample analysis form.

20. The average of the three determinations will be calculated. If all three determinations do not fall within 35 percent of the average value, the sample will be homogenized again and steps 14 through 17 will be repeated.
21. At 20 percent of XRF stations (with individual locations to be determined in the field in consultation with EPA oversight personnel), sieved XRF samples (a minimum of 35 g) will be properly labeled for confirmatory lead analysis.
22. Confirmatory samples will be transferred to sample coolers and store on ice at 4°C and shipped to the analytical laboratory along with all appropriate documentation.
23. After field XRF analysis is complete, any remaining sample will be disposed of in a manner consistent with other investigation-derived waste.

Detailed descriptions of daily sampling team operations are provided in the SOPs in Attachment A2.

2.4 DECONTAMINATION

All sampling equipment coming into direct contact with samples will be decontaminated prior to beginning field work, between sampling stations, and at the conclusion of the field effort as outlined in SOP-5 (Attachment A2). Cleanroom 100-certified nitrile gloves will be used for handling samples and will be discarded in between sampling stations. Clean gloves will be worn at each sampling station to avoid transfer of potential contaminants. If a lapse of time occurs between equipment decontamination and its use, the sampling equipment will be kept wrapped in aluminum foil until time for use. To minimize sample cross-contamination, disposable gloves will be replaced between stations.

2.5 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be used to assess sample variability and evaluate potential sources of contamination. The types of QC samples that will be collected for this task are described in this section. Detailed information on quality assurance and quality control (QA/QC) procedures, limits, and reporting are described in detail in the quality assurance and project plan. If QC problems are encountered, they will be brought to the attention of the task QA coordinator. Corrective actions, if appropriate, will be implemented to meet the task's data quality indicators.

Field QC samples include the collection of triplicate ICS samples and equipment rinsate blanks. These samples will be submitted to and analyzed by the analytical chemistry laboratory.

Field QC samples for XRF analyses include energy calibration checks, instrument blanks, calibration verification checks, and precision checks several times a day.

2.5.1 Triplicate ICS Samples

Triplicate ICS samples will be collected at some locations to characterize heterogeneity within a DU. Three complete sets of ICS increments will be collected in sediment DUs 2, 3, and 9 (Table A1a) and also in soil DU 4 (Table A1b). At each DU subject to triplicate sampling, the additional increments will be collected from a set of randomly positioned locations that is distinct from the primary increment locations. Triplicate ICS samples will be composited in the field and processed by the laboratory using the same procedures as the primary ICS samples.

2.5.2 Equipment Rinsate Blanks

Equipment rinsate blanks are collected to identify possible contamination from the sampling environment or sampling equipment (e.g., stainless steel scoops, bowls). Equipment rinsate blanks will be generated once a day for each kind of sampling equipment used. After equipment decontamination is complete, an equipment rinsate blank will be collected by running distilled/deionized water over the sampling equipment. The samples will be collected in a certified-clean glass container provided by the analytical laboratory.

2.6 INDIVIDUAL SAMPLE LABELING

Procedures for sample labeling are described herein (see SOP-6; Attachment A2). Each distinct sample will be assigned a unique identifier based on DU type (which indicates medium sampled), collection method/analysis performed, and station number (where appropriate) as shown below:

- Decision unit number or ferry landing area: SDU-## = sediment DU number; UDU-## = upland (soil) DU number; F-1 = east bank cable ferry landing; F-2 = west bank cable ferry landing
- Collection method/analysis performed: ICS = incremental composite sample; XRF = X-ray fluorescence sample; COR = coring sample.

- ICS replicate identifier = A, B, or C (ICS samples only)
- XRF station or core number: ## = station number (XRF and core samples only, includes both sediment and upland decision units)
- Core interval: ### = interval number for a core sample (001 = 0 to 15 cm; 002 = 15 to 45 cm; 003 = 45 to 75 cm)
- ER = equipment rinsate blank (equipment blanks only)

Example sample identification numbers (IDs)s are:

- SDU-02-ICS-C = sediment sample collected using incremental composite sampling from sediment DU 2, replicate C
- UDU-05-ICS = soil sample collected using incremental composite sampling from soil DU 5
- UDU-01-XRF-05 = soil sample collected from upland DU 1 for XRF analysis at XRF station 05
- SDU-08-COR-01-001 = sediment core sample collected from sediment DU 8, core number 1, from the 0 to 15 cm interval
- SDU-10-ER = equipment rinsate taken at sediment DU 10

Field duplicate samples will be assigned unique identifiers in the field using fictitious station ID numbers that will be clearly document in the field notes. These samples will not be identifies as field duplicates to the laboratory.

2.7 SAMPLE HANDLING

Records will be maintained to document all activities and data associated with field sampling and with chemical analyses. Results of data verification and validation activities will also be documented. Procedures for documenting field activities are described herein (see SOP-4; Attachment A2); laboratory procedures are presented in Appendix C of the quality assurance project plan.

Planning and documentation of all activities are emphasized to ensure that sample identity and integrity are preserved during all stages of the field operation. The following documentation will be provided with samples:

- A field record form that contains information about each sampling station
- Photo documentation
- A sample identification label that accompanies and identifies each individual sample

- A COC form that provides continuous tracking information for all samples.

The following information will be handwritten on the sample label at the time of collection with an indelible marker (or preprinted sample labels may be used):

- Sediment sample number
- Date
- Time.

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. If possible, the individual who made the error will correct it.

Sample labels will be placed either on the sample container or with the sample container inside resealable plastic bags. When individual samples are prepared for shipment, this sample label will remain with the packaging.

Sediment and soil samples should also be characterized according to the following parameters, and recorded in field logs (SOP-4; Attachment A2):

- Substrate type (e.g., sand, silt, clay)
- Texture (e.g., fine-grain, coarse, poorly sorted sand)
- Color
- Visual presence of biological structures (e.g., amphipods, plant roots, etc.)
- Presence of shells
- Presence of debris (e.g., twigs, leaves), especially organic debris
- Stratification, if any
- Presence of a sheen, if any
- Odor (e.g., hydrogen sulfide), if any.

2.8 CULTURAL RESOURCES

In accordance with the protocols outlined in Attachment A4, Archaeological Monitoring Protocol, a cultural resources monitor will be present throughout the duration of the sampling effort. The monitoring archaeologist(s) will visually examine each sample before and after it is collected. An SOP for handling and reporting of cultural resources also is provided in Attachment A2 as SOP-8.

2.9 SAMPLE DOCUMENTATION, PACKAGING, AND TRANSPORT

This section describes procedures for handling samples prior to shipping to the analytical laboratory (see SOP-9 and SOP-10 in Attachment A2). Planning and documentation of all activities are emphasized to ensure that sample identity and integrity are preserved during all stages of the field operation. The following documentation will be provided with the soil samples:

- A sample identification label that accompanies and identifies each soil sample
- A COC form that provides continuous tracking information for all samples
- A COC label that seals each shipping container.

The following information will be hand-written on the sample label (see blank and filled-out example of a sample label in Attachment A3) at the time of collection with an indelible marker:

- Soil sample number (may be pre-filled out)
- Sampler's initials
- Date
- Time.

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 sample labels will be placed on each sample container. Sample coolers and packaging materials will be supplied by the analytical laboratory. ICS samples in 5-gallon plastic buckets will be sealed. The buckets will then be packed in a cooler lined with a large plastic bag. Glass jars used for equipment rinsate blank samples will be packed to prevent breakage and separated in the cooler by bubble wrap or other shock-absorbent material. Wet ice in sealed plastic bags will then be placed in the cooler to maintain a temperature of approximately 4°C (±2°C). When the cooler is full, the COC form will be placed into a resealable bag and taped to the inside lid of the cooler. Each cooler will be sealed with three COC seals—one on each of the unhinged sides of the lid (see filled-out example of a custody seal in Attachment A3). On each side of the cooler, a This End Up arrow label will be attached; a Fragile label will be attached to the top of the cooler.

The shipping containers will be clearly labeled with sufficient information (i.e., name of task, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification. These packaging and shipping procedures

are in accordance with U.S. Department of Transportation regulations as specified in 49 Code of Federal Regulations (CFR) 173.6 and 49 CFR 173.24. Coolers containing samples for chemical analyses will be transported to the laboratory by courier or overnight shipping service, with tracking information provided, so that they arrive at the processing laboratory within 48 hours from the time of sample shipment.

After the chemistry samples have been received by the laboratory, they will be stored under refrigeration at approximately 4°C (±2°C).

2.10 STUDY-DERIVED WASTE

All study-derived wastes will be disposed of at appropriate facilities (USEPA 2008). All disposable materials and supplies used for sample collection and processing (e.g., paper towels and gloves) will be placed in heavyweight garbage bags or other appropriate containers. This waste will be placed in a normal refuse container for disposal at a solid waste landfill. Solvent wastes will be stored in containers and disposed at an appropriate offsite facility. Acid waste will be neutralized and disposed locally.

3 FIELD DOCUMENTATION

The integrity of each sample from the time of collection to the point of data reporting must be maintained. Proper record-keeping and COC procedures will be implemented to allow samples to be traced from collection to final disposition. Representative photographs will be taken of each type of sampling activity performed during the study. Site photographs from various angles and views of the sampling locations will be collected.

3.1 FIELD LOG

All field activities and observations will be noted in a field log. The field log will be either a bound document containing individual field and sample log forms or an electronic tablet containing the same documentation. Information will include personnel, date, time, station designation, sampler, types of sample(s) collected, and general observations. Any changes that occur during sampling (e.g., personnel, responsibilities, deviations from the FSP) and the reasons for these changes will be documented in the field log. The log will identify onsite visitors (if any) and the number of photographs taken at each sampling station. The field supervisor is responsible for ensuring that the field log and all field data forms are correct; if electronic records are kept, the field supervisor will upload those to the secure project web site on a daily basis, or as often as practicable. Requirements for logbook-keeping include the following:

- If paper logbooks are used
  - They will be bound, with consecutively numbered pages.
  - Removal of any pages, even if illegible, will be prohibited.
  - Entries will be made legibly with black (or dark) waterproof ink.
  - Corrections will be made by drawing a single line through the original entry, with the corrected entry written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.
- Each day's first entry will be made on a new, blank page.
- Easy-to-understand, descriptive language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself).

- Blank lines on a page or blank pages in the file book will be lined out to indicate that they were intentionally left blank.
- The date and time, based on a 24-hour clock (e.g., 0900 for 9:00 a.m. and 2100 for 9:00 p.m.), will appear on each page.

In addition to the preceding requirements, if a paper logbook is used, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry. The field supervisor, after reading the day's entries, also must sign and date the last page of each daily entry in the field logbook.

The type of information that may be included in the field log and/or field data forms includes the following:

- Task name, task location, and task number
- Task start date and end date
- Weather conditions
- Name of person making entries and other field staff
- Onsite visitors, if any
- Sampling vessel, if any
- Date and collection time of each sample
- The sampling station name
- Sampling location coordinates derived from GPS for each station
- Specific information on each type of sampling activity
- Observations made during sample collection
- Number of photographs taken at each sampling location
- A record of site health and safety meetings, updates, and related monitoring
- Any deviation from the sampling plan and reasons for deviation.

In addition, a sampling location map will be updated during sampling and will be maintained throughout the sampling event. All logs must be completed at the time any observations are made. Copies of all logs and forms will be retained by TAI and its technical team. It is advisable to photocopy each day's entries to provide a backup copy that can be kept at a secure location (field laboratory, hotel room, or the like).

3.2 CHAIN-OF-CUSTODY PROCEDURES

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A COC record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC will be included in laboratory and QA/QC reports. Attachment A3 contains an example of the COC form that will be used during the study, with directions for how to fill out the form in SOP-9 (Attachment A2).

The COC form will be either paper or electronic and, at a minimum, will include the following information:

- Site name
- Field supervisor's name and team members responsible for collection of the listed samples
- Collection date and time for each sample
- Sample type (i.e., sediment or rinsate)
- Number of sample containers (i.e., coolers) shipped
- Requested analyses for each sample (as indicated in Table A2)
- Sample preservation information (if any)
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer, and the designated sample custodian at the receiving facility.

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

The laboratory will designate a sample custodian who will be responsible for receiving samples and documenting their progress through the analytical process. The laboratory sample custodian will confirm the integrity of the custody seals upon sample arrival at the laboratory. The laboratory sample custodian will also ensure that the COC and

sample tracking forms are properly completed, signed, dated, and initialed upon receipt of the samples.

Upon receipt of the samples by the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels (numbers and tags) to those on the COC form. If sample temperatures fall outside the acceptable range, the field supervisor should be alerted immediately. The custodian will enter sample numbers into a laboratory tracking system by task code and sample designation. The custodian will also assign a unique laboratory sample identifier to each sample number and will be responsible for distributing the samples to the appropriate analyst or for storing samples at the correct temperature in an appropriate and secure area.

4 REFERENCES

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FIGURES

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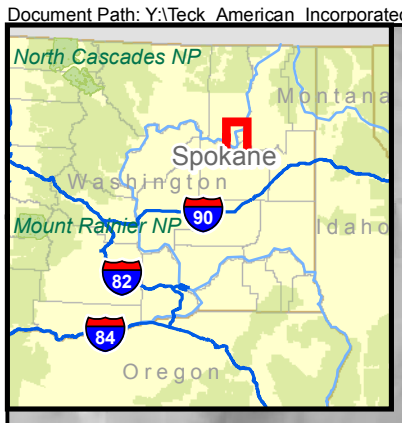

Ferry Landing Area

Hackley Parcel

SDU-8

SDU-1

716

YAM Area

SDU-2

Tailings Pond Outlet

Young America Mill Site

UDU-5

SDU-3

Young America Mine Site

SDU-9

F-1

UDU-6

F-2

UDU-1-4

Historic Ferry Site

SDU-10

715

SDU-4

Bossburg Area

Bossburg

714

713

25

712

Bear

Evans

Left Bank River Mile 711

Powell

SDU-5

711

Evans Campground Beach

SDU-6

Evans Campground Beach

710

SDU-7

Left Bank River Mile 710

709

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure A1. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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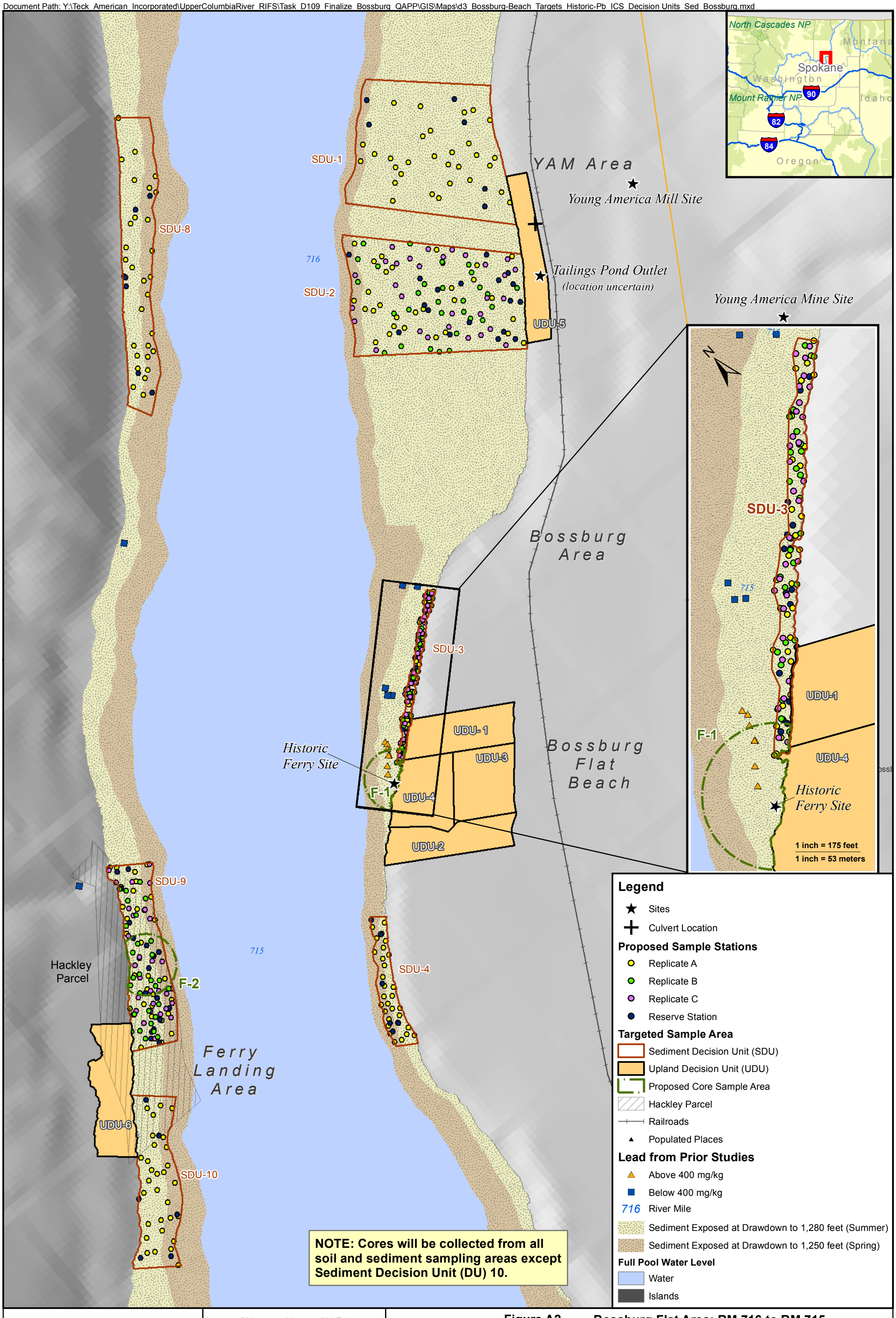


HDR

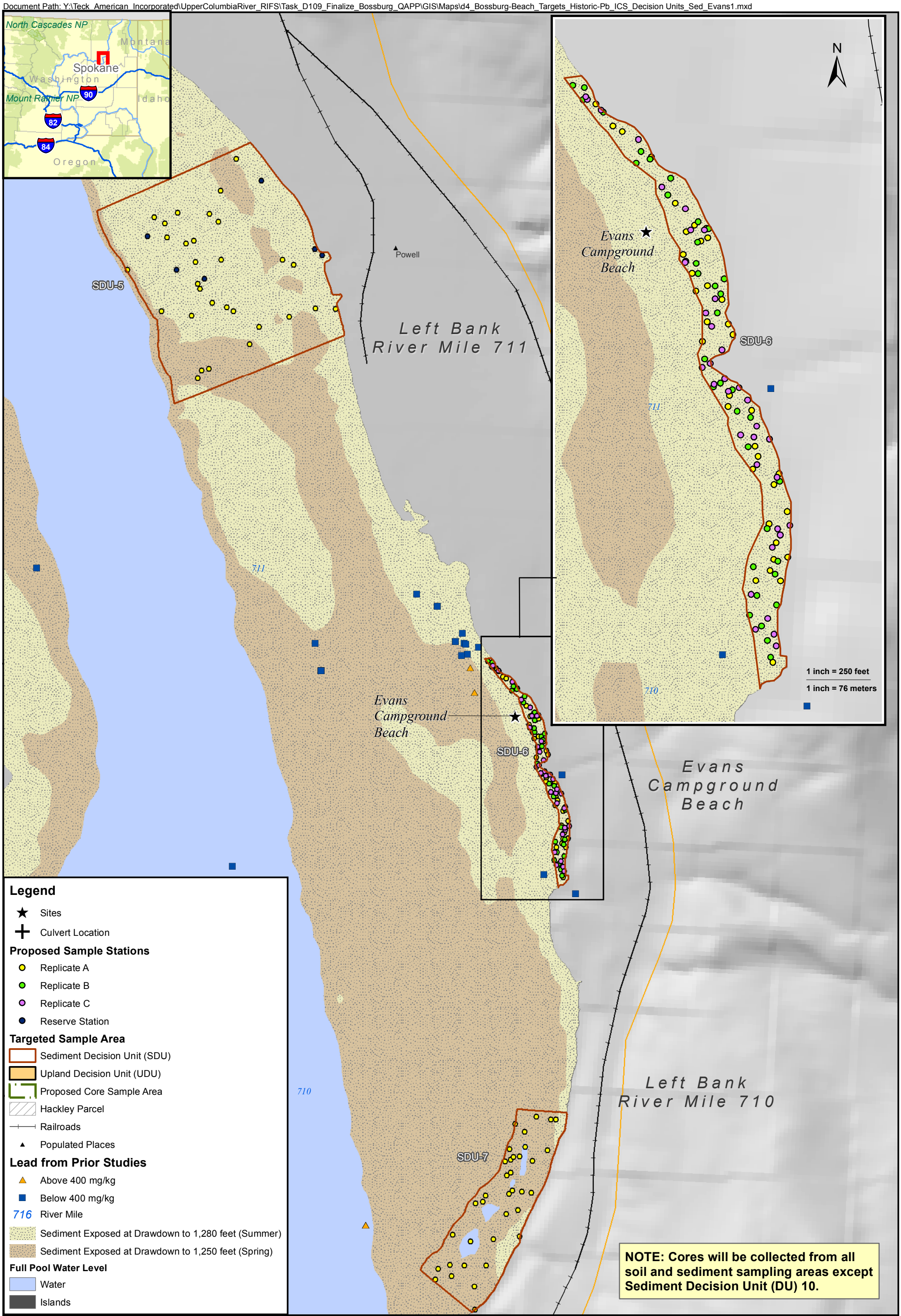
0 200 400 600 Feet

0 50 100 150 Meters

Figure A2. **Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations**

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d4_Bossburg-Beach_Targets_Historic-Pb_ICS_Decision Units_Sed_Evans1.mxd



HDR

Figure A3. **Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations**

Upper Columbia River, WA

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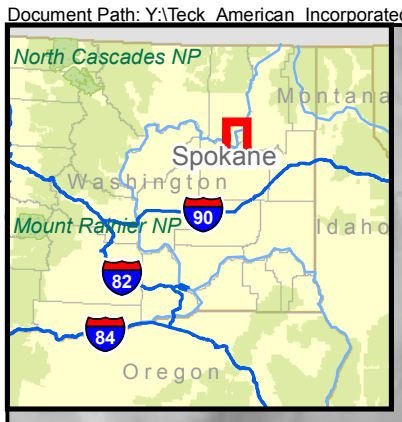

YAM Area

SDU-8

716

SDU-1

SDU-2

UDU-5

Tailings Pond Outlet

Young America Mill Site

Young America Mine Site

Hackley Parcel

SDU-9

SDU-3

UDU-1

UDU-6

UDU-4

Historic Ferry Site

SDU-4

UDU-3

UDU-2

SDU-10

715

Ferry Landing Area

Bossburg Area

Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714

713

25

712

Bear

Evans

Powell

SDU-5

Left Bank River Mile 711

711

Evans Campground Beach

SDU-6

710

SDU-7

Left Bank River Mile 710

709

Legend

- ★ Sites
- \+ Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see ICS detail figure)
- Railroads
- ▲ Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure A4. **Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations**

Upper Columbia River, WA

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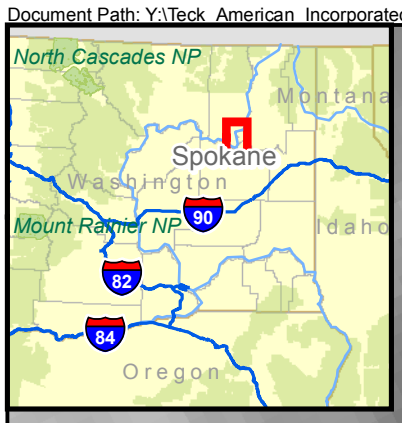


SDU-8
SDU-1
SDU-2
SDU-3
SDU-9
SDU-10
YAM Area
Young America Mill Site
UDU-5
Tailings Pond Outlet
(location uncertain)
716
715
Bossburg Area
UDU-1
UDU-2
UDU-3
UDU-4
UDU-6
F-1
F-2
Historic Ferry Site
Hackley Parcel
Ferry Landing Area

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30%
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

1 inch = 164 feet
1 inch = 50 meters

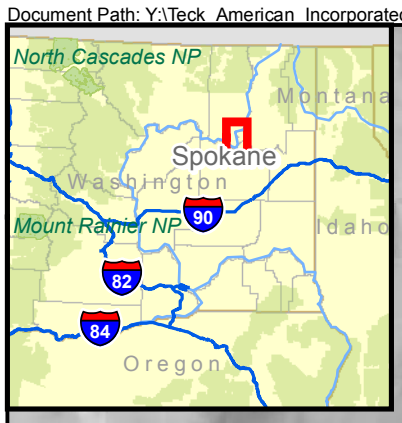
0 200 400 600 Feet
0 50 100 150 Meters

HDR

Figure A5. **Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations**

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d7_Bossburg-Beach_XRF_Decision Units_Cover.mxd



SDU-8
716
SDU-1
YAM Area
Tailings Pond Outlet
Young America Mill Site
SDU-2
UDU-5
Young America Mine Site
Hackley Parcel
SDU-9
F-1
SDU-3
UDU-6
F-2
Historic Ferry Site
UDU-1 - 4
Ferry Landing Area
SDU-10
715
SDU-4
Bossburg Area
Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714
713
25
Evans
Bear
712
Left Bank River Mile 711
SDU-5
Powell
711
Evans Campground Beach
SDU-6
710
SDU-7
Left Bank River Mile 710
709

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see XRF detail figure)
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

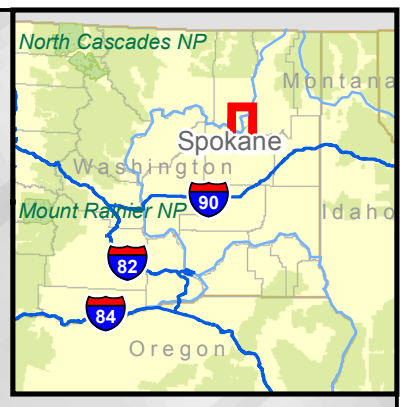
0 250 500 750 Meters

N

Figure A6. **Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations**

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d8_Bossburg-Beach_XRF_Decision Units_Boss.mxd



SDU-1
SDU-8
SDU-2
716
SDU-3
UDU-1
UDU-5
UDU-2
UDU-4
UDU-3
F-1
F-2
SDU-9
SDU-10
SDU-04
UDU-6
715

Young America Mill Site

Tailings Pond Outlet

Young America Mine Site

YAM Area

Bossburg Area

Bossburg Flat Beach

Historic Ferry Site

Ferry Landing Area

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30%
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

NOTE 1: In Upland (Soil) DU 5, XRF stations were located throughout the Sediment Decision Unit (DU), without limitation with respect to slope. If field conditions at a proposed location prove to be unsafe (e.g., slope > 30%), stations would be relocated in the field in consultation with EPA oversight staff.

NOTE 2: Cores will be collected from all soil and sediment sampling areas except Sediment DU 10.

HDR

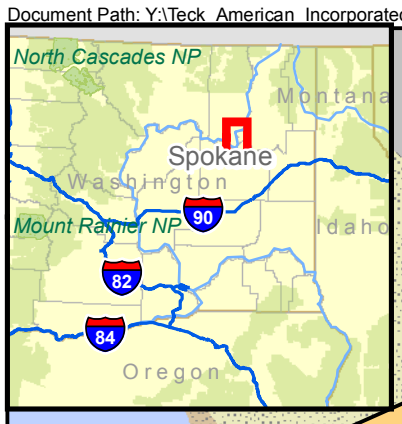
0 200 400 600 Feet

0 50 100 150 Meters

Figure A7. **Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations**

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d9_Bossburg-Beach_XRF_Decision Units_Evans.mxd



N

SDU-5

Powell

Left Bank
River Mile 711

Evans
Campground
Beach

SDU-6

711

710

1 inch = 250 feet

1 inch = 76 meters

Evans
Campground
Beach

SDU-6

Evans
Campground
Beach

SDU-7

Left Bank
River Mile 710

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

HDR

0 350 700 1,050 Feet

0 100 200 300 Meters

N

Figure A8. **Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations**

Upper Columbia River, WA

3 !+$S

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-01	423630.84	5401600.76	48.7627	-118.0392	Primary
SDU-01-02	423639.10	5401572.94	48.7625	-118.0391	Primary
SDU-01-03	423561.09	5401621.46	48.7629	-118.0401	Primary
SDU-01-04	423487.54	5401630.90	48.7630	-118.0411	Primary
SDU-01-05	423606.19	5401524.37	48.7620	-118.0395	Primary
SDU-01-06	423467.76	5401598.51	48.7627	-118.0414	Primary
SDU-01-07	423546.63	5401564.98	48.7624	-118.0403	Primary
SDU-01-08	423470.32	5401675.20	48.7634	-118.0414	Primary
SDU-01-09	423483.19	5401602.38	48.7627	-118.0412	Primary
SDU-01-10	423618.44	5401607.41	48.7628	-118.0394	Primary
SDU-01-11	423578.57	5401478.54	48.7616	-118.0399	Primary
SDU-01-12	423591.34	5401567.34	48.7624	-118.0397	Primary
SDU-01-13	423500.83	5401536.39	48.7621	-118.0410	Primary
SDU-01-14	423446.28	5401580.60	48.7625	-118.0417	Primary
SDU-01-15	423497.63	5401547.32	48.7622	-118.0410	Primary
SDU-01-16	423546.64	5401622.76	48.7629	-118.0403	Primary
SDU-01-17	423474.37	5401652.35	48.7632	-118.0413	Primary
SDU-01-18	423554.86	5401525.29	48.7620	-118.0402	Primary
SDU-01-19	423574.63	5401659.35	48.7632	-118.0400	Primary
SDU-01-20	423539.40	5401588.88	48.7626	-118.0404	Primary
SDU-01-21	423504.09	5401608.43	48.7628	-118.0409	Primary
SDU-01-22	423556.23	5401551.04	48.7623	-118.0402	Primary
SDU-01-23	423547.92	5401690.13	48.7635	-118.0403	Primary
SDU-01-24	423588.63	5401546.53	48.7622	-118.0398	Primary
SDU-01-25	423563.43	5401574.67	48.7625	-118.0401	Primary
SDU-01-26	423483.66	5401615.73	48.7628	-118.0412	Primary
SDU-01-27	423592.55	5401520.85	48.7620	-118.0397	Primary
SDU-01-28	423529.44	5401541.81	48.7622	-118.0406	Primary
SDU-01-29	423577.03	5401458.95	48.7614	-118.0399	Primary
SDU-01-30	423450.75	5401658.18	48.7632	-118.0417	Primary
SDU-01-R01	423544.63	5401479.69	48.7616	-118.0403	Reserve
SDU-01-R02	423608.25	5401595.82	48.7627	-118.0395	Reserve
SDU-01-R03	423620.19	5401632.54	48.7630	-118.0393	Reserve
SDU-01-R04	423497.83	5401690.92	48.7635	-118.0410	Reserve
SDU-01-R05	423520.31	5401721.62	48.7638	-118.0407	Reserve
SDU-01-R06	423563.06	5401500.20	48.7618	-118.0401	Reserve
Sediment Decision Unit 2					
SDU-02A-01	423365.94	5401507.17	48.7619	-118.0428	Primary
SDU-02A-02	423475.31	5401421.06	48.7611	-118.0413	Primary
SDU-02A-03	423440.99	5401312.01	48.7601	-118.0417	Primary
SDU-02A-04	423329.14	5401424.80	48.7611	-118.0433	Primary
SDU-02A-05	423413.96	5401404.55	48.7609	-118.0421	Primary
SDU-02A-06	423457.30	5401408.51	48.7610	-118.0415	Primary
SDU-02A-07	423306.22	5401432.62	48.7612	-118.0436	Primary
SDU-02A-08	423319.02	5401437.62	48.7612	-118.0434	Primary
SDU-02A-09	423363.13	5401531.17	48.7621	-118.0428	Primary
SDU-02A-10	423325.42	5401502.85	48.7618	-118.0433	Primary
SDU-02A-11	423355.87	5401381.48	48.7607	-118.0429	Primary
SDU-02A-12	423439.20	5401459.26	48.7614	-118.0418	Primary
SDU-02A-13	423357.78	5401431.33	48.7612	-118.0429	Primary
SDU-02A-14	423299.76	5401506.93	48.7618	-118.0437	Primary
SDU-02A-15	423282.13	5401438.13	48.7612	-118.0439	Primary
SDU-02A-16	423371.31	5401377.48	48.7607	-118.0427	Primary
SDU-02A-17	423369.97	5401426.20	48.7611	-118.0427	Primary
SDU-02A-18	423461.29	5401323.65	48.7602	-118.0414	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02A-19	423331.38	5401445.01	48.7613	-118.0432	Primary
SDU-02A-20	423325.13	5401475.38	48.7616	-118.0433	Primary
SDU-02A-21	423524.50	5401394.79	48.7609	-118.0406	Primary
SDU-02A-22	423376.85	5401528.78	48.7620	-118.0426	Primary
SDU-02A-23	423445.76	5401480.31	48.7616	-118.0417	Primary
SDU-02A-24	423311.87	5401476.04	48.7616	-118.0435	Primary
SDU-02A-25	423304.27	5401486.04	48.7617	-118.0436	Primary
SDU-02A-26	423459.10	5401368.29	48.7606	-118.0415	Primary
SDU-02A-27	423423.30	5401421.21	48.7611	-118.0420	Primary
SDU-02A-28	423377.53	5401505.95	48.7618	-118.0426	Primary
SDU-02A-29	423448.50	5401285.48	48.7599	-118.0416	Primary
SDU-02A-30	423359.02	5401571.04	48.7624	-118.0429	Primary
SDU-02B-01	423323.59	5401524.36	48.7620	-118.0434	Primary
SDU-02B-02	423413.07	5401381.78	48.7607	-118.0421	Primary
SDU-02B-03	423439.73	5401460.96	48.7614	-118.0418	Primary
SDU-02B-04	423413.88	5401430.31	48.7612	-118.0421	Primary
SDU-02B-05	423456.45	5401393.37	48.7608	-118.0415	Primary
SDU-02B-06	423466.72	5401430.14	48.7612	-118.0414	Primary
SDU-02B-07	423347.04	5401550.69	48.7622	-118.0430	Primary
SDU-02B-08	423374.44	5401419.78	48.7611	-118.0426	Primary
SDU-02B-09	423386.57	5401403.06	48.7609	-118.0425	Primary
SDU-02B-10	423353.11	5401440.82	48.7613	-118.0429	Primary
SDU-02B-11	423357.31	5401352.98	48.7605	-118.0429	Primary
SDU-02B-12	423362.70	5401521.73	48.7620	-118.0428	Primary
SDU-02B-13	423394.21	5401419.01	48.7611	-118.0424	Primary
SDU-02B-14	423396.68	5401453.70	48.7614	-118.0424	Primary
SDU-02B-15	423450.07	5401358.94	48.7605	-118.0416	Primary
SDU-02B-16	423337.37	5401373.60	48.7606	-118.0431	Primary
SDU-02B-17	423380.44	5401449.89	48.7613	-118.0426	Primary
SDU-02B-18	423457.99	5401377.57	48.7607	-118.0415	Primary
SDU-02B-19	423462.29	5401418.77	48.7611	-118.0415	Primary
SDU-02B-20	423382.92	5401364.71	48.7606	-118.0425	Primary
SDU-02B-21	423413.29	5401367.63	48.7606	-118.0421	Primary
SDU-02B-22	423344.28	5401361.70	48.7605	-118.0430	Primary
SDU-02B-23	423422.26	5401514.36	48.7619	-118.0420	Primary
SDU-02B-24	423281.10	5401417.25	48.7610	-118.0439	Primary
SDU-02B-25	423369.61	5401562.31	48.7624	-118.0427	Primary
SDU-02B-26	423331.75	5401451.68	48.7614	-118.0432	Primary
SDU-02B-27	423423.41	5401395.22	48.7609	-118.0420	Primary
SDU-02B-28	423425.99	5401353.00	48.7605	-118.0419	Primary
SDU-02B-29	423306.62	5401407.49	48.7609	-118.0436	Primary
SDU-02B-30	423497.47	5401354.65	48.7605	-118.0410	Primary
SDU-02C-01	423496.55	5401381.42	48.7607	-118.0410	Primary
SDU-02C-02	423437.23	5401489.51	48.7617	-118.0418	Primary
SDU-02C-03	423408.38	5401337.72	48.7603	-118.0422	Primary
SDU-02C-04	423426.25	5401301.17	48.7600	-118.0419	Primary
SDU-02C-05	423473.39	5401444.37	48.7613	-118.0413	Primary
SDU-02C-06	423279.65	5401482.77	48.7616	-118.0440	Primary
SDU-02C-07	423343.15	5401404.70	48.7609	-118.0431	Primary
SDU-02C-08	423406.67	5401497.62	48.7618	-118.0422	Primary
SDU-02C-09	423358.81	5401463.19	48.7615	-118.0429	Primary
SDU-02C-10	423398.72	5401528.36	48.7620	-118.0423	Primary
SDU-02C-11	423362.77	5401481.91	48.7616	-118.0428	Primary
SDU-02C-12	423386.12	5401505.30	48.7618	-118.0425	Primary
SDU-02C-13	423380.70	5401380.75	48.7607	-118.0426	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02C-14	423397.73	5401391.88	48.7608	-118.0423	Primary
SDU-02C-15	423429.17	5401362.27	48.7606	-118.0419	Primary
SDU-02C-16	423463.59	5401464.10	48.7615	-118.0414	Primary
SDU-02C-17	423409.76	5401478.77	48.7616	-118.0422	Primary
SDU-02C-18	423445.55	5401465.20	48.7615	-118.0417	Primary
SDU-02C-19	423514.50	5401376.57	48.7607	-118.0407	Primary
SDU-02C-20	423391.13	5401347.70	48.7604	-118.0424	Primary
SDU-02C-21	423516.19	5401396.67	48.7609	-118.0407	Primary
SDU-02C-22	423375.89	5401518.96	48.7620	-118.0426	Primary
SDU-02C-23	423290.97	5401500.76	48.7618	-118.0438	Primary
SDU-02C-24	423327.71	5401534.89	48.7621	-118.0433	Primary
SDU-02C-25	423274.81	5401428.67	48.7611	-118.0440	Primary
SDU-02C-26	423345.92	5401390.29	48.7608	-118.0430	Primary
SDU-02C-27	423471.62	5401356.39	48.7605	-118.0413	Primary
SDU-02C-28	423485.43	5401413.10	48.7610	-118.0411	Primary
SDU-02C-29	423453.30	5401373.60	48.7607	-118.0416	Primary
SDU-02C-30	423425.35	5401335.23	48.7603	-118.0419	Primary
SDU-02A-R01	423374.93	5401429.92	48.7612	-118.0426	Reserve
SDU-02A-R02	423486.85	5401335.36	48.7603	-118.0411	Reserve
SDU-02A-R03	423476.84	5401346.80	48.7604	-118.0412	Reserve
SDU-02A-R04	423503.11	5401380.10	48.7607	-118.0409	Reserve
SDU-02A-R05	423424.54	5401316.00	48.7601	-118.0419	Reserve
SDU-02A-R06	423397.51	5401464.10	48.7615	-118.0423	Reserve
SDU-02B-R01	423496.79	5401362.83	48.7606	-118.0410	Reserve
SDU-02B-R02	423406.71	5401433.83	48.7612	-118.0422	Reserve
SDU-02B-R03	423408.76	5401364.48	48.7606	-118.0422	Reserve
SDU-02B-R04	423484.81	5401381.81	48.7607	-118.0411	Reserve
SDU-02B-R05	423374.79	5401420.33	48.7611	-118.0426	Reserve
SDU-02B-R06	423318.66	5401424.85	48.7611	-118.0434	Reserve
SDU-02C-R01	423438.64	5401417.08	48.7611	-118.0418	Reserve
SDU-02C-R02	423497.63	5401423.54	48.7611	-118.0410	Reserve
SDU-02C-R03	423341.29	5401564.27	48.7624	-118.0431	Reserve
SDU-02C-R04	423374.17	5401370.09	48.7606	-118.0426	Reserve
SDU-02C-R05	423438.02	5401318.49	48.7602	-118.0418	Reserve
SDU-02C-R06	423443.37	5401298.27	48.7600	-118.0417	Reserve
Sediment Decision Unit 3					
SDU-03A-01	423075.43	5401081.95	48.7580	-118.0467	Primary
SDU-03A-02	423046.12	5401075.30	48.7579	-118.0471	Primary
SDU-03A-03	422893.02	5400942.44	48.7567	-118.0491	Primary
SDU-03A-04	422977.57	5401017.64	48.7574	-118.0480	Primary
SDU-03A-05	422953.98	5400993.74	48.7572	-118.0483	Primary
SDU-03A-06	423083.50	5401091.50	48.7581	-118.0465	Primary
SDU-03A-07	422881.53	5400934.65	48.7566	-118.0493	Primary
SDU-03A-08	422965.42	5401004.46	48.7573	-118.0481	Primary
SDU-03A-09	422930.98	5400977.64	48.7570	-118.0486	Primary
SDU-03A-10	422948.57	5400993.52	48.7572	-118.0484	Primary
SDU-03A-11	422960.74	5401013.46	48.7574	-118.0482	Primary
SDU-03A-12	422938.71	5400982.31	48.7571	-118.0485	Primary
SDU-03A-13	423025.31	5401056.61	48.7578	-118.0473	Primary
SDU-03A-14	422886.41	5400944.45	48.7567	-118.0492	Primary
SDU-03A-15	423025.66	5401050.24	48.7577	-118.0473	Primary
SDU-03A-16	422911.29	5400957.94	48.7569	-118.0489	Primary
SDU-03A-17	422925.42	5400985.25	48.7571	-118.0487	Primary
SDU-03A-18	422902.56	5400957.13	48.7568	-118.0490	Primary
SDU-03A-19	422984.99	5401015.02	48.7574	-118.0479	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03A-20	423001.20	5401035.84	48.7576	-118.0477	Primary
SDU-03A-21	422889.97	5400951.48	48.7568	-118.0492	Primary
SDU-03A-22	422927.40	5400971.82	48.7570	-118.0486	Primary
SDU-03A-23	423078.13	5401090.09	48.7581	-118.0466	Primary
SDU-03A-24	422876.63	5400940.09	48.7567	-118.0493	Primary
SDU-03A-25	423070.75	5401093.52	48.7581	-118.0467	Primary
SDU-03A-26	423067.38	5401085.69	48.7580	-118.0468	Primary
SDU-03A-27	423001.95	5401028.31	48.7575	-118.0476	Primary
SDU-03A-28	422990.07	5401023.10	48.7575	-118.0478	Primary
SDU-03A-29	423091.79	5401096.58	48.7581	-118.0464	Primary
SDU-03A-30	423036.86	5401056.28	48.7578	-118.0472	Primary
SDU-03B-01	422980.84	5401019.31	48.7574	-118.0479	Primary
SDU-03B-02	422986.69	5401023.93	48.7575	-118.0479	Primary
SDU-03B-03	423021.41	5401046.16	48.7577	-118.0474	Primary
SDU-03B-04	423028.20	5401060.50	48.7578	-118.0473	Primary
SDU-03B-05	423010.08	5401036.69	48.7576	-118.0475	Primary
SDU-03B-06	423044.95	5401075.95	48.7579	-118.0471	Primary
SDU-03B-07	422892.87	5400942.88	48.7567	-118.0491	Primary
SDU-03B-08	422920.20	5400964.51	48.7569	-118.0487	Primary
SDU-03B-09	423022.73	5401051.03	48.7577	-118.0474	Primary
SDU-03B-10	422875.01	5400940.13	48.7567	-118.0494	Primary
SDU-03B-11	423033.15	5401055.81	48.7578	-118.0472	Primary
SDU-03B-12	423040.98	5401066.34	48.7578	-118.0471	Primary
SDU-03B-13	423036.73	5401059.31	48.7578	-118.0472	Primary
SDU-03B-14	422934.26	5400982.52	48.7571	-118.0486	Primary
SDU-03B-15	422963.54	5401012.84	48.7574	-118.0482	Primary
SDU-03B-16	422921.44	5400975.30	48.7570	-118.0487	Primary
SDU-03B-17	422895.74	5400952.35	48.7568	-118.0491	Primary
SDU-03B-18	423049.97	5401077.13	48.7579	-118.0470	Primary
SDU-03B-19	422939.29	5400979.13	48.7571	-118.0485	Primary
SDU-03B-20	423085.85	5401098.64	48.7581	-118.0465	Primary
SDU-03B-21	422904.97	5400959.70	48.7569	-118.0490	Primary
SDU-03B-22	423013.70	5401048.80	48.7577	-118.0475	Primary
SDU-03B-23	422960.67	5401006.12	48.7573	-118.0482	Primary
SDU-03B-24	422993.20	5401021.39	48.7574	-118.0478	Primary
SDU-03B-25	423084.30	5401089.64	48.7581	-118.0465	Primary
SDU-03B-26	422926.24	5400982.51	48.7571	-118.0487	Primary
SDU-03B-27	422967.08	5401001.65	48.7573	-118.0481	Primary
SDU-03B-28	422898.58	5400958.01	48.7569	-118.0490	Primary
SDU-03B-29	422976.05	5401012.38	48.7574	-118.0480	Primary
SDU-03B-30	422948.63	5400999.49	48.7572	-118.0484	Primary
SDU-03C-01	423036.26	5401060.71	48.7578	-118.0472	Primary
SDU-03C-02	422986.55	5401024.92	48.7575	-118.0479	Primary
SDU-03C-03	422972.23	5401015.58	48.7574	-118.0480	Primary
SDU-03C-04	423036.74	5401066.10	48.7578	-118.0472	Primary
SDU-03C-05	422885.36	5400945.57	48.7567	-118.0492	Primary
SDU-03C-06	423019.90	5401042.05	48.7576	-118.0474	Primary
SDU-03C-07	423067.91	5401079.04	48.7580	-118.0468	Primary
SDU-03C-08	423008.31	5401036.05	48.7576	-118.0476	Primary
SDU-03C-09	423050.36	5401069.60	48.7579	-118.0470	Primary
SDU-03C-10	423087.50	5401096.02	48.7581	-118.0465	Primary
SDU-03C-11	422949.80	5400997.88	48.7572	-118.0483	Primary
SDU-03C-12	422924.52	5400976.81	48.7570	-118.0487	Primary
SDU-03C-13	423050.22	5401075.12	48.7579	-118.0470	Primary
SDU-03C-14	422954.65	5401009.87	48.7573	-118.0483	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03C-15	423010.72	5401042.77	48.7576	-118.0475	Primary
SDU-03C-16	423023.40	5401056.87	48.7578	-118.0474	Primary
SDU-03C-17	423063.68	5401084.22	48.7580	-118.0468	Primary
SDU-03C-18	422899.61	5400958.32	48.7569	-118.0490	Primary
SDU-03C-19	422957.60	5401001.92	48.7573	-118.0482	Primary
SDU-03C-20	423078.03	5401099.88	48.7582	-118.0466	Primary
SDU-03C-21	422906.54	5400959.69	48.7569	-118.0489	Primary
SDU-03C-22	423079.92	5401093.28	48.7581	-118.0466	Primary
SDU-03C-23	422978.65	5401010.81	48.7573	-118.0480	Primary
SDU-03C-24	422917.15	5400964.56	48.7569	-118.0488	Primary
SDU-03C-25	423070.91	5401086.41	48.7580	-118.0467	Primary
SDU-03C-26	422935.28	5400985.60	48.7571	-118.0485	Primary
SDU-03C-27	422887.12	5400939.38	48.7567	-118.0492	Primary
SDU-03C-28	423055.82	5401077.23	48.7579	-118.0469	Primary
SDU-03C-29	423031.02	5401063.65	48.7578	-118.0473	Primary
SDU-03C-30	422962.43	5401012.22	48.7574	-118.0482	Primary
SDU-03A-R01	423003.03	5401040.73	48.7576	-118.0476	Reserve
SDU-03A-R02	422978.85	5401022.65	48.7574	-118.0480	Reserve
SDU-03A-R03	423035.59	5401059.68	48.7578	-118.0472	Reserve
SDU-03A-R04	422889.18	5400947.17	48.7568	-118.0492	Reserve
SDU-03A-R05	422916.93	5400972.62	48.7570	-118.0488	Reserve
SDU-03A-R06	422987.08	5401027.19	48.7575	-118.0478	Reserve
SDU-03B-R01	422962.46	5401001.83	48.7573	-118.0482	Reserve
SDU-03B-R02	422994.03	5401028.52	48.7575	-118.0478	Reserve
SDU-03B-R03	423072.83	5401083.40	48.7580	-118.0467	Reserve
SDU-03B-R04	422896.05	5400947.54	48.7568	-118.0491	Reserve
SDU-03B-R05	422936.79	5400975.25	48.7570	-118.0485	Reserve
SDU-03B-R06	423062.05	5401082.13	48.7580	-118.0468	Reserve
SDU-03C-R01	422896.00	5400951.21	48.7568	-118.0491	Reserve
SDU-03C-R02	423048.80	5401077.52	48.7580	-118.0470	Reserve
SDU-03C-R03	422907.49	5400955.91	48.7568	-118.0489	Reserve
SDU-03C-R04	422954.83	5400996.30	48.7572	-118.0483	Reserve
SDU-03C-R05	422981.92	5401019.90	48.7574	-118.0479	Reserve
SDU-03C-R06	422958.40	5401003.23	48.7573	-118.0482	Reserve
Sediment Decision Unit 4					
SDU-04-01	422603.47	5400657.78	48.7541	-118.0530	Primary
SDU-04-02	422672.21	5400762.34	48.7551	-118.0521	Primary
SDU-04-03	422678.61	5400778.72	48.7552	-118.0520	Primary
SDU-04-04	422626.54	5400658.95	48.7541	-118.0527	Primary
SDU-04-05	422630.71	5400680.62	48.7543	-118.0526	Primary
SDU-04-06	422620.95	5400688.83	48.7544	-118.0528	Primary
SDU-04-07	422669.67	5400744.43	48.7549	-118.0521	Primary
SDU-04-08	422609.61	5400644.67	48.7540	-118.0529	Primary
SDU-04-09	422658.77	5400732.51	48.7548	-118.0523	Primary
SDU-04-10	422656.04	5400748.44	48.7549	-118.0523	Primary
SDU-04-11	422679.08	5400749.70	48.7550	-118.0520	Primary
SDU-04-12	422682.58	5400762.14	48.7551	-118.0519	Primary
SDU-04-13	422652.93	5400723.17	48.7547	-118.0523	Primary
SDU-04-14	422639.31	5400711.80	48.7546	-118.0525	Primary
SDU-04-15	422596.57	5400622.09	48.7538	-118.0531	Primary
SDU-04-16	422616.68	5400628.55	48.7539	-118.0528	Primary
SDU-04-17	422632.22	5400700.46	48.7545	-118.0526	Primary
SDU-04-18	422615.51	5400613.02	48.7537	-118.0528	Primary
SDU-04-19	422617.81	5400676.91	48.7543	-118.0528	Primary
SDU-04-20	422608.85	5400682.01	48.7543	-118.0529	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 4 (continued)					
SDU-04-21	422641.10	5400689.90	48.7544	-118.0525	Primary
SDU-04-22	422668.91	5400730.41	48.7548	-118.0521	Primary
SDU-04-23	422585.81	5400626.22	48.7538	-118.0532	Primary
SDU-04-24	422696.57	5400771.48	48.7552	-118.0517	Primary
SDU-04-25	422606.88	5400670.63	48.7542	-118.0530	Primary
SDU-04-26	422590.00	5400640.17	48.7540	-118.0532	Primary
SDU-04-27	422619.44	5400651.33	48.7541	-118.0528	Primary
SDU-04-28	422595.71	5400650.41	48.7541	-118.0531	Primary
SDU-04-29	422607.79	5400622.30	48.7538	-118.0529	Primary
SDU-04-30	422618.06	5400666.60	48.7542	-118.0528	Primary
SDU-04-R01	422631.97	5400705.38	48.7546	-118.0526	Reserve
SDU-04-R02	422680.35	5400762.15	48.7551	-118.0520	Reserve
SDU-04-R03	422684.79	5400788.72	48.7553	-118.0519	Reserve
SDU-04-R04	422595.15	5400640.26	48.7540	-118.0531	Reserve
SDU-04-R05	422600.39	5400652.06	48.7541	-118.0530	Reserve
SDU-04-R06	422609.92	5400643.39	48.7540	-118.0529	Reserve
Sediment Decision Unit 5					
SDU-05-01	424472.26	5395156.32	48.7049	-118.0266	Primary
SDU-05-02	424399.92	5395020.87	48.7036	-118.0275	Primary
SDU-05-03	424464.46	5395247.37	48.7057	-118.0267	Primary
SDU-05-04	424423.78	5394887.57	48.7024	-118.0272	Primary
SDU-05-05	424366.56	5395269.89	48.7059	-118.0280	Primary
SDU-05-06	424405.11	5395202.62	48.7053	-118.0275	Primary
SDU-05-07	424749.82	5395036.86	48.7038	-118.0228	Primary
SDU-05-08	424647.43	5395143.85	48.7048	-118.0242	Primary
SDU-05-09	424415.33	5395097.09	48.7043	-118.0273	Primary
SDU-05-10	424335.38	5395243.99	48.7056	-118.0284	Primary
SDU-05-11	424501.84	5395031.62	48.7037	-118.0261	Primary
SDU-05-12	424386.76	5395194.71	48.7052	-118.0277	Primary
SDU-05-13	424449.75	5395051.43	48.7039	-118.0269	Primary
SDU-05-14	424420.63	5395085.72	48.7042	-118.0273	Primary
SDU-05-15	424621.07	5395155.26	48.7049	-118.0245	Primary
SDU-05-16	424308.62	5395258.43	48.7058	-118.0288	Primary
SDU-05-17	424339.88	5395210.75	48.7053	-118.0284	Primary
SDU-05-18	424700.88	5395037.45	48.7038	-118.0234	Primary
SDU-05-19	424508.57	5395400.73	48.7071	-118.0261	Primary
SDU-05-20	424326.13	5395031.86	48.7037	-118.0285	Primary
SDU-05-21	424485.03	5395041.34	48.7038	-118.0264	Primary
SDU-05-22	424414.23	5394867.40	48.7023	-118.0273	Primary
SDU-05-23	424408.72	5395150.39	48.7048	-118.0274	Primary
SDU-05-24	424636.47	5395017.45	48.7036	-118.0243	Primary
SDU-05-25	424443.82	5395267.29	48.7059	-118.0270	Primary
SDU-05-26	424441.21	5394892.32	48.7025	-118.0269	Primary
SDU-05-27	424469.89	5395323.25	48.7064	-118.0266	Primary
SDU-05-28	424563.41	5394993.91	48.7034	-118.0253	Primary
SDU-05-29	424541.10	5394951.78	48.7030	-118.0256	Primary
SDU-05-30	424244.37	5395132.02	48.7046	-118.0297	Primary
SDU-05-R01	424362.83	5395131.72	48.7046	-118.0280	Reserve
SDU-05-R02	424569.42	5395348.39	48.7066	-118.0253	Reserve
SDU-05-R03	424293.31	5395212.92	48.7054	-118.0290	Reserve
SDU-05-R04	424699.09	5395181.36	48.7051	-118.0235	Reserve
SDU-05-R05	424717.13	5395166.72	48.7050	-118.0232	Reserve
SDU-05-R06	424431.62	5395109.47	48.7044	-118.0271	Reserve

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6					
SDU-06A-01	425237.10	5393946.60	48.6941	-118.0160	Primary
SDU-06A-02	425260.79	5393962.50	48.6942	-118.0156	Primary
SDU-06A-03	425306.90	5393826.09	48.6930	-118.0150	Primary
SDU-06A-04	425212.58	5394072.57	48.6952	-118.0163	Primary
SDU-06A-05	425302.20	5393747.94	48.6923	-118.0150	Primary
SDU-06A-06	425241.84	5393997.48	48.6945	-118.0159	Primary
SDU-06A-07	425240.79	5394049.61	48.6950	-118.0159	Primary
SDU-06A-08	425301.44	5393654.36	48.6915	-118.0150	Primary
SDU-06A-09	425235.94	5394038.05	48.6949	-118.0160	Primary
SDU-06A-10	425308.23	5393728.40	48.6921	-118.0149	Primary
SDU-06A-11	425155.57	5394142.98	48.6958	-118.0171	Primary
SDU-06A-12	425241.44	5393964.60	48.6942	-118.0159	Primary
SDU-06A-13	425285.11	5393850.98	48.6932	-118.0153	Primary
SDU-06A-14	425254.96	5393984.99	48.6944	-118.0157	Primary
SDU-06A-15	425304.43	5393763.16	48.6924	-118.0150	Primary
SDU-06A-16	425265.24	5393952.89	48.6941	-118.0156	Primary
SDU-06A-17	425285.91	5393728.64	48.6921	-118.0153	Primary
SDU-06A-18	425227.67	5394008.93	48.6946	-118.0161	Primary
SDU-06A-19	425260.46	5393887.43	48.6935	-118.0156	Primary
SDU-06A-20	425219.56	5394025.89	48.6948	-118.0162	Primary
SDU-06A-21	425164.40	5394137.83	48.6958	-118.0170	Primary
SDU-06A-22	425314.92	5393749.94	48.6923	-118.0149	Primary
SDU-06A-23	425282.19	5393883.95	48.6935	-118.0153	Primary
SDU-06A-24	425298.79	5393737.84	48.6922	-118.0151	Primary
SDU-06A-25	425140.07	5394162.97	48.6960	-118.0173	Primary
SDU-06A-26	425283.25	5393830.25	48.6930	-118.0153	Primary
SDU-06A-27	425190.68	5394114.67	48.6956	-118.0166	Primary
SDU-06A-28	425230.13	5394052.57	48.6950	-118.0161	Primary
SDU-06A-29	425302.40	5393816.28	48.6929	-118.0150	Primary
SDU-06A-30	425314.38	5393791.67	48.6927	-118.0149	Primary
SDU-06B-01	425304.62	5393706.64	48.6919	-118.0150	Primary
SDU-06B-02	425268.86	5393883.04	48.6935	-118.0155	Primary
SDU-06B-03	425303.49	5393734.42	48.6922	-118.0150	Primary
SDU-06B-04	425129.61	5394178.10	48.6961	-118.0175	Primary
SDU-06B-05	425299.29	5393658.80	48.6915	-118.0151	Primary
SDU-06B-06	425233.42	5394055.71	48.6951	-118.0160	Primary
SDU-06B-07	425283.67	5393741.30	48.6922	-118.0153	Primary
SDU-06B-08	425280.23	5393697.19	48.6918	-118.0153	Primary
SDU-06B-09	425189.41	5394112.80	48.6956	-118.0166	Primary
SDU-06B-10	425281.00	5393877.57	48.6935	-118.0153	Primary
SDU-06B-11	425247.28	5393905.12	48.6937	-118.0158	Primary
SDU-06B-12	425146.94	5394155.76	48.6959	-118.0172	Primary
SDU-06B-13	425233.43	5394008.61	48.6946	-118.0160	Primary
SDU-06B-14	425307.64	5393819.14	48.6929	-118.0150	Primary
SDU-06B-15	425278.77	5393850.64	48.6932	-118.0154	Primary
SDU-06B-16	425306.09	5393746.44	48.6923	-118.0150	Primary
SDU-06B-17	425119.17	5394180.12	48.6962	-118.0176	Primary
SDU-06B-18	425248.74	5393997.16	48.6945	-118.0158	Primary
SDU-06B-19	425257.04	5394003.81	48.6946	-118.0157	Primary
SDU-06B-20	425208.21	5394095.44	48.6954	-118.0164	Primary
SDU-06B-21	425128.37	5394167.15	48.6960	-118.0175	Primary
SDU-06B-22	425205.78	5394080.26	48.6953	-118.0164	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6 (continued)					
SDU-06B-23	425264.51	5393902.69	48.6937	-118.0156	Primary
SDU-06B-24	425181.28	5394119.78	48.6956	-118.0167	Primary
SDU-06B-25	425177.10	5394109.13	48.6955	-118.0168	Primary
SDU-06B-26	425242.88	5394049.36	48.6950	-118.0159	Primary
SDU-06B-27	425291.01	5393687.28	48.6918	-118.0152	Primary
SDU-06B-28	425232.92	5394036.92	48.6949	-118.0160	Primary
SDU-06B-29	425250.89	5393972.82	48.6943	-118.0158	Primary
SDU-06B-30	425296.41	5393674.08	48.6916	-118.0151	Primary
SDU-06C-01	425179.08	5394130.63	48.6957	-118.0168	Primary
SDU-06C-02	425248.90	5393985.52	48.6944	-118.0158	Primary
SDU-06C-03	425222.01	5394019.88	48.6947	-118.0162	Primary
SDU-06C-04	425298.36	5393857.65	48.6933	-118.0151	Primary
SDU-06C-05	425305.17	5393823.03	48.6930	-118.0150	Primary
SDU-06C-06	425284.21	5393859.37	48.6933	-118.0153	Primary
SDU-06C-07	425308.08	5393770.28	48.6925	-118.0150	Primary
SDU-06C-08	425200.47	5394087.32	48.6953	-118.0165	Primary
SDU-06C-09	425286.97	5393834.38	48.6931	-118.0153	Primary
SDU-06C-10	425236.99	5393923.04	48.6939	-118.0160	Primary
SDU-06C-11	425238.97	5394048.14	48.6950	-118.0159	Primary
SDU-06C-12	425271.97	5393861.58	48.6933	-118.0155	Primary
SDU-06C-13	425257.58	5393912.89	48.6938	-118.0157	Primary
SDU-06C-14	425300.88	5393758.94	48.6924	-118.0151	Primary
SDU-06C-15	425245.67	5393960.28	48.6942	-118.0158	Primary
SDU-06C-16	425226.60	5394048.28	48.6950	-118.0161	Primary
SDU-06C-17	425296.62	5393694.12	48.6918	-118.0151	Primary
SDU-06C-18	425132.36	5394167.39	48.6961	-118.0174	Primary
SDU-06C-19	425254.84	5393938.91	48.6940	-118.0157	Primary
SDU-06C-20	425316.94	5393778.98	48.6926	-118.0148	Primary
SDU-06C-21	425285.57	5393684.21	48.6917	-118.0152	Primary
SDU-06C-22	425144.99	5394157.40	48.6960	-118.0172	Primary
SDU-06C-23	425240.17	5393972.44	48.6943	-118.0159	Primary
SDU-06C-24	425302.51	5393680.03	48.6917	-118.0150	Primary
SDU-06C-25	425270.69	5393904.41	48.6937	-118.0155	Primary
SDU-06C-26	425221.76	5394067.60	48.6952	-118.0162	Primary
SDU-06C-27	425281.64	5393716.23	48.6920	-118.0153	Primary
SDU-06C-28	425247.81	5393907.84	48.6937	-118.0158	Primary
SDU-06C-29	425260.74	5393901.19	48.6937	-118.0156	Primary
SDU-06C-30	425304.38	5393669.32	48.6916	-118.0150	Primary
SDU-06A-R01	425297.78	5393780.57	48.6926	-118.0151	Reserve
SDU-06A-R02	425287.93	5393841.90	48.6931	-118.0152	Reserve
SDU-06A-R03	425231.23	5393992.52	48.6945	-118.0160	Reserve
SDU-06A-R04	425222.32	5394046.74	48.6950	-118.0162	Reserve
SDU-06A-R05	425241.90	5394041.02	48.6949	-118.0159	Reserve
SDU-06A-R06	425261.90	5393897.51	48.6936	-118.0156	Reserve
SDU-06B-R01	425231.53	5394017.61	48.6947	-118.0160	Reserve
SDU-06B-R02	425253.58	5393908.84	48.6937	-118.0157	Reserve
SDU-06B-R03	425239.13	5393930.63	48.6939	-118.0159	Reserve
SDU-06B-R04	425296.03	5393776.17	48.6926	-118.0151	Reserve
SDU-06B-R05	425286.98	5393715.15	48.6920	-118.0152	Reserve
SDU-06B-R06	425253.86	5393989.99	48.6945	-118.0157	Reserve
SDU-06C-R01	425130.93	5394169.67	48.6961	-118.0174	Reserve
SDU-06C-R02	425244.17	5393926.48	48.6939	-118.0159	Reserve

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6 (continued)					
SDU-06C-R03	425221.45	5394018.80	48.6947	-118.0162	Reserve
SDU-06C-R04	425286.78	5393869.34	48.6934	-118.0153	Reserve
SDU-06C-R05	425278.37	5393893.31	48.6936	-118.0154	Reserve
SDU-06C-R06	425305.67	5393775.93	48.6925	-118.0150	Reserve
Sediment Decision Unit 7					
SDU-07-01	425077.64	5392770.80	48.6835	-118.0179	Primary
SDU-07-02	425210.03	5392999.75	48.6856	-118.0161	Primary
SDU-07-03	425030.99	5392686.86	48.6827	-118.0185	Primary
SDU-07-04	425181.35	5392975.27	48.6853	-118.0165	Primary
SDU-07-05	425236.70	5393072.85	48.6862	-118.0158	Primary
SDU-07-06	425164.23	5392836.20	48.6841	-118.0167	Primary
SDU-07-07	425202.40	5392890.15	48.6846	-118.0162	Primary
SDU-07-08	425264.42	5392991.46	48.6855	-118.0154	Primary
SDU-07-09	425284.81	5393065.24	48.6862	-118.0151	Primary
SDU-07-10	425164.80	5392929.98	48.6849	-118.0168	Primary
SDU-07-11	425088.97	5392862.42	48.6843	-118.0178	Primary
SDU-07-12	425087.51	5392605.44	48.6820	-118.0177	Primary
SDU-07-13	425209.07	5393035.23	48.6859	-118.0162	Primary
SDU-07-14	425034.15	5392787.04	48.6836	-118.0185	Primary
SDU-07-15	425178.39	5392894.00	48.6846	-118.0166	Primary
SDU-07-16	425114.58	5392712.44	48.6830	-118.0174	Primary
SDU-07-17	425086.99	5392660.43	48.6825	-118.0178	Primary
SDU-07-18	425170.58	5392885.44	48.6845	-118.0167	Primary
SDU-07-19	425106.88	5392865.95	48.6843	-118.0175	Primary
SDU-07-20	424992.39	5392677.63	48.6826	-118.0190	Primary
SDU-07-21	425113.22	5392881.56	48.6845	-118.0174	Primary
SDU-07-22	425132.89	5392775.78	48.6835	-118.0172	Primary
SDU-07-23	425161.15	5392963.30	48.6852	-118.0168	Primary
SDU-07-24	425174.55	5392936.93	48.6850	-118.0166	Primary
SDU-07-25	425174.08	5392968.19	48.6853	-118.0166	Primary
SDU-07-26	425224.75	5392888.06	48.6846	-118.0159	Primary
SDU-07-27	425191.76	5392845.42	48.6842	-118.0164	Primary
SDU-07-28	424999.21	5392703.30	48.6829	-118.0190	Primary
SDU-07-29	425272.38	5393065.08	48.6862	-118.0153	Primary
SDU-07-30	425185.91	5393055.14	48.6861	-118.0165	Primary
SDU-07-R01	425196.60	5392975.83	48.6853	-118.0163	Reserve
SDU-07-R02	425172.43	5392993.92	48.6855	-118.0167	Reserve
SDU-07-R03	425227.45	5392964.95	48.6852	-118.0159	Reserve
SDU-07-R04	425196.50	5392781.77	48.6836	-118.0163	Reserve
SDU-07-R05	425062.81	5392712.29	48.6830	-118.0181	Reserve
SDU-07-R06	425026.79	5392713.56	48.6830	-118.0186	Reserve

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 8					
SDU-08-01	423137.23	5401825.68	48.7647	-118.0460	Primary
SDU-08-02	423122.43	5401770.43	48.7642	-118.0461	Primary
SDU-08-03	423096.57	5401801.20	48.7645	-118.0465	Primary
SDU-08-04	422964.72	5401616.42	48.7628	-118.0483	Primary
SDU-08-05	423181.79	5401905.36	48.7654	-118.0454	Primary
SDU-08-06	423175.50	5401868.59	48.7651	-118.0454	Primary
SDU-08-07	423021.23	5401655.32	48.7631	-118.0475	Primary
SDU-08-08	423083.58	5401787.43	48.7643	-118.0467	Primary
SDU-08-09	423038.21	5401677.32	48.7633	-118.0473	Primary
SDU-08-10	423004.77	5401681.57	48.7634	-118.0477	Primary
SDU-08-11	423051.14	5401715.43	48.7637	-118.0471	Primary
SDU-08-12	422961.54	5401635.13	48.7630	-118.0483	Primary
SDU-08-13	423093.90	5401742.45	48.7639	-118.0465	Primary
SDU-08-14	423072.56	5401725.41	48.7638	-118.0468	Primary
SDU-08-15	423220.95	5401956.02	48.7659	-118.0448	Primary
SDU-08-16	423204.67	5401900.27	48.7654	-118.0450	Primary
SDU-08-17	423202.82	5401851.71	48.7649	-118.0451	Primary
SDU-08-18	423184.71	5401844.72	48.7649	-118.0453	Primary
SDU-08-19	423082.90	5401771.82	48.7642	-118.0467	Primary
SDU-08-20	422985.97	5401651.68	48.7631	-118.0480	Primary
SDU-08-21	422998.70	5401666.89	48.7632	-118.0478	Primary
SDU-08-22	422983.81	5401633.63	48.7629	-118.0480	Primary
SDU-08-23	422995.59	5401639.76	48.7630	-118.0478	Primary
SDU-08-24	423064.95	5401770.25	48.7642	-118.0469	Primary
SDU-08-25	423187.20	5401832.73	48.7648	-118.0453	Primary
SDU-08-26	423126.09	5401823.44	48.7647	-118.0461	Primary
SDU-08-27	423009.37	5401655.00	48.7631	-118.0477	Primary
SDU-08-28	423082.57	5401745.40	48.7640	-118.0467	Primary
SDU-08-29	423149.46	5401809.79	48.7645	-118.0458	Primary
SDU-08-30	423021.35	5401666.76	48.7632	-118.0475	Primary
SDU-08-R01	422976.97	5401609.49	48.7627	-118.0481	Reserve
SDU-08-R02	423057.06	5401756.68	48.7641	-118.0470	Reserve
SDU-08-R03	423176.33	5401834.68	48.7648	-118.0454	Reserve
SDU-08-R04	423065.18	5401767.58	48.7642	-118.0469	Reserve
SDU-08-R05	423145.88	5401833.85	48.7648	-118.0458	Reserve
SDU-08-R06	422981.75	5401645.70	48.7631	-118.0480	Reserve
Sediment Decision Unit 9					
SDU-09A-01	422438.53	5401031.99	48.7575	-118.0550	Primary
SDU-09A-02	422435.61	5401082.55	48.7579	-118.0550	Primary
SDU-09A-03	422359.09	5400890.04	48.7562	-118.0560	Primary
SDU-09A-04	422459.44	5401040.60	48.7575	-118.0550	Primary
SDU-09A-05	422294.12	5400879.79	48.7561	-118.0570	Primary
SDU-09A-06	422360.19	5400968.44	48.7569	-118.0560	Primary
SDU-09A-07	422458.27	5401072.98	48.7578	-118.0550	Primary
SDU-09A-08	422409.52	5401039.95	48.7575	-118.0560	Primary
SDU-09A-09	422341.44	5400925.96	48.7565	-118.0570	Primary
SDU-09A-10	422362.03	5400928.07	48.7565	-118.0560	Primary
SDU-09A-11	422443.05	5401115.47	48.7582	-118.0550	Primary
SDU-09A-12	422348.84	5400915.49	48.7564	-118.0570	Primary
SDU-09A-13	422337.51	5400903.97	48.7563	-118.0570	Primary
SDU-09A-14	422344.59	5400889.35	48.7562	-118.0570	Primary
SDU-09A-15	422487.93	5401080.46	48.7579	-118.0550	Primary
SDU-09A-16	422440.11	5401010.42	48.7573	-118.0550	Primary
SDU-09A-17	422342.37	5400864.29	48.7559	-118.0570	Primary
SDU-09A-18	422321.97	5400863.90	48.7559	-118.0570	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09A-19	422375.45	5400953.30	48.7567	-118.0560	Primary
SDU-09A-20	422417.33	5401057.80	48.7577	-118.0560	Primary
SDU-09A-21	422445.59	5401065.74	48.7578	-118.0550	Primary
SDU-09A-22	422401.03	5400997.91	48.7572	-118.0560	Primary
SDU-09A-23	422359.64	5400939.42	48.7566	-118.0560	Primary
SDU-09A-24	422450.74	5401108.37	48.7582	-118.0550	Primary
SDU-09A-25	422393.67	5401022.95	48.7574	-118.0560	Primary
SDU-09A-26	422377.37	5400902.52	48.7563	-118.0560	Primary
SDU-09A-27	422431.15	5401041.07	48.7575	-118.0550	Primary
SDU-09A-28	422382.92	5400982.83	48.7570	-118.0560	Primary
SDU-09A-29	422391.52	5400933.20	48.7566	-118.0560	Primary
SDU-09A-30	422466.63	5401084.77	48.7579	-118.0550	Primary
SDU-09B-01	422320.10	5400924.13	48.7565	-118.0570	Primary
SDU-09B-02	422308.02	5400885.43	48.7561	-118.0570	Primary
SDU-09B-03	422437.38	5401072.65	48.7578	-118.0550	Primary
SDU-09B-04	422320.73	5400935.45	48.7566	-118.0570	Primary
SDU-09B-05	422413.76	5400989.91	48.7571	-118.0560	Primary
SDU-09B-06	422357.80	5400910.63	48.7564	-118.0560	Primary
SDU-09B-07	422462.23	5401069.10	48.7578	-118.0550	Primary
SDU-09B-08	422400.99	5400973.01	48.7569	-118.0560	Primary
SDU-09B-09	422431.53	5401081.29	48.7579	-118.0550	Primary
SDU-09B-10	422329.21	5400896.69	48.7562	-118.0570	Primary
SDU-09B-11	422323.32	5400874.28	48.7560	-118.0570	Primary
SDU-09B-12	422366.94	5400964.34	48.7568	-118.0560	Primary
SDU-09B-13	422324.64	5400885.39	48.7561	-118.0570	Primary
SDU-09B-14	422451.48	5401044.15	48.7576	-118.0550	Primary
SDU-09B-15	422345.08	5400961.08	48.7568	-118.0570	Primary
SDU-09B-16	422424.15	5401034.93	48.7575	-118.0560	Primary
SDU-09B-17	422348.50	5400942.34	48.7566	-118.0570	Primary
SDU-09B-18	422339.95	5400913.09	48.7564	-118.0570	Primary
SDU-09B-19	422383.49	5400936.87	48.7566	-118.0560	Primary
SDU-09B-20	422341.52	5400899.74	48.7563	-118.0570	Primary
SDU-09B-21	422396.25	5401000.31	48.7572	-118.0560	Primary
SDU-09B-22	422401.36	5401032.24	48.7575	-118.0560	Primary
SDU-09B-23	422373.90	5400945.55	48.7567	-118.0560	Primary
SDU-09B-24	422309.09	5400900.00	48.7563	-118.0570	Primary
SDU-09B-25	422299.01	5400907.77	48.7563	-118.0570	Primary
SDU-09B-26	422429.03	5401059.76	48.7577	-118.0550	Primary
SDU-09B-27	422373.08	5400934.64	48.7566	-118.0560	Primary
SDU-09B-28	422356.37	5400966.52	48.7569	-118.0560	Primary
SDU-09B-29	422381.12	5400995.76	48.7571	-118.0560	Primary
SDU-09B-30	422385.48	5400918.26	48.7564	-118.0560	Primary
SDU-09C-01	422349.71	5400897.78	48.7562	-118.0560	Primary
SDU-09C-02	422490.96	5401078.82	48.7579	-118.0550	Primary
SDU-09C-03	422374.27	5400897.82	48.7563	-118.0560	Primary
SDU-09C-04	422394.93	5400966.39	48.7569	-118.0560	Primary
SDU-09C-05	422358.47	5400883.12	48.7561	-118.0560	Primary
SDU-09C-06	422420.57	5401037.18	48.7575	-118.0560	Primary
SDU-09C-07	422434.49	5401092.46	48.7580	-118.0550	Primary
SDU-09C-08	422377.57	5400915.02	48.7564	-118.0560	Primary
SDU-09C-09	422321.96	5400904.98	48.7563	-118.0570	Primary
SDU-09C-10	422341.91	5400939.09	48.7566	-118.0570	Primary
SDU-09C-11	422453.61	5401076.71	48.7579	-118.0550	Primary
SDU-09C-12	422422.20	5401050.20	48.7576	-118.0560	Primary
SDU-09C-13	422439.88	5401032.04	48.7575	-118.0550	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09C-14	422325.50	5400926.00	48.7565	-118.0570	Primary
SDU-09C-15	422371.04	5400978.88	48.7570	-118.0560	Primary
SDU-09C-16	422405.05	5400955.57	48.7568	-118.0560	Primary
SDU-09C-17	422439.53	5401113.76	48.7582	-118.0550	Primary
SDU-09C-18	422364.18	5400959.89	48.7568	-118.0560	Primary
SDU-09C-19	422299.31	5400907.67	48.7563	-118.0570	Primary
SDU-09C-20	422341.83	5400911.94	48.7564	-118.0570	Primary
SDU-09C-21	422472.29	5401056.88	48.7577	-118.0550	Primary
SDU-09C-22	422388.56	5400915.08	48.7564	-118.0560	Primary
SDU-09C-23	422371.78	5400925.60	48.7565	-118.0560	Primary
SDU-09C-24	422352.34	5400917.24	48.7564	-118.0560	Primary
SDU-09C-25	422393.03	5401018.85	48.7573	-118.0560	Primary
SDU-09C-26	422384.28	5400984.19	48.7570	-118.0560	Primary
SDU-09C-27	422435.43	5401016.37	48.7573	-118.0550	Primary
SDU-09C-28	422362.12	5400898.09	48.7563	-118.0560	Primary
SDU-09C-29	422318.41	5400876.13	48.7560	-118.0570	Primary
SDU-09C-30	422362.09	5400933.78	48.7566	-118.0560	Primary
SDU-09A-R01	422404.48	5400989.88	48.7571	-118.0560	Reserve
SDU-09A-R02	422321.41	5400886.16	48.7561	-118.0570	Reserve
SDU-09A-R03	422343.19	5400892.22	48.7562	-118.0570	Reserve
SDU-09A-R04	422354.02	5400936.84	48.7566	-118.0560	Reserve
SDU-09A-R05	422411.28	5400970.01	48.7569	-118.0560	Reserve
SDU-09A-R06	422446.78	5401103.33	48.7581	-118.0550	Reserve
SDU-09B-R01	422396.84	5401011.27	48.7573	-118.0560	Reserve
SDU-09B-R02	422434.43	5401080.58	48.7579	-118.0550	Reserve
SDU-09B-R03	422313.79	5400879.69	48.7561	-118.0570	Reserve
SDU-09B-R04	422318.50	5400925.12	48.7565	-118.0570	Reserve
SDU-09B-R05	422366.08	5400894.94	48.7562	-118.0560	Reserve
SDU-09B-R06	422362.47	5400919.53	48.7564	-118.0560	Reserve
SDU-09C-R01	422383.59	5400961.60	48.7568	-118.0560	Reserve
SDU-09C-R02	422319.09	5400866.51	48.7560	-118.0570	Reserve
SDU-09C-R03	422326.39	5400887.55	48.7562	-118.0570	Reserve
SDU-09C-R04	422408.36	5401032.90	48.7575	-118.0560	Reserve
SDU-09C-R05	422401.70	5400969.92	48.7569	-118.0560	Reserve
SDU-09C-R06	422462.22	5401094.58	48.7580	-118.0550	Reserve
Sediment Decision Unit 10					
SDU-10-01	422121.36	5400672.62	48.7542	-118.0596	Primary
SDU-10-02	422238.00	5400804.41	48.7554	-118.0580	Primary
SDU-10-03	422100.04	5400634.56	48.7538	-118.0598	Primary
SDU-10-04	422139.78	5400663.87	48.7541	-118.0593	Primary
SDU-10-05	422130.00	5400651.00	48.7540	-118.0594	Primary
SDU-10-06	422266.05	5400779.23	48.7552	-118.0576	Primary
SDU-10-07	422226.71	5400755.86	48.7550	-118.0581	Primary
SDU-10-08	422113.35	5400595.63	48.7535	-118.0597	Primary
SDU-10-09	422165.15	5400677.78	48.7542	-118.0590	Primary
SDU-10-10	422104.99	5400659.23	48.7541	-118.0598	Primary
SDU-10-11	422165.70	5400721.01	48.7546	-118.0590	Primary
SDU-10-12	422165.60	5400702.18	48.7545	-118.0590	Primary
SDU-10-13	422182.00	5400720.14	48.7546	-118.0587	Primary
SDU-10-14	422208.57	5400755.72	48.7550	-118.0584	Primary
SDU-10-15	422216.02	5400767.96	48.7551	-118.0583	Primary
SDU-10-16	422184.58	5400743.91	48.7548	-118.0587	Primary
SDU-10-17	422090.19	5400640.86	48.7539	-118.0600	Primary
SDU-10-18	422152.81	5400657.01	48.7541	-118.0591	Primary
SDU-10-19	422121.40	5400621.25	48.7537	-118.0595	Primary

Table A1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 10 (continued)					
SDU-10-20	422191.34	5400715.34	48.7546	-118.0586	Primary
SDU-10-21	422132.41	5400626.67	48.7538	-118.0594	Primary
SDU-10-22	422180.66	5400755.08	48.7549	-118.0588	Primary
SDU-10-23	422148.21	5400712.80	48.7546	-118.0592	Primary
SDU-10-24	422255.98	5400794.06	48.7553	-118.0577	Primary
SDU-10-25	422180.22	5400730.27	48.7547	-118.0588	Primary
SDU-10-26	422202.82	5400718.57	48.7546	-118.0585	Primary
SDU-10-27	422162.81	5400650.63	48.7540	-118.0590	Primary
SDU-10-28	422220.23	5400740.72	48.7548	-118.0582	Primary
SDU-10-29	422238.06	5400791.04	48.7553	-118.0580	Primary
SDU-10-30	422193.58	5400691.80	48.7544	-118.0586	Primary
SDU-10-R01	422113.36	5400613.03	48.7537	-118.0597	Reserve
SDU-10-R02	422245.19	5400815.12	48.7555	-118.0579	Reserve
SDU-10-R03	422136.24	5400710.38	48.7545	-118.0594	Reserve
SDU-10-R04	422077.60	5400642.89	48.7539	-118.0601	Reserve
SDU-10-R05	422222.90	5400761.89	48.7550	-118.0582	Reserve
SDU-10-R06	422163.66	5400653.81	48.7540	-118.0590	Reserve

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-01	422967.34	5400915.40	48.7565	-118.0481	Primary
UDU-01-02	422955.26	5400946.77	48.7568	-118.0483	Primary
UDU-01-03	422945.62	5400955.22	48.7568	-118.0484	Primary
UDU-01-04	422943.96	5400925.29	48.7566	-118.0484	Primary
UDU-01-05	422895.35	5400941.05	48.7567	-118.0491	Primary
UDU-01-06	423017.29	5400912.54	48.7565	-118.0474	Primary
UDU-01-07	422984.73	5400905.79	48.7564	-118.0479	Primary
UDU-01-08	422963.84	5400902.64	48.7564	-118.0481	Primary
UDU-01-09	422925.69	5400930.53	48.7566	-118.0487	Primary
UDU-01-10	422927.83	5400966.67	48.7569	-118.0486	Primary
UDU-01-11	423035.90	5400903.59	48.7564	-118.0472	Primary
UDU-01-12	422974.13	5400894.28	48.7563	-118.0480	Primary
UDU-01-13	422915.94	5400935.29	48.7567	-118.0488	Primary
UDU-01-14	422992.44	5400900.71	48.7564	-118.0477	Primary
UDU-01-15	423051.29	5400883.99	48.7562	-118.0469	Primary
UDU-01-16	422966.32	5400886.82	48.7562	-118.0481	Primary
UDU-01-17	422989.13	5400934.05	48.7567	-118.0478	Primary
UDU-01-18	422932.72	5400942.02	48.7567	-118.0486	Primary
UDU-01-19	422966.59	5400930.13	48.7566	-118.0481	Primary
UDU-01-20	422908.95	5400950.70	48.7568	-118.0489	Primary
UDU-01-21	422927.93	5400945.48	48.7567	-118.0486	Primary
UDU-01-22	423045.32	5400902.67	48.7564	-118.0470	Primary
UDU-01-23	422906.92	5400935.89	48.7567	-118.0489	Primary
UDU-01-24	423058.08	5400890.19	48.7563	-118.0469	Primary
UDU-01-25	423032.94	5400860.12	48.7560	-118.0472	Primary
UDU-01-26	422954.63	5400929.51	48.7566	-118.0483	Primary
UDU-01-27	422996.30	5400925.16	48.7566	-118.0477	Primary
UDU-01-28	422960.38	5400933.13	48.7566	-118.0482	Primary
UDU-01-29	422942.22	5400970.97	48.7570	-118.0484	Primary
UDU-01-30	423032.78	5400892.90	48.7563	-118.0472	Primary
UDU-01-R01	422965.88	5400899.88	48.7563	-118.0481	Reserve
UDU-01-R02	423005.70	5400897.64	48.7563	-118.0476	Reserve
UDU-01-R03	422958.12	5400943.42	48.7567	-118.0482	Reserve
UDU-01-R04	422930.55	5400907.93	48.7564	-118.0486	Reserve
UDU-01-R05	423025.23	5400888.39	48.7562	-118.0473	Reserve
UDU-01-R06	422993.08	5400876.69	48.7561	-118.0477	Reserve
UDU-01-R07	423014.27	5400874.52	48.7561	-118.0474	Reserve
UDU-01-R08	423043.48	5400897.61	48.7563	-118.0471	Reserve
UDU-01-R09	422969.07	5400905.07	48.7564	-118.0481	Reserve
Soil Decision Unit 2					
UDU-02-01	422911.81	5400849.36	48.7559	-118.0488	Primary
UDU-02-02	422949.09	5400833.24	48.7557	-118.0483	Primary
UDU-02-03	422938.06	5400852.22	48.7559	-118.0485	Primary
UDU-02-04	422912.11	5400839.41	48.7558	-118.0488	Primary
UDU-02-05	422927.78	5400787.13	48.7553	-118.0486	Primary
UDU-02-06	422930.40	5400841.87	48.7558	-118.0486	Primary
UDU-02-07	422950.39	5400812.33	48.7556	-118.0483	Primary
UDU-02-08	422968.00	5400803.33	48.7555	-118.0481	Primary
UDU-02-09	422886.32	5400822.88	48.7556	-118.0492	Primary
UDU-02-10	422939.01	5400792.12	48.7554	-118.0485	Primary
UDU-02-11	422969.93	5400841.56	48.7558	-118.0480	Primary
UDU-02-12	422939.33	5400822.38	48.7556	-118.0485	Primary
UDU-02-13	422921.34	5400860.71	48.7560	-118.0487	Primary
UDU-02-14	422963.46	5400883.55	48.7562	-118.0481	Primary
UDU-02-15	422968.14	5400866.15	48.7560	-118.0481	Primary

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 2 (continued)					
UDU-02-16	422964.12	5400859.33	48.7560	-118.0481	Primary
UDU-02-17	422947.68	5400797.36	48.7554	-118.0483	Primary
UDU-02-18	422945.11	5400871.44	48.7561	-118.0484	Primary
UDU-02-19	422926.00	5400807.27	48.7555	-118.0486	Primary
UDU-02-20	423004.22	5400844.00	48.7558	-118.0476	Primary
UDU-02-21	422913.14	5400819.74	48.7556	-118.0488	Primary
UDU-02-22	422974.44	5400855.24	48.7559	-118.0480	Primary
UDU-02-23	422964.86	5400828.39	48.7557	-118.0481	Primary
UDU-02-24	422949.58	5400824.71	48.7557	-118.0483	Primary
UDU-02-25	422899.16	5400830.06	48.7557	-118.0490	Primary
UDU-02-26	422921.44	5400803.64	48.7555	-118.0487	Primary
UDU-02-27	422966.51	5400798.08	48.7554	-118.0481	Primary
UDU-02-28	423020.27	5400841.39	48.7558	-118.0474	Primary
UDU-02-29	422928.01	5400854.85	48.7559	-118.0486	Primary
UDU-02-30	422935.44	5400804.26	48.7555	-118.0485	Primary
Soil Decision Unit 3					
UDU-03-01	422892.25	5400764.18	48.7551	-118.0491	Primary
UDU-03-02	422854.90	5400796.94	48.7554	-118.0496	Primary
UDU-03-03	422852.40	5400816.50	48.7556	-118.0496	Primary
UDU-03-04	422911.52	5400792.37	48.7554	-118.0488	Primary
UDU-03-05	422790.75	5400866.19	48.7560	-118.0505	Primary
UDU-03-06	422802.50	5400821.16	48.7556	-118.0503	Primary
UDU-03-07	422937.20	5400762.24	48.7551	-118.0485	Primary
UDU-03-08	422915.29	5400768.98	48.7552	-118.0488	Primary
UDU-03-09	422901.24	5400748.33	48.7550	-118.0490	Primary
UDU-03-10	422806.34	5400858.57	48.7560	-118.0503	Primary
UDU-03-11	422830.28	5400806.13	48.7555	-118.0499	Primary
UDU-03-12	422838.87	5400807.38	48.7555	-118.0498	Primary
UDU-03-13	422913.69	5400738.38	48.7549	-118.0488	Primary
UDU-03-14	422901.66	5400784.75	48.7553	-118.0490	Primary
UDU-03-15	422898.88	5400795.71	48.7554	-118.0490	Primary
UDU-03-16	422888.59	5400779.57	48.7553	-118.0491	Primary
UDU-03-17	422788.37	5400817.94	48.7556	-118.0505	Primary
UDU-03-18	422894.04	5400777.49	48.7552	-118.0491	Primary
UDU-03-19	422769.70	5400835.32	48.7557	-118.0508	Primary
UDU-03-20	422761.02	5400835.05	48.7557	-118.0509	Primary
UDU-03-21	422871.39	5400787.09	48.7553	-118.0494	Primary
UDU-03-22	422847.35	5400802.20	48.7554	-118.0497	Primary
UDU-03-23	422778.84	5400826.71	48.7557	-118.0506	Primary
UDU-03-24	422859.20	5400779.26	48.7552	-118.0495	Primary
UDU-03-25	422786.43	5400823.02	48.7556	-118.0505	Primary
UDU-03-26	422863.15	5400800.89	48.7554	-118.0495	Primary
UDU-03-27	422906.27	5400778.41	48.7552	-118.0489	Primary
UDU-03-28	422776.67	5400848.69	48.7559	-118.0507	Primary
UDU-03-29	422871.61	5400801.14	48.7554	-118.0494	Primary
UDU-03-30	422914.23	5400756.47	48.7550	-118.0488	Primary
UDU-03-R01	422833.37	5400797.67	48.7554	-118.0499	Reserve
UDU-03-R02	422926.86	5400776.22	48.7552	-118.0486	Reserve
UDU-03-R03	422817.82	5400827.18	48.7557	-118.0501	Reserve
UDU-03-R04	422814.07	5400812.37	48.7555	-118.0502	Reserve
UDU-03-R05	422890.39	5400762.84	48.7551	-118.0491	Reserve

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4					
UDU-04A-01	422878.64	5400824.23	48.7557	-118.0493	Primary
UDU-04A-02	422898.34	5400906.71	48.7564	-118.0490	Primary
UDU-04A-03	422823.69	5400875.82	48.7561	-118.0500	Primary
UDU-04A-04	422872.16	5400903.81	48.7564	-118.0494	Primary
UDU-04A-05	422862.76	5400857.90	48.7560	-118.0495	Primary
UDU-04A-06	422875.06	5400863.05	48.7560	-118.0493	Primary
UDU-04A-07	422868.28	5400921.33	48.7565	-118.0494	Primary
UDU-04A-08	422838.11	5400872.40	48.7561	-118.0498	Primary
UDU-04A-09	422885.87	5400846.83	48.7559	-118.0492	Primary
UDU-04A-10	422910.53	5400904.91	48.7564	-118.0489	Primary
UDU-04A-11	422883.05	5400833.88	48.7557	-118.0492	Primary
UDU-04A-12	422858.62	5400846.89	48.7559	-118.0496	Primary
UDU-04A-13	422862.40	5400879.60	48.7561	-118.0495	Primary
UDU-04A-14	422862.71	5400825.41	48.7557	-118.0495	Primary
UDU-04A-15	422903.05	5400847.05	48.7559	-118.0490	Primary
UDU-04A-16	422869.79	5400820.65	48.7556	-118.0494	Primary
UDU-04A-17	422810.06	5400867.22	48.7560	-118.0502	Primary
UDU-04A-18	422876.86	5400852.17	48.7559	-118.0493	Primary
UDU-04A-19	422871.87	5400835.55	48.7558	-118.0494	Primary
UDU-04A-20	422904.92	5400900.17	48.7563	-118.0489	Primary
UDU-04A-21	422872.16	5400868.44	48.7560	-118.0494	Primary
UDU-04A-22	422883.35	5400860.28	48.7560	-118.0492	Primary
UDU-04A-23	422864.18	5400834.67	48.7557	-118.0495	Primary
UDU-04A-24	422846.05	5400859.90	48.7560	-118.0497	Primary
UDU-04A-25	422883.25	5400931.67	48.7566	-118.0492	Primary
UDU-04A-26	422837.15	5400863.00	48.7560	-118.0499	Primary
UDU-04A-27	422913.84	5400887.55	48.7562	-118.0488	Primary
UDU-04A-28	422902.24	5400889.33	48.7562	-118.0490	Primary
UDU-04A-29	422905.23	5400855.55	48.7559	-118.0489	Primary
UDU-04A-30	422944.70	5400893.69	48.7563	-118.0484	Primary
UDU-04B-01	422878.76	5400925.21	48.7566	-118.0493	Primary
UDU-04B-02	422874.71	5400860.00	48.7560	-118.0493	Primary
UDU-04B-03	422837.21	5400862.35	48.7560	-118.0499	Primary
UDU-04B-04	422876.36	5400840.19	48.7558	-118.0493	Primary
UDU-04B-05	422841.72	5400874.93	48.7561	-118.0498	Primary
UDU-04B-06	422864.33	5400831.46	48.7557	-118.0495	Primary
UDU-04B-07	422897.74	5400850.65	48.7559	-118.0490	Primary
UDU-04B-08	422895.51	5400868.13	48.7560	-118.0491	Primary
UDU-04B-09	422850.13	5400835.97	48.7558	-118.0497	Primary
UDU-04B-10	422836.48	5400849.59	48.7559	-118.0499	Primary
UDU-04B-11	422847.57	5400909.96	48.7564	-118.0497	Primary
UDU-04B-12	422916.35	5400897.61	48.7563	-118.0488	Primary
UDU-04B-13	422833.90	5400891.38	48.7562	-118.0499	Primary
UDU-04B-14	422827.67	5400855.53	48.7559	-118.0500	Primary
UDU-04B-15	422873.32	5400897.43	48.7563	-118.0494	Primary
UDU-04B-16	422825.94	5400892.72	48.7563	-118.0500	Primary
UDU-04B-17	422868.38	5400851.78	48.7559	-118.0494	Primary
UDU-04B-18	422921.22	5400899.70	48.7563	-118.0487	Primary
UDU-04B-19	422813.08	5400875.39	48.7561	-118.0502	Primary
UDU-04B-20	422829.27	5400884.78	48.7562	-118.0500	Primary
UDU-04B-21	422933.24	5400885.71	48.7562	-118.0486	Primary
UDU-04B-22	422924.24	5400869.45	48.7561	-118.0487	Primary
UDU-04B-23	422879.93	5400892.91	48.7563	-118.0493	Primary
UDU-04B-24	422852.64	5400868.10	48.7560	-118.0496	Primary
UDU-04B-25	422857.32	5400844.02	48.7558	-118.0496	Primary

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04B-26	422880.70	5400931.37	48.7566	-118.0493	Primary
UDU-04B-27	422907.44	5400908.77	48.7564	-118.0489	Primary
UDU-04B-28	422875.50	5400885.56	48.7562	-118.0493	Primary
UDU-04B-29	422880.83	5400912.64	48.7564	-118.0493	Primary
UDU-04B-30	422881.51	5400886.71	48.7562	-118.0493	Primary
UDU-04C-01	422912.40	5400905.50	48.7564	-118.0488	Primary
UDU-04C-02	422851.22	5400876.76	48.7561	-118.0497	Primary
UDU-04C-03	422910.52	5400916.28	48.7565	-118.0489	Primary
UDU-04C-04	422870.17	5400874.81	48.7561	-118.0494	Primary
UDU-04C-05	422889.10	5400881.26	48.7562	-118.0492	Primary
UDU-04C-06	422806.48	5400871.79	48.7561	-118.0503	Primary
UDU-04C-07	422850.89	5400843.34	48.7558	-118.0497	Primary
UDU-04C-08	422859.01	5400826.11	48.7557	-118.0496	Primary
UDU-04C-09	422871.64	5400856.16	48.7559	-118.0494	Primary
UDU-04C-10	422867.61	5400834.83	48.7557	-118.0494	Primary
UDU-04C-11	422865.66	5400881.95	48.7562	-118.0495	Primary
UDU-04C-12	422860.29	5400836.24	48.7558	-118.0495	Primary
UDU-04C-13	422895.47	5400925.09	48.7566	-118.0491	Primary
UDU-04C-14	422835.30	5400875.73	48.7561	-118.0499	Primary
UDU-04C-15	422926.00	5400906.80	48.7564	-118.0487	Primary
UDU-04C-16	422904.10	5400921.45	48.7565	-118.0490	Primary
UDU-04C-17	422915.42	5400881.07	48.7562	-118.0488	Primary
UDU-04C-18	422872.16	5400901.36	48.7563	-118.0494	Primary
UDU-04C-19	422907.50	5400880.45	48.7562	-118.0489	Primary
UDU-04C-20	422840.44	5400864.85	48.7560	-118.0498	Primary
UDU-04C-21	422880.06	5400848.18	48.7559	-118.0493	Primary
UDU-04C-22	422924.22	5400872.64	48.7561	-118.0487	Primary
UDU-04C-23	422811.25	5400879.83	48.7561	-118.0502	Primary
UDU-04C-24	422882.13	5400867.86	48.7560	-118.0492	Primary
UDU-04C-25	422857.41	5400890.96	48.7562	-118.0496	Primary
UDU-04C-26	422815.53	5400885.95	48.7562	-118.0502	Primary
UDU-04C-27	422862.67	5400867.15	48.7560	-118.0495	Primary
UDU-04C-28	422902.78	5400849.76	48.7559	-118.0490	Primary
UDU-04C-29	422902.43	5400900.85	48.7563	-118.0490	Primary
UDU-04C-30	422826.99	5400866.97	48.7560	-118.0500	Primary
UDU-04A-R01	422897.00	5400837.28	48.7558	-118.0490	Reserve
UDU-04A-R02	422871.43	5400813.95	48.7556	-118.0494	Reserve
UDU-04A-R03	422877.75	5400858.83	48.7560	-118.0493	Reserve
UDU-04A-R04	422935.65	5400901.18	48.7564	-118.0485	Reserve
UDU-04A-R05	422892.90	5400901.77	48.7564	-118.0491	Reserve
UDU-04A-R06	422922.92	5400911.89	48.7564	-118.0487	Reserve
UDU-04A-R07	422884.20	5400883.67	48.7562	-118.0492	Reserve
UDU-04B-R01	422883.10	5400894.57	48.7563	-118.0492	Reserve
UDU-04B-R02	422847.26	5400842.06	48.7558	-118.0497	Reserve
UDU-04B-R03	422857.63	5400820.76	48.7556	-118.0496	Reserve
UDU-04B-R04	422890.48	5400925.93	48.7566	-118.0491	Reserve
UDU-04B-R05	422931.06	5400878.29	48.7561	-118.0486	Reserve
UDU-04B-R06	422882.95	5400825.30	48.7557	-118.0492	Reserve
UDU-04B-R07	422895.48	5400868.84	48.7561	-118.0491	Reserve
UDU-04B-R08	422904.04	5400912.12	48.7564	-118.0490	Reserve
UDU-04B-R09	422890.13	5400886.67	48.7562	-118.0491	Reserve
UDU-04B-R10	422890.89	5400852.63	48.7559	-118.0491	Reserve
UDU-04B-R11	422889.98	5400915.22	48.7565	-118.0491	Reserve
UDU-04C-R01	422893.42	5400903.23	48.7564	-118.0491	Reserve
UDU-04C-R02	422883.83	5400865.41	48.7560	-118.0492	Reserve

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04C-R03	422912.54	5400880.27	48.7562	-118.0488	Reserve
UDU-04C-R04	422831.85	5400868.62	48.7560	-118.0499	Reserve
UDU-04C-R05	422904.54	5400892.94	48.7563	-118.0489	Reserve
UDU-04C-R06	422889.47	5400881.65	48.7562	-118.0491	Reserve
UDU-04C-R07	422933.73	5400877.36	48.7561	-118.0485	Reserve
UDU-04C-R08	422875.23	5400842.69	48.7558	-118.0493	Reserve
Soil Decision Unit 5					
UDU-05-01	423463.26	5401280.87	48.7598	-118.0414	Primary
UDU-05-02	423525.67	5401328.97	48.7603	-118.0406	Primary
UDU-05-03	423510.63	5401339.05	48.7604	-118.0408	Primary
UDU-05-04	423475.46	5401305.23	48.7601	-118.0413	Primary
UDU-05-05	423525.17	5401320.54	48.7602	-118.0406	Primary
UDU-05-06	423500.09	5401337.34	48.7603	-118.0409	Primary
UDU-05-07	423615.60	5401470.38	48.7616	-118.0394	Primary
UDU-05-08	423586.69	5401433.79	48.7612	-118.0398	Primary
UDU-05-09	423575.27	5401403.66	48.7609	-118.0399	Primary
UDU-05-10	423496.16	5401313.37	48.7601	-118.0410	Primary
UDU-05-11	423565.65	5401433.61	48.7612	-118.0401	Primary
UDU-05-12	423522.21	5401335.27	48.7603	-118.0406	Primary
UDU-05-13	423550.70	5401380.42	48.7607	-118.0402	Primary
UDU-05-14	423568.33	5401383.52	48.7608	-118.0400	Primary
UDU-05-15	423486.88	5401320.83	48.7602	-118.0411	Primary
UDU-05-16	423540.07	5401372.72	48.7607	-118.0404	Primary
UDU-05-17	423584.79	5401415.64	48.7611	-118.0398	Primary
UDU-05-18	423519.73	5401320.92	48.7602	-118.0407	Primary
UDU-05-19	423570.79	5401397.62	48.7609	-118.0400	Primary
UDU-05-20	423572.33	5401425.68	48.7611	-118.0400	Primary
UDU-05-21	423506.13	5401294.12	48.7600	-118.0408	Primary
UDU-05-22	423545.65	5401344.77	48.7604	-118.0403	Primary
UDU-05-23	423515.72	5401325.87	48.7602	-118.0407	Primary
UDU-05-24	423522.61	5401362.14	48.7606	-118.0406	Primary
UDU-05-25	423548.58	5401357.54	48.7605	-118.0403	Primary
UDU-05-26	423596.43	5401464.28	48.7615	-118.0396	Primary
UDU-05-27	423518.96	5401330.85	48.7603	-118.0407	Primary
UDU-05-28	423573.14	5401420.46	48.7611	-118.0399	Primary
UDU-05-29	423548.48	5401399.48	48.7609	-118.0403	Primary
UDU-05-30	423580.11	5401410.54	48.7610	-118.0398	Primary
UDU-05-R01	423506.01	5401303.30	48.7600	-118.0408	Reserve
UDU-05-R02	423486.11	5401295.23	48.7600	-118.0411	Reserve
UDU-05-R03	423586.71	5401419.31	48.7611	-118.0398	Reserve
UDU-05-R04	423498.72	5401297.55	48.7600	-118.0409	Reserve
UDU-05-R05	423496.70	5401277.82	48.7598	-118.0410	Reserve
UDU-05-R06	423521.10	5401327.20	48.7603	-118.0406	Reserve
UDU-05-R07	423495.67	5401289.29	48.7599	-118.0410	Reserve
UDU-05-R08	423517.03	5401307.16	48.7601	-118.0407	Reserve
UDU-05-R09	423567.99	5401433.86	48.7612	-118.0400	Reserve
UDU-05-R10	423482.40	5401287.26	48.7599	-118.0412	Reserve
UDU-05-R11	423609.73	5401449.79	48.7614	-118.0395	Reserve
UDU-05-R12	423516.08	5401316.63	48.7602	-118.0407	Reserve
UDU-05-R13	423545.81	5401354.89	48.7605	-118.0403	Reserve
UDU-05-R14	423580.96	5401412.31	48.7610	-118.0398	Reserve
UDU-05-R15	423524.69	5401323.40	48.7602	-118.0406	Reserve
UDU-05-R16	423499.34	5401285.49	48.7599	-118.0409	Reserve
UDU-05-R17	423620.17	5401479.74	48.7616	-118.0393	Reserve
UDU-05-R18	423612.30	5401465.85	48.7615	-118.0394	Reserve

Table A1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-R19	423508.42	5401311.18	48.7601	-118.0408	Reserve
UDU-05-R20	423565.05	5401384.35	48.7608	-118.0400	Reserve
UDU-05-R21	423472.76	5401274.12	48.7598	-118.0413	Reserve
UDU-05-R22	423506.73	5401296.89	48.7600	-118.0408	Reserve
UDU-05-R23	423486.96	5401301.70	48.7600	-118.0411	Reserve
Soil Decision Unit 6					
UDU-06-01	422184.22	5400810.96	48.7554	-118.0587	Primary
UDU-06-02	422240.14	5400910.05	48.7563	-118.0580	Primary
UDU-06-03	422238.46	5400870.89	48.7560	-118.0580	Primary
UDU-06-04	422212.12	5400905.85	48.7563	-118.0584	Primary
UDU-06-05	422207.91	5400880.79	48.7561	-118.0584	Primary
UDU-06-06	422176.13	5400805.14	48.7554	-118.0588	Primary
UDU-06-07	422189.41	5400789.71	48.7553	-118.0587	Primary
UDU-06-08	422165.00	5400811.30	48.7554	-118.0590	Primary
UDU-06-09	422208.53	5400865.41	48.7559	-118.0584	Primary
UDU-06-10	422226.83	5400870.44	48.7560	-118.0582	Primary
UDU-06-11	422220.48	5400897.54	48.7562	-118.0583	Primary
UDU-06-12	422194.45	5400828.32	48.7556	-118.0586	Primary
UDU-06-13	422238.77	5400845.55	48.7558	-118.0580	Primary
UDU-06-14	422204.71	5400795.15	48.7553	-118.0584	Primary
UDU-06-15	422218.37	5400882.67	48.7561	-118.0583	Primary
UDU-06-16	422198.57	5400838.07	48.7557	-118.0585	Primary
UDU-06-17	422276.25	5400930.53	48.7565	-118.0575	Primary
UDU-06-18	422166.79	5400825.57	48.7556	-118.0590	Primary
UDU-06-19	422223.27	5400880.21	48.7561	-118.0582	Primary
UDU-06-20	422207.41	5400822.84	48.7556	-118.0584	Primary
UDU-06-21	422274.31	5400900.49	48.7563	-118.0575	Primary
UDU-06-22	422184.72	5400842.82	48.7557	-118.0587	Primary
UDU-06-23	422248.91	5400859.62	48.7559	-118.0579	Primary
UDU-06-24	422224.06	5400839.33	48.7557	-118.0582	Primary
UDU-06-25	422154.02	5400783.74	48.7552	-118.0591	Primary
UDU-06-26	422186.26	5400799.10	48.7553	-118.0587	Primary
UDU-06-27	422221.62	5400828.80	48.7556	-118.0582	Primary
UDU-06-28	422193.69	5400855.42	48.7558	-118.0586	Primary
UDU-06-29	422280.89	5400898.44	48.7562	-118.0574	Primary
UDU-06-30	422207.52	5400845.08	48.7558	-118.0584	Primary
UDU-06-R01	422260.55	5400883.36	48.7561	-118.0577	Reserve
UDU-06-R02	422202.16	5400852.63	48.7558	-118.0585	Reserve
UDU-06-R03	422274.17	5400916.47	48.7564	-118.0575	Reserve
UDU-06-R04	422206.47	5400885.39	48.7561	-118.0584	Reserve
UDU-06-R05	422224.21	5400875.78	48.7560	-118.0582	Reserve
UDU-06-R06	422216.76	5400846.91	48.7558	-118.0583	Reserve

Table A1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-XRF-01	423555.56	5401691.38	48.7635	-118.0402	Primary
SDU-01-XRF-02	423473.06	5401636.38	48.7630	-118.0413	Primary
SDU-01-XRF-03	423528.06	5401636.38	48.7630	-118.0406	Primary
SDU-01-XRF-04	423583.06	5401636.38	48.7630	-118.0399	Primary
SDU-01-XRF-05	423445.56	5401581.38	48.7625	-118.0417	Primary
SDU-01-XRF-06	423555.56	5401581.38	48.7625	-118.0402	Primary
SDU-01-XRF-07	423610.56	5401581.38	48.7626	-118.0395	Primary
SDU-01-XRF-08	423528.06	5401526.38	48.7620	-118.0406	Primary
SDU-01-XRF-09	423555.56	5401471.38	48.7616	-118.0402	Primary
SDU-01-XRF-R01	423500.56	5401691.38	48.7635	-118.0410	Reserve
SDU-01-XRF-R02	423418.06	5401636.38	48.7630	-118.0421	Reserve
SDU-01-XRF-R03	423638.06	5401636.38	48.7630	-118.0391	Reserve
SDU-01-XRF-R04	423500.56	5401581.38	48.7625	-118.0410	Reserve
SDU-01-XRF-R05	423583.06	5401526.38	48.7621	-118.0398	Reserve
Sediment Decision Unit 2					
SDU-02-XRF-01	423325.30	5401483.86	48.7616	-118.0433	Primary
SDU-02-XRF-02	423380.30	5401483.86	48.7616	-118.0426	Primary
SDU-02-XRF-03	423435.30	5401483.86	48.7617	-118.0418	Primary
SDU-02-XRF-04	423352.80	5401428.86	48.7611	-118.0429	Primary
SDU-02-XRF-05	423462.80	5401428.86	48.7612	-118.0414	Primary
SDU-02-XRF-06	423380.30	5401373.86	48.7607	-118.0426	Primary
SDU-02-XRF-07	423435.30	5401373.86	48.7607	-118.0418	Primary
SDU-02-XRF-08	423490.30	5401373.86	48.7607	-118.0411	Primary
SDU-02-XRF-R01	423352.80	5401538.86	48.7621	-118.0430	Reserve
SDU-02-XRF-R02	423297.80	5401428.86	48.7611	-118.0437	Reserve
SDU-02-XRF-R03	423407.80	5401428.86	48.7612	-118.0422	Reserve
SDU-02-XRF-R04	423407.80	5401318.86	48.7602	-118.0422	Reserve
SDU-02-XRF-R05	423462.80	5401318.86	48.7602	-118.0414	Reserve
Sediment Decision Unit 3					
SDU-03-XRF-01	423086.79	5401100.46	48.7582	-118.0465	Primary
SDU-03-XRF-02	423029.29	5401055.46	48.7577	-118.0473	Primary
SDU-03-XRF-03	422971.79	5401010.46	48.7573	-118.0481	Primary
SDU-03-XRF-04	422914.29	5400965.46	48.7569	-118.0488	Primary
SDU-03-XRF-R01	423061.79	5401080.46	48.7580	-118.0468	Reserve
SDU-03-XRF-R02	422996.79	5401030.46	48.7575	-118.0477	Reserve
SDU-03-XRF-R03	422939.29	5400985.46	48.7571	-118.0485	Reserve
SDU-03-XRF-R04	422881.79	5400940.46	48.7567	-118.0493	Reserve
Sediment Decision Unit 4					
SDU-04-XRF-01	422692.19	5400781.16	48.7552	-118.0518	Primary
SDU-04-XRF-02	422650.19	5400721.16	48.7547	-118.0524	Primary
SDU-04-XRF-03	422632.19	5400685.16	48.7544	-118.0526	Primary
SDU-04-XRF-04	422596.19	5400613.16	48.7537	-118.0531	Primary
SDU-04-XRF-R01	422674.19	5400745.16	48.7549	-118.0520	Reserve
SDU-04-XRF-R02	422614.19	5400649.16	48.7540	-118.0528	Reserve
Sediment Decision Unit 5					
SDU-05-XRF-01	424294.01	5395316.60	48.7063	-118.0290	Primary
SDU-05-XRF-02	424544.01	5395316.60	48.7063	-118.0256	Primary
SDU-05-XRF-03	424356.51	5395191.60	48.7052	-118.0281	Primary
SDU-05-XRF-04	424606.51	5395191.60	48.7052	-118.0247	Primary
SDU-05-XRF-05	424419.01	5395066.60	48.7041	-118.0273	Primary
SDU-05-XRF-06	424544.01	5395066.60	48.7041	-118.0256	Primary
SDU-05-XRF-07	424669.01	5395066.60	48.7041	-118.0239	Primary

Table A1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 5 (continued)					
SDU-05-XRF-08	424356.51	5394941.60	48.7029	-118.0281	Primary
SDU-05-XRF-09	424606.51	5394941.60	48.7030	-118.0247	Primary
SDU-05-XRF-R01	424419.01	5395316.60	48.7063	-118.0273	Reserve
SDU-05-XRF-R02	424231.51	5395191.60	48.7052	-118.0298	Reserve
SDU-05-XRF-R03	424481.51	5395191.60	48.7052	-118.0264	Reserve
SDU-05-XRF-R04	424294.01	5395066.60	48.7040	-118.0290	Reserve
SDU-05-XRF-R05	424481.51	5394941.60	48.7029	-118.0264	Reserve
Sediment Decision Unit 6					
SDU-06-XRF-01	425126.24	5394173.90	48.6961	-118.0175	Primary
SDU-06-XRF-02	425223.74	5394068.90	48.6952	-118.0162	Primary
SDU-06-XRF-03	425246.24	5393933.90	48.6940	-118.0158	Primary
SDU-06-XRF-04	425306.24	5393813.90	48.6929	-118.0150	Primary
SDU-06-XRF-05	425298.74	5393678.90	48.6917	-118.0151	Primary
SDU-06-XRF-R01	425178.74	5394128.90	48.6957	-118.0168	Reserve
SDU-06-XRF-R02	425238.74	5394008.90	48.6946	-118.0159	Reserve
SDU-06-XRF-R03	425276.24	5393873.90	48.6934	-118.0154	Reserve
SDU-06-XRF-R04	425298.74	5393738.90	48.6922	-118.0151	Reserve
Sediment Decision Unit 7					
SDU-07-XRF-01	425254.78	5393031.17	48.6858	-118.0155	Primary
SDU-07-XRF-02	425194.78	5392911.17	48.6848	-118.0163	Primary
SDU-07-XRF-03	425134.78	5392791.17	48.6837	-118.0171	Primary
SDU-07-XRF-04	425074.78	5392671.17	48.6826	-118.0179	Primary
SDU-07-XRF-R01	425224.78	5392971.17	48.6853	-118.0159	Reserve
SDU-07-XRF-R02	425164.78	5392851.17	48.6842	-118.0167	Reserve
SDU-07-XRF-R03	425104.78	5392731.17	48.6831	-118.0175	Reserve
Sediment Decision Unit 8					
SDU-08-XRF-01	423209.27	5401902.00	48.7654	-118.0450	Primary
SDU-08-XRF-02	423131.27	5401824.00	48.7647	-118.0460	Primary
SDU-08-XRF-03	423072.77	5401746.00	48.7640	-118.0468	Primary
SDU-08-XRF-04	422994.77	5401668.00	48.7633	-118.0479	Primary
SDU-08-XRF-R01	423170.27	5401863.00	48.7650	-118.0455	Reserve
SDU-08-XRF-R02	423111.77	5401785.00	48.7643	-118.0463	Reserve
SDU-08-XRF-R03	423033.77	5401707.00	48.7636	-118.0473	Reserve
Sediment Decision Unit 9					
SDU-09-XRF-01	422480.15	5401083.34	48.7579	-118.0548	Primary
SDU-09-XRF-02	422419.13	5401027.18	48.7574	-118.0556	Primary
SDU-09-XRF-03	422373.05	5400950.09	48.7567	-118.0562	Primary
SDU-09-XRF-04	422326.96	5400873.00	48.7560	-118.0568	Primary
SDU-09-XRF-R01	422449.64	5401055.26	48.7577	-118.0552	Reserve
SDU-09-XRF-R02	422403.56	5400978.17	48.7570	-118.0558	Reserve
SDU-09-XRF-R03	422342.54	5400922.01	48.7565	-118.0566	Reserve
Sediment Decision Unit 10					
SDU-10-XRF-01	422246.13	5400805.54	48.7554	-118.0579	Primary
SDU-10-XRF-02	422198.11	5400743.74	48.7548	-118.0585	Primary
SDU-10-XRF-03	422150.09	5400681.94	48.7543	-118.0592	Primary
SDU-10-XRF-04	422102.07	5400620.14	48.7537	-118.0598	Primary
SDU-10-XRF-R01	422222.12	5400774.64	48.7551	-118.0582	Reserve
SDU-10-XRF-R02	422174.10	5400712.84	48.7546	-118.0588	Reserve
SDU-10-XRF-R03	422126.08	5400651.04	48.7540	-118.0595	Reserve

Table A1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-XRF-01	422896.73	5400940.79	48.7567	-118.0491	Primary
UDU-01-XRF-02	422931.73	5400940.79	48.7567	-118.0486	Primary
UDU-01-XRF-03	422966.73	5400940.79	48.7567	-118.0481	Primary
UDU-01-XRF-04	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-01-XRF-05	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-01-XRF-06	422914.23	5400905.79	48.7564	-118.0488	Primary
UDU-01-XRF-07	422949.23	5400905.79	48.7564	-118.0483	Primary
UDU-01-XRF-R01	422984.23	5400905.79	48.7564	-118.0479	Reserve
Soil Decision Unit 2					
UDU-02-XRF-01	422931.73	5400870.79	48.7561	-118.0486	Primary
UDU-02-XRF-02	422966.73	5400870.79	48.7561	-118.0481	Primary
UDU-02-XRF-03	422949.23	5400835.79	48.7558	-118.0483	Primary
UDU-02-XRF-04	422984.23	5400835.79	48.7558	-118.0478	Primary
UDU-02-XRF-05	422931.73	5400800.79	48.7554	-118.0486	Primary
UDU-02-XRF-06	422966.73	5400800.79	48.7555	-118.0481	Primary
UDU-02-XRF-R01	422914.23	5400835.79	48.7558	-118.0488	Reserve
UDU-02-XRF-R02	423019.23	5400835.79	48.7558	-118.0474	Reserve
Soil Decision Unit 3					
UDU-03-XRF-01	422879.23	5400765.79	48.7551	-118.0493	Primary
UDU-03-XRF-02	422774.23	5400835.79	48.7557	-118.0507	Primary
UDU-03-XRF-03	422809.23	5400835.79	48.7557	-118.0502	Primary
UDU-03-XRF-04	422844.23	5400835.79	48.7558	-118.0498	Primary
UDU-03-XRF-05	422826.73	5400800.79	48.7554	-118.0500	Primary
UDU-03-XRF-06	422861.73	5400800.79	48.7554	-118.0495	Primary
UDU-03-XRF-07	422896.73	5400800.79	48.7554	-118.0490	Primary
UDU-03-XRF-08	422914.23	5400765.79	48.7551	-118.0488	Primary
UDU-03-XRF-R01	422949.23	5400765.79	48.7551	-118.0483	Reserve
Soil Decision Unit 4					
UDU-04-XRF-01	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-04-XRF-02	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-04-XRF-03	422826.73	5400870.79	48.7561	-118.0500	Primary
UDU-04-XRF-04	422896.73	5400870.79	48.7561	-118.0490	Primary
UDU-04-XRF-05	422879.23	5400835.79	48.7558	-118.0493	Primary
UDU-04-XRF-R01	422861.73	5400870.79	48.7561	-118.0495	Reserve
UDU-04-XRF-R02	422914.23	5400905.79	48.7564	-118.0488	Reserve
Soil Decision Unit 5					
UDU-05-XRF-01	423595.75	5401448.21	48.7614	-118.0396	Primary
UDU-05-XRF-02	423562.75	5401426.21	48.7612	-118.0401	Primary
UDU-05-XRF-03	423584.75	5401426.21	48.7612	-118.0398	Primary
UDU-05-XRF-04	423551.75	5401404.21	48.7610	-118.0402	Primary
UDU-05-XRF-05	423573.75	5401404.21	48.7610	-118.0399	Primary
UDU-05-XRF-06	423540.75	5401382.21	48.7608	-118.0404	Primary
UDU-05-XRF-07	423562.75	5401382.21	48.7608	-118.0401	Primary
UDU-05-XRF-08	423551.75	5401360.21	48.7606	-118.0402	Primary
UDU-05-XRF-09	423540.75	5401338.21	48.7604	-118.0404	Primary
UDU-05-XRF-10	423485.75	5401316.21	48.7602	-118.0411	Primary
UDU-05-XRF-11	423507.75	5401316.21	48.7602	-118.0408	Primary
UDU-05-XRF-12	423496.75	5401294.21	48.7600	-118.0410	Primary
UDU-05-XRF-13	423485.75	5401272.21	48.7598	-118.0411	Primary
UDU-05-XRF-R01	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R02	423529.75	5401360.21	48.7606	-118.0405	Reserve
UDU-05-XRF-R03	423518.75	5401338.21	48.7604	-118.0407	Reserve

Table A1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-XRF-R04	423474.75	5401294.21	48.7600	-118.0413	Reserve
UDU-05-XRF-R05	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R06	423529.75	5401360.21	48.7606	-118.0405	Reserve
UDU-05-XRF-R07	423518.75	5401338.21	48.7604	-118.0407	Reserve
UDU-05-XRF-R08	423474.75	5401294.21	48.7600	-118.0413	Reserve
Soil Decision Unit 6					
UDU-06-XRF-01	422281.43	5400935.14	48.7566	-118.0574	Primary
UDU-06-XRF-02	422251.68	5400895.96	48.7562	-118.0578	Primary
UDU-06-XRF-03	422216.89	5400862.07	48.7559	-118.0583	Primary
UDU-06-XRF-04	422187.13	5400822.90	48.7556	-118.0587	Primary
UDU-06-XRF-05	422154.20	5400786.40	48.7552	-118.0591	Primary
UDU-06-XRF-R01	422261.53	5400920.83	48.7564	-118.0577	Reserve
UDU-06-XRF-R02	422231.77	5400881.66	48.7561	-118.0581	Reserve
UDU-06-XRF-R03	422202.01	5400842.49	48.7557	-118.0585	Reserve
UDU-06-XRF-R04	422172.25	5400803.31	48.7554	-118.0589	Reserve
SDU-06-XRF-R03	425276.24	5393873.90	48.6934	-118.0154	Reserve
SDU-06-XRF-R04	425298.74	5393738.90	48.6922	-118.0151	Reserve
Sediment Decision Unit 7					
SDU-07-XRF-01	425254.78	5393031.17	48.6858	-118.0155	Primary
SDU-07-XRF-02	425194.78	5392911.17	48.6848	-118.0163	Primary
SDU-07-XRF-03	425134.78	5392791.17	48.6837	-118.0171	Primary
SDU-07-XRF-04	425074.78	5392671.17	48.6826	-118.0179	Primary
SDU-07-XRF-R01	425224.78	5392971.17	48.6853	-118.0159	Reserve
SDU-07-XRF-R02	425164.78	5392851.17	48.6842	-118.0167	Reserve
SDU-07-XRF-R03	425104.78	5392731.17	48.6831	-118.0175	Reserve
Sediment Decision Unit 8					
SDU-08-XRF-01	423209.27	5401902.00	48.7654	-118.0450	Primary
SDU-08-XRF-02	423131.27	5401824.00	48.7647	-118.0460	Primary
SDU-08-XRF-03	423072.77	5401746.00	48.7640	-118.0468	Primary
SDU-08-XRF-04	422994.77	5401668.00	48.7633	-118.0479	Primary
SDU-08-XRF-R01	423170.27	5401863.00	48.7650	-118.0455	Reserve
SDU-08-XRF-R02	423111.77	5401785.00	48.7643	-118.0463	Reserve
SDU-08-XRF-R03	423033.77	5401707.00	48.7636	-118.0473	Reserve
Sediment Decision Unit 9					
SDU-09-XRF-01	422480.15	5401083.34	48.7579	-118.0548	Primary
SDU-09-XRF-02	422419.13	5401027.18	48.7574	-118.0556	Primary
SDU-09-XRF-03	422373.05	5400950.09	48.7567	-118.0562	Primary
SDU-09-XRF-04	422326.96	5400873.00	48.7560	-118.0568	Primary
SDU-09-XRF-R01	422449.64	5401055.26	48.7577	-118.0552	Reserve
SDU-09-XRF-R02	422403.56	5400978.17	48.7570	-118.0558	Reserve
SDU-09-XRF-R03	422342.54	5400922.01	48.7565	-118.0566	Reserve
Sediment Decision Unit 10					
SDU-10-XRF-01	422246.13	5400805.54	48.7554	-118.0579	Primary
SDU-10-XRF-02	422198.11	5400743.74	48.7548	-118.0585	Primary
SDU-10-XRF-03	422150.09	5400681.94	48.7543	-118.0592	Primary
SDU-10-XRF-04	422102.07	5400620.14	48.7537	-118.0598	Primary
SDU-10-XRF-R01	422222.12	5400774.64	48.7551	-118.0582	Reserve
SDU-10-XRF-R02	422174.10	5400712.84	48.7546	-118.0588	Reserve
SDU-10-XRF-R03	422126.08	5400651.04	48.7540	-118.0595	Reserve

Table A2. Sampling Containers, Preservation, and Holding Time Requirements for Sediment and Soil Chemistry

Analysis	Container		Preservation	Holding Time	Minimum Laboratory Sample Size	Total Minimum Sample Size Needed [a, b]
	Type	Size				
Whole Sediment	Plastic	1 gallon	4 ± 2ºC			
Grain size				6 months	100 g	100 g
Sediment < 2 mm size fraction						51 g[f]
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	
Percent moisture				6 months	10 g	
pH				7 days	20 g	
Total organic carbon				28 days	1 g	
Sediment < 250 µm size fraction						22 g[g]
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	
IVBA [e]				6 months	2 g	
Whole Soil	Plastic	1 gallon	4 ± 2ºC			100 g
Grain size				6 months	100 g	
Soil < 2 mm size fraction						151 g[f]
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	
Percent moisture				6 months	10 g	
pH				7 days	20 g	
Total organic carbon				28 days	1 g	
CEC				14 days	100 g	
Soil < 150 µm size fraction						22 g[h]
TAL metals						
EPA 6020A metals [c]				6 months	10 g	
EPA 6010C metals [d]				6 months	10 g	
IVBA [e]				6 months	2 g	

Notes:

[a] Total sample size does not include additional sample volumes needed for laboratory quality control or field duplicate samples.

[b] Project field duplicate samples should be collected for 10 percent of all analytical sediment samples and submitted blind to the analytical laboratory.

[c] TAL metals—aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, and zinc.

[d] TAL metals—calcium, iron, magnesium, potassium, and sodium.

[e] Samples will be sieved by the analytical laboratory.

[f] Mass represents the amount of <2 mm sieved material.

[g] Mass represents the amount of <250 µm sieved material.

[h] Mass represents the amount of <150 µm sieved material.

CEC - cation exchange capacity

TAL - target analyte list

IVBA - *in vitro* bio-accessibility assay (lead and arsenic only)

ATTACHMENT A1

GENERAL SITE HEALTH AND SAFETY PLAN ADDENDUM
BOSSBURG FLAT BEACH REFINED SEDIMENT AND SOIL STUDY

CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
COPC	chemical of potential concern
GPS	global positioning system
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 (Exponent Inc.) for the Bossburg Flat Beach Refined Sediment Study at the Upper Columbia River (UCR) site (Site) in support of the remedial investigation and feasibility study (RI/FS) for the Site.

Exponent Task Manager Date

Exponent Corporate Health and Safety Officer Date

SITE HEALTH AND SAFETY PLAN ADDENDUM ACKNOWLEDGEMENT

This Addendum to the general SHSP (TCAI 2009) is approved by 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 Exponent 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
Employee signature	Company	Date
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1 INTRODUCTION

This Addendum to the UCR RI/FS general SHSP 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 the Addendum and the general SHSP, and any discrepancies will follow the most protective practices.

It is Exponent'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.

Exponent 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 crew 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 Exponent's project file. A copy of the form will be provided to 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 onsite team during a safety briefing and will be recorded in the field notebook.

1.1 ORGANIZATION

Task-specific safety procedures associated with sediment and 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

Sediment and soil samples will be collected at stations in near-shore sediments and soil adjacent to and down-gradient of the Young America Mill (YAM) site. Specifically, in areas adjacent to the former YAM site, the former cable ferry landings, and along the east riverbank from Bossburg Flat Beach (river mile [RM] 716) to Evans Campground Beach (RM 710) on the UCR (see Site map, Attachment A1-1). Each sediment and soil sample will be collected using a stainless steel soil "punch" or a coring devise. Access to all of the sediment and soil collection areas will be by land. The coordinates of each sediment and soil sample station location will be surveyed using a global positioning system (GPS) unit.

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 2-1 summarizes potential physical hazards posed by proposed Site activities. Table 2-2 presents potential physical hazards that are expected to be present during sediment sampling activities.

Table 2-1. Summary of Activities and Potential Hazards

Activity	Potential Hazard
Sediment or 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 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 A1-2); 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 policy (Attachment A1-3); 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 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 sediment sampling activities, Tables 4-1 and 4-2 identify the PPE required for sampling.

Table 4-1. Level of Protection Required for Site Activities

	Level of Protection	
Site Activity	Initial[a]	Contingency[b]
Sediment or soil sampling	MD	Leave Site, reassess situation
Sample handling	D	Leave Site, reassess situation

[a] See Table 4-2 for definitions

[b] Based on unexpected change in Site conditions

Table 4-2. Levels of Protection and Personal Protective Equipment

Protection Level	Required	Personal Protection 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 onsite 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
[X]	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 sediment or soil sampling activities. If windblown dust becomes problematic to the field crew, operations may be suspended. Tables 5-1 and 5-2 provide air monitoring requirements and action levels to be used during sampling activities.

Table 5-1. Site-specific Air Monitoring Requirements

Monitoring Instrument	Calibration Frequency	Parameters of Interest	Monitoring Frequency
Visual	N/A	Dust	Continuous

Table 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 6-1 for local contact information)
- [X] Facility emergency medical provider
- [X] First aid-trained field staff (for remote areas only)

Table 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 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/ hill, drive a little further 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.	TBD	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 A1- 1)		

In case of serious injuries, death, or other emergency, the TAI and Exponent task managers must be notified immediately. Contact numbers are listed in Table 6-2.

Table 6-2. Corporate Emergency Telephone Numbers

Corporate Resources	Name	Work/Cellular Telephone
TAI Task Manager	Kris McCaig	Work: (509) 623-4501 Cellular: (509) 434-8542
Exponent Task Manager	Anne Fairbrother	Work: (425) 519-8716 Cellular: (425) 213-7699

Table 6-3 provides local hospital contact and location information. See Attachment A1-1 for a detailed hospital location map.

Table 6-3. Project Area Hospital Information

Facility Name	Hours of Operation	Phone Number	Address	City
Coulee Community Hospital	24 hour emergency	509-633-1753	411 Fortuyn Road	Grand Coulee
Ferry County Memorial Hospital	24 hour emergency	509-775-3333	36 Klondike Road	Republic
Lincoln Hospital	24 hour emergency	509-725-7101	10 Nichols Street	Davenport
St Joseph's Hospital	24 hour emergency	509-935-8211	500 East Webster Street	Chewelah
Mount Carmel Hospital	24 hour emergency	509-684-2561	982 East Columbia Street	Colville
Deer Park Hospital	24 hour emergency	509-276-5061	East 1015 'D' Street	Deer Park

Table 6-3. Project Area Hospital Information (continued)

Facility Name	Hours of Operation	Phone Number	Address	City
Deaconess Medical Center-Spokane	24 hour 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 hour emergency	509-474-3131	West 101 Eighth Avenue	Spokane
Veterans Affairs Medical Center	7:30am-4:00pm	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 task manager. All incidents will be documented in the field logbook. If applicable, a corrective action form will be filled out (see Field Sampling Plan Attachment A1) 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. Because the majority of sampling will be on the water, and in remote locations, no designation (e.g., traffic cones or caution tape) will be utilized.

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 sediment or 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 sediment and 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 two-way radios or 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 four hours while performing field collection activities.

When working onboard a boat or near/over water, wear a PFD at all times. Inspect the PFDs daily prior to use and do not use if defective. Information on boating safety is presented in the general SHSP (TCAI 2009 Section 9.2).

Some of 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.

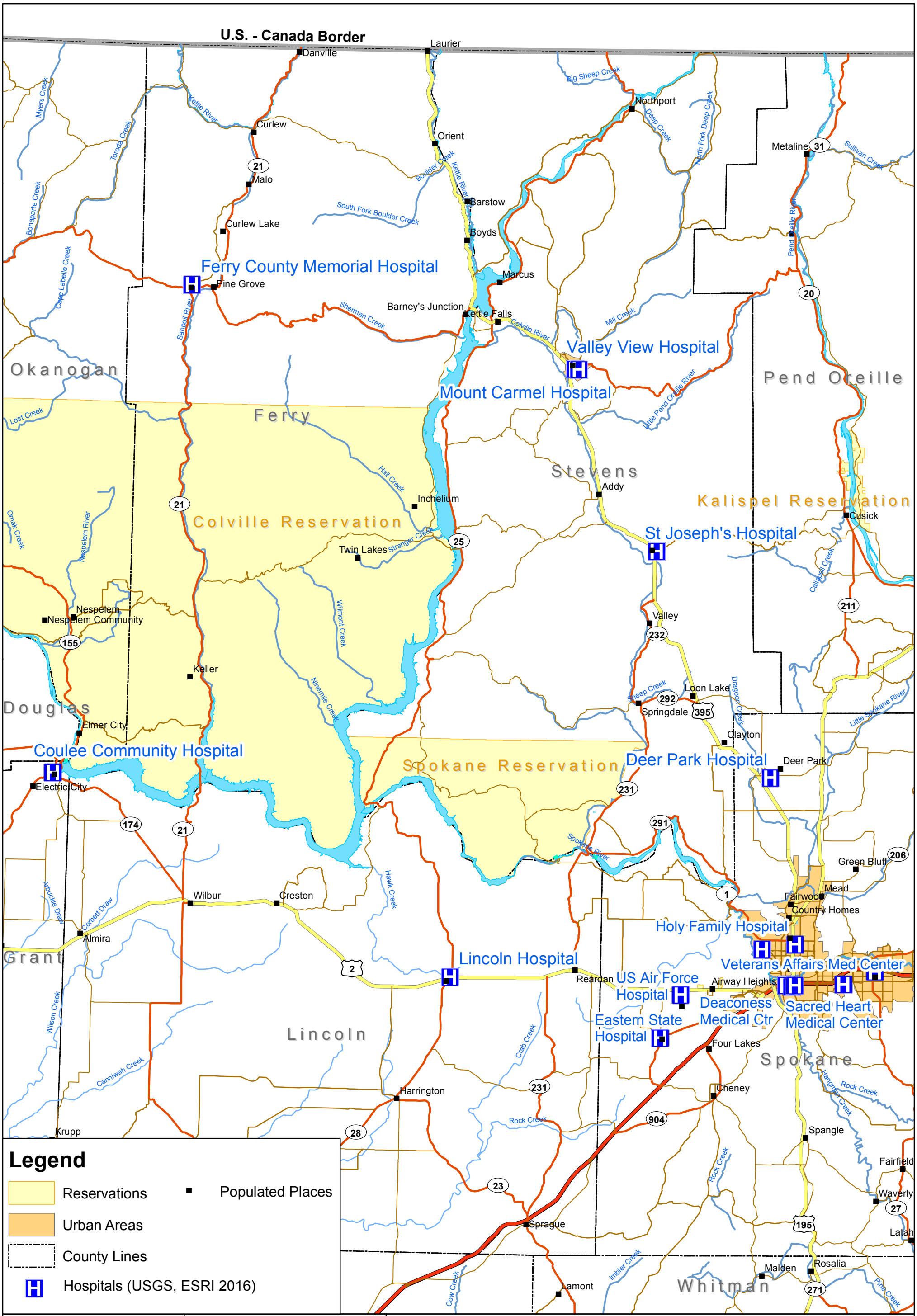
Always wear nitrile gloves and safety glasses or goggles when handling sampling equipment, samples, or preservative chemicals (if required). Keep a 1-liter eye wash bottle accessible during all field work. Avoid getting preservatives on your skin or clothes. If any preservatives are spilled or splashed 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

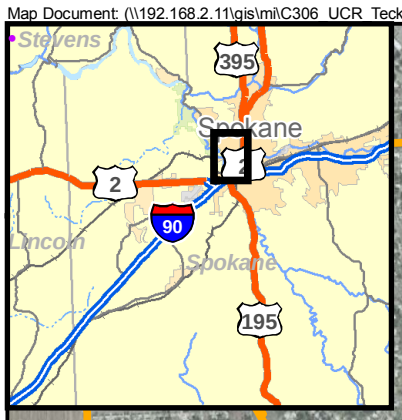
TCAI. 2009. Upper Columbia River general site health and safety plan for the remedial investigation and feasibility study. Prepared for Teck American Incorporated. Integral Consulting Inc., Mercer Island, Washington, and Parametrix, Bellevue, WA.

ATTACHMENT A1-1

SITE MAP AND HOSPITAL LOCATION MAPS


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

Map Document: (\\192.168.2.11\gis\mi\C306_UCR_Teck-Cominco\t0800_0802\UCR_SWQAPP_HospitalAllSpokane_05152008.mxd) JP-- 02/23/2009



Holy Family Hospital
North 5633 Lidgerwood Avenue
Spokane, WA
509-482-0111

Veterans Affairs Medical Center
North 4815 Assembly Street
Spokane WA
509-434-7032

St. Luke's Rehab
711 South Cowley Street
Spokane WA

Deaconess Medical Center-Spokane
800 West Fifth Avenue
Spokane WA
509-473-7178

Sacred Heart Medical Center
101 West Eighth Avenue
Spokane WA
509-474-3131

Indian Trail
Five Mile
Wall
Francis
291
Belt
A
Ash
Monroe
Driscoll
Wellesley
Maple
Empire
Garland
Courtland
Cochran
Euclid
Aubrey L White
Downriver Park
Northwest
North Foothills
Pettet
Indiana
Pettit
Mission
Maxwell
Summit
Broadway
Ohio
Spokane Falls
290
Riverside
Sprague
Browne
3rd
S
Stevens
Walnut
9th
Sumner
10th
Grand
14th
Bernard
Cedar
Sunset
195
2
90

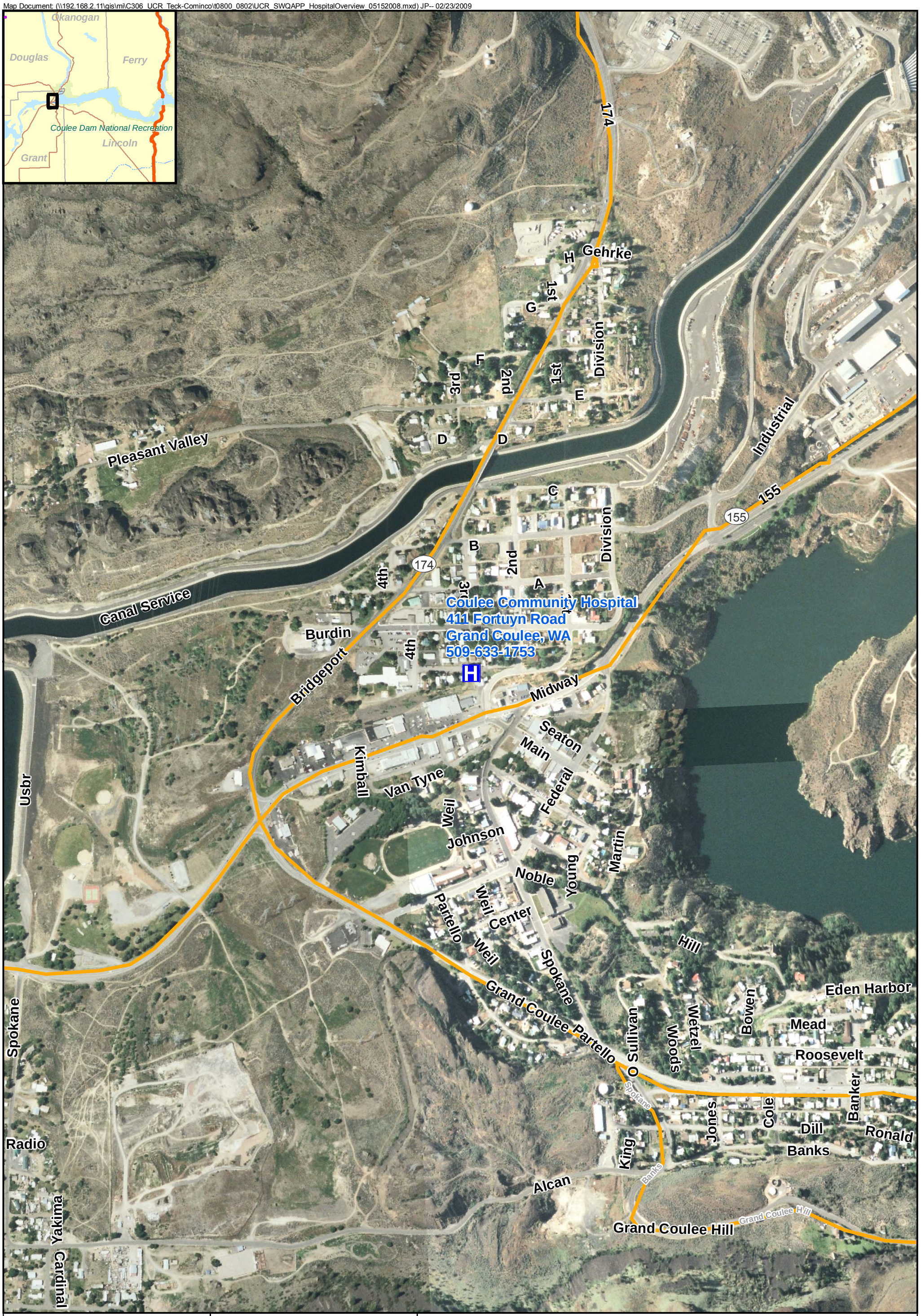
Integral Parametrix

Kilometers
0 0.25 0.5
Miles
0 0.25 0.5
N

Spokane Area Hospital Locations

Upper Columbia River, WA

Map Document: (\\192.168.2.11\gis\mi\C306_UCR_Teck-Cominco\t0800_0802\UCR_SWQAPP_HospitalOverview_05152008.mxd) JP-- 02/23/2009



Integral Parametrix

Meters
0 50 100

Feet
0 250 500

N

Coulee Community Hospital Location

Upper Columbia River, WA

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Dalton
5th
Reiper
4th
4th
Christensen
3rd
Forest
Margaret
3rd
Arcadia
2nd
2nd
Stevens
1st
Reiper
Crawford
Crawford
Crawford
Washington
Jefferson
High
A
Margaret
Mission
B
Arcadia
Washington
Evergreen
C
Orchard
Reiper
D
Deer Park Hospital
East 1015 D Street
Deer Park, WA
509-276-5061
Stevens
D
E
E
Parker
F
Forest
Colville
Arcadia
H
H
Dalton
I

Integral Parametrix

Meters
0 50 100
Feet
0 250 500
N

Deer Park Hospital Location

Upper Columbia River, WA

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Integral Parametrix

Meters
0 50 100
Feet
0 250 500
N

Ferry County Memorial Hospital Location

Upper Columbia River, WA

Map Document: (\\192.168.2.11\gis\mi\C306_UCR_Teck-Cominco\t0800_0802\UCR_SWQAPP_HospitalLincoln_05152008.mxd) JP-- 02/23/2009

Integral Parametrix

Meters
0 50 100

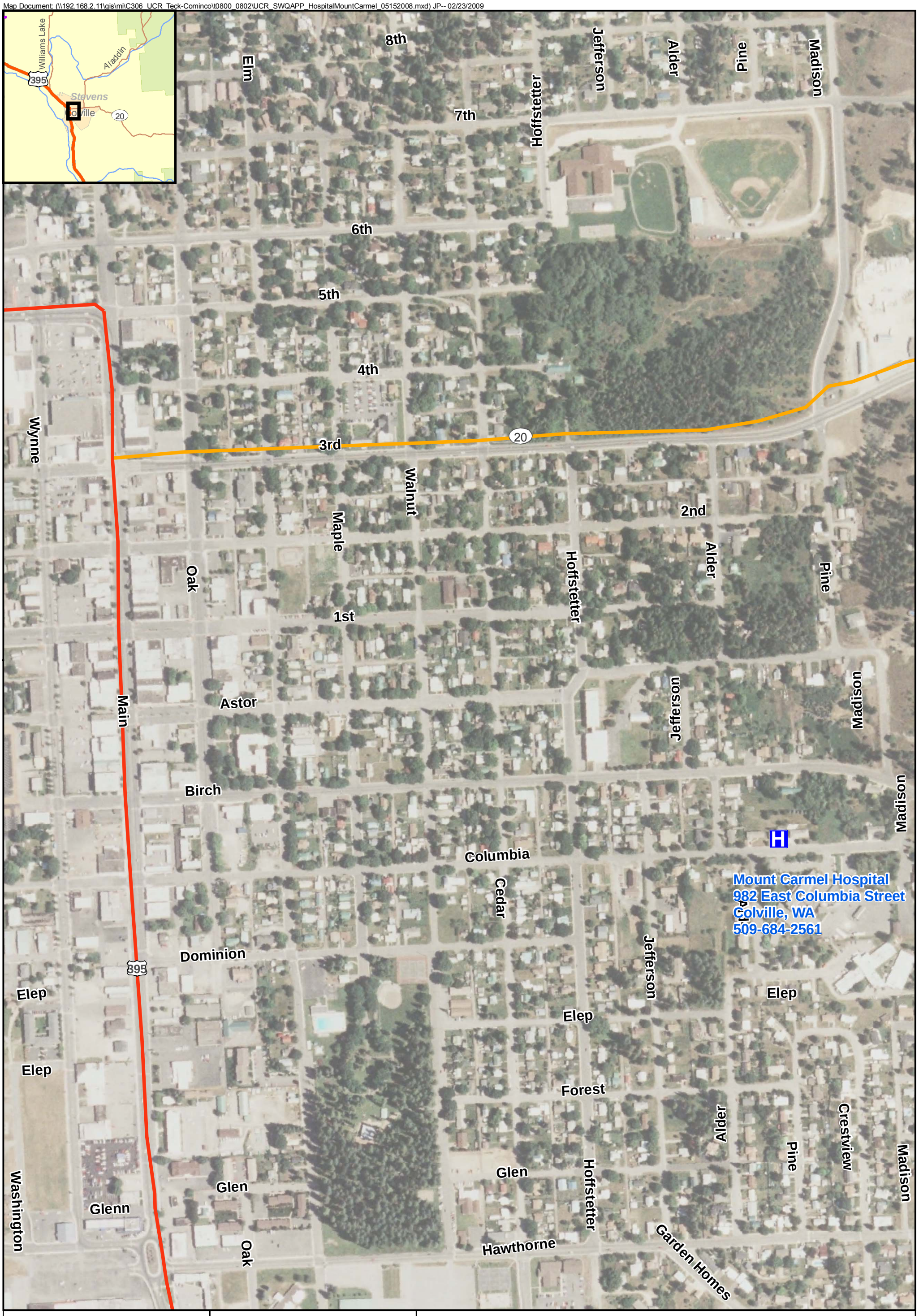
Feet
0 250 500

N

Lincoln Hospital Location

Upper Columbia River, WA

Map Document: (\\192.168.2.11\gis\mi\C306_UCR_Teck-Cominco\t0800_0802\UCR_SWQAPP_HospitalMountCarmel_05152008.mxd) JP-- 02/23/2009



Integral Parametrix

Meters
0 50 100

Feet
0 250 500

N

Mount Carmel Hospital Location

Upper Columbia River, WA

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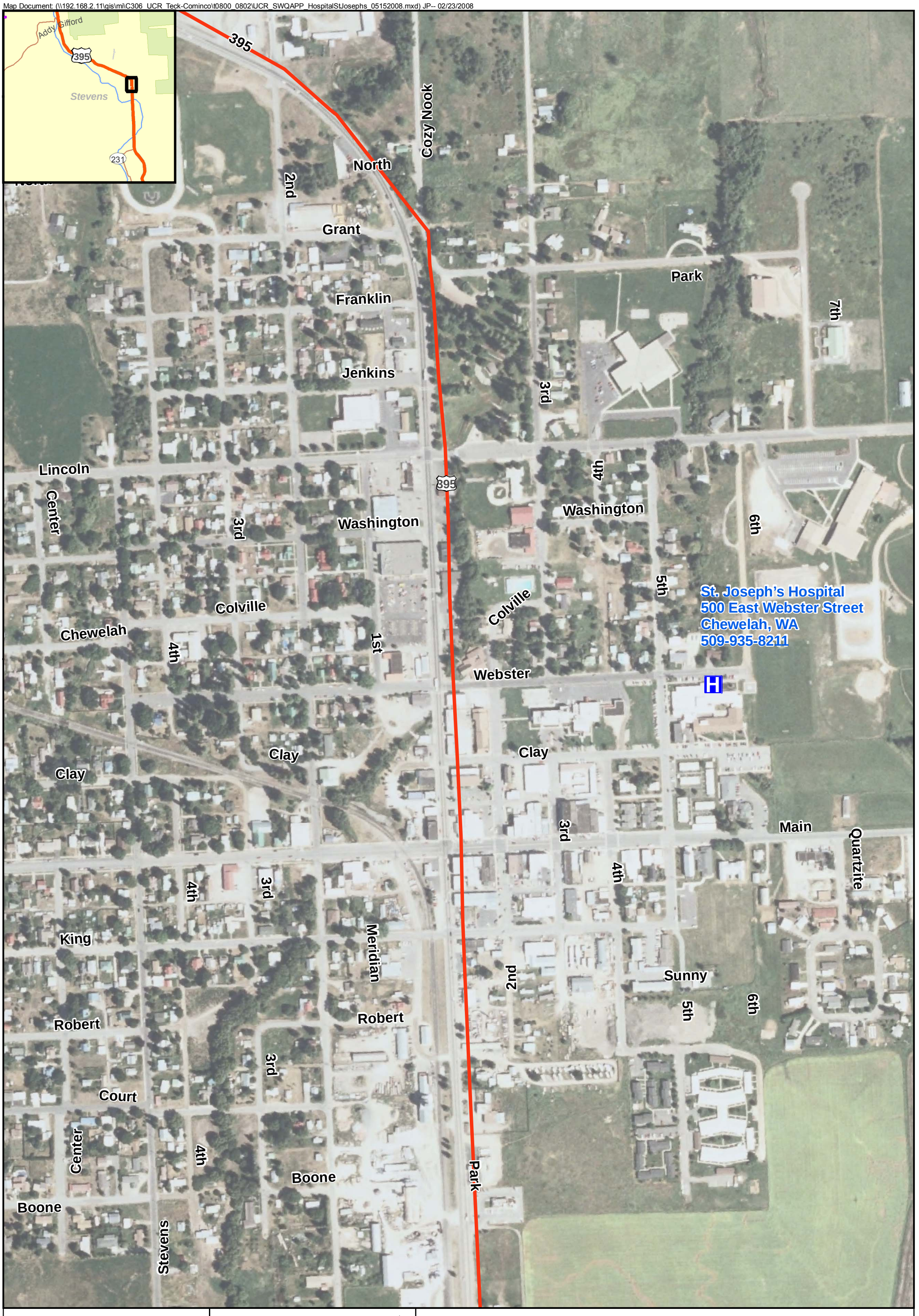


Integral Parametrix

Meters
0 50 100
Feet
0 250 500
N

St. Joseph's Hospital Location

Upper Columbia River, WA

ATTACHMENT A1-2

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.

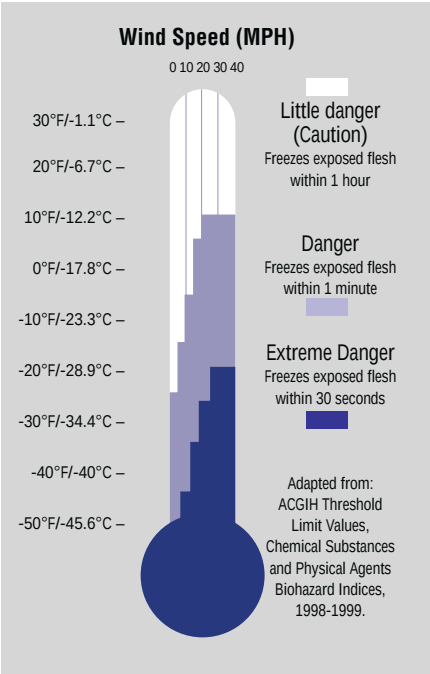
What to do: (water temperatures)

- 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 A1-3

HEAT-RELATED ILLNESS PREVENTION POLICY

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.)

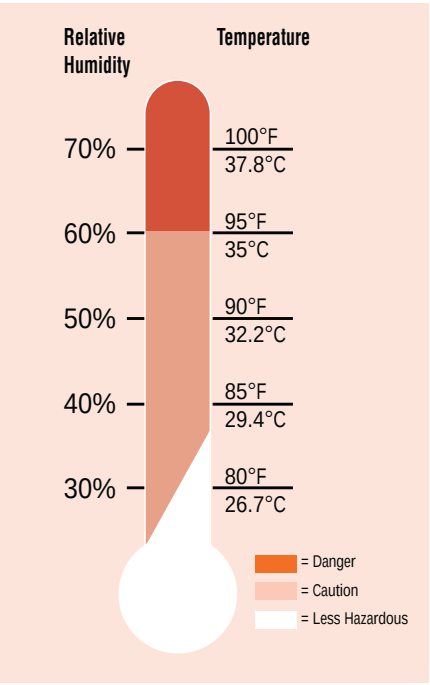
Workers are at increased risk when…

- 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
440-3333E-S(9/03)

ATTACHMENT A2

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE SOP-1

POSITIONING AT SAMPLE COLLECTION AREAS

Scope and Applicability

This standard operating procedure (SOP) describes procedures used for locating sampling stations for the Bossburg Flat Beach Refined Sediment and Soil Study. Accurate station positioning is required to help ensure quality and consistency in collecting samples and in data interpretation and analysis. Station positioning must be both absolutely accurate in that it correctly defines a position by latitude and longitude, and relatively accurate in that the position must be repeatable. The methods described in this SOP are usable for any handheld geographic positioning system (GPS); however, consult the owner's manual 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 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. If possible, GPS accuracy will be verified at the beginning or at the end of each sampling day.

Station Location Procedures

Pre-selected sampling station locations, along with other applicable geographic information systems (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 during the reconnaissance visit to sampling sites prior to the field sampling event. In the event a pre-selected location cannot be sampled, any alternative or additional locations sampled will be entered into the GPS unit and recorded in the field logbook.

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 stations (e.g., increment locations within each decision unit [DU]) will be visited. The stations then will be selected one at a time from the pre-determined locations that have been entered into the GPS unit. Upon selection of a target location, the positioning data of the location will be displayed on the handheld unit to assist the field team in proceeding to the location. A confirmed position will be recorded electronically at each location where samples are collected. Ancillary information will be recorded in the field logbook, and may include the personnel operating the GPS system, elevation, and the time samples were collected.

A brief summary of procedures to locate a specific increment location using a handheld GPS unit are as 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 sample is not accessible, move north within 2 m of the GPS location. If still inaccessible, move 2 m west, south and east, until a sample is obtained.
- Document the sample location elevation on the field data form.
- Save the sample location into the GPS memory, as well as note the site coordinates in the field log book.
- Charge the unit and batteries when not in use.

Upon completion of the sampling effort, all data points will be downloaded from the GPS unit and displayed in a GIS. Any discrepancies between the pre-determined increment locations and actual increment locations will be mapped and described with any supporting documentation in the field sampling report.

STANDARD OPERATING PROCEDURE SOP-2

INCREMENTAL COMPOSITE SAMPLE (ICS) SURFACE SAMPLE COLLECTION

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface sediment and soil samples (i.e., 0 to 15 cm below ground surface) using incremental composite sampling for the Bossburg Flat Beach Refined Sediment and Soil Sampling Study. The study quality assurance project plan describes the sampling rationale behind each of the decision units (DUs) to be sampled. The field sampling plan (FSP) lists each sampling location and the analytical analyses to be performed. The procedures listed below may be modified in the field by the field supervisor and field personnel, based on field and site conditions, after appropriate annotations have been made in the field logbook.

Equipment and Materials

This procedure will allow accurate, representative samples to be collected, but requires vigilant care and precision by each sample team member. The following is a list of equipment and materials needed by the sampling team:

- Handheld global positioning system (GPS) device
- Soil probes capable of collecting cores 4 cm in diameter and 15 cm deep (or equivalent)
- Tape measure
- Survey stakes or flags
- Maps
- Camera and digital storage card
- Field logbook
- Pens and pencils
- Chain-of-custody records and custody seals
- Field data sheets
- Sample labels
- 5-gallon plastic buckets
- Re-sealable plastic bags

- Cooler(s)
- Wet ice
- Canvas or plastic sheet on which to work with collected samples
- 2 mm sieve
- Disposable nitrile gloves for handling samples
- Radios (for communication)
- Project-specific FSP and health and safety plan (HSP).

Procedures for ICS Surface Sample Collection

The steps below detail sample collection procedures for this ICS sampling effort.

1. Transport field personnel and sampling equipment to the DU selected for ICS sampling.
2. Locate each increment location using a handheld GPS and convey sampling equipment and personnel to this location.
3. A cultural resources monitor will inspect and approve each ICS sample location.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).
5. Select a location to collect the sample within 2 m of the GPS increment location specified in Tables A1a and A1b. If a sample is inaccessible, move 2 m north of the GPS location, move 2 m west, then south and east until a sample is obtained. The actual increment location may be shifted from the planned GPS location to target available sediment or soil and avoid obstacles such as woody vegetation or rocks.
6. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
7. Collect the increment(s) from each increment location (see Tables A1a and A1b) using a decontaminated soil punch or equivalent sampling device.
    a. Increment samples for laboratory analysis will be collected using a 4-cm-diameter soil punch (or equivalent) from the 0 to 15 cm depth interval.
    b. All increments collected at an increment location should be collected as close as possible to the planned station location.
8. Place the increment into a quart-sized resealable plastic bag.

9. Allow the cultural resources representative to inspect the increment in the quart-sized bag(s).
    a. If the increment passes cultural resources review, continue sample collection.
    b. If the increment does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.
10. Transfer the increment for laboratory analysis from the quart-sized inspection bag into a 5-gallon bucket containing any previously collected increments from the DU.
11. Complete field documentation for this increment location.
12. Grossly decontaminate (brush off) sample collection equipment between increment locations within one DU. Fully decontaminate sampling equipment between DUs as described in Section 2.4 of Appendix A and SOP-5.
13. Discard DU-dedicated sampling equipment such as gloves, quart-sized inspection bags.
14. At the close of the field day, transfer ICS samples to sample coolers and store on ice at 4°C.
15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation.

STANDARD OPERATING PROCEDURE SOP-3

CORE SAMPLE COLLECTION

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface and subsurface core samples for the Bossburg Flat Beach Refined Sediment and Soil Sampling Study. Up to three surface and subsurface intervals will be collected: 0 to 15 cm (0 to 6 inches), 15 to 45 cm (6 to 12 inches), and 45 to 75 cm (12 to 18 inches). The depth to which subsurface intervals can be collected may be limited to the depth of refusal at any given coring station. The study quality assurance project plan describes the sampling rationale behind each of the Decision Units (DUs) to be sampled. The field sampling plan (FSP) lists each sampling location and the analytical analyses to be performed. The procedures listed below may be modified in the field by the field supervisor and field personnel, based on field and site conditions, after appropriate annotations have been made in the field logbook.

Equipment and Materials

This procedure will allow accurate, representative samples to be collected, but requires vigilant care and precision by each sample team member. The following is a list of equipment and materials needed by the sampling team:

- Handheld global positioning system (GPS) device
- Auger or coring device (e.g., stainless-steel bucket auger with special teeth, coring device with liner and core catcher, stainless-steel hand auger, or equivalent type of equipment) or equivalent
- Tape measure or stainless steel ruler
- Survey stakes or flags
- Maps
- Camera and digital storage card
- Field logbook
- Pens and pencils
- Chain-of-custody records and custody seals
- Field data sheets

- Sample labels
- Re-sealable plastic bags
- Cooler(s)
- Wet ice
- Canvas or plastic sheet on which to work with collected samples
- 2 mm sieve
- Disposable nitrile gloves for handling samples
- Radios (for communication)
- Project-specific FSP and health and safety plan (HSP).

Procedures for Core Sample Collection

The steps below detail the core collection procedures for this core sampling effort.

1. Transport field personnel and sampling equipment to a location for core sampling.
2. Determine each core location in consultation with EPA oversight personnel, convey sampling equipment and personnel to those locations, and record coordinates for each core sampling location using a handheld GPS.
3. A cultural resources monitor will inspect and approve each core sample location prior to any sediment or soil disturbance.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).
5. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
6. Collect surface and subsurface intervals from each coring location using a decontaminated auger or coring device (e.g., stainless-steel bucket auger with special teeth, coring device with liner and core catcher, stainless-steel hand auger, or equivalent type of equipment). A stainless steel ruler will be used to ensure that sediment from the correct interval is collected.
    a. All core samples collected at a location should be collected as close as possible to the station location selected in consultation with EPA oversight personnel.
    b. The target minimum sample mass to be collected for any core interval is 50 g (as determined above for ICS sample increments)

7. Sticks, twigs, rocks, and other large material will be manually removed.
8. Place each core interval into a quart-sized resealable plastic bag.
9. Allow the cultural resources representative to inspect the each core sample.
    a. If the core sample passes cultural resources review, continue sample collection.
    b. If the core sample does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.
10. Appropriately label each core interval for laboratory analysis.
11. Complete field documentation for this coring location.
12. Grossly decontaminate (brush off) sample collection equipment between coring attempts at a location. Fully decontaminate sampling equipment between coring locations as described in Section 2.4 and SOP-5.
13. Discard core sample-dedicated sampling equipment such as gloves, quart-sized inspection bags.
14. At the close of the field day, transfer core samples to sample coolers and store on ice at 4°C.
15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation.

STANDARD OPERATING PROCEDURE SOP-4

FIELD DOCUMENTATION

Scope and Applicability

This standard operating procedure (SOP) presents the general information that should be documented for all sediment and soil collection activities. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition. All information pertaining to field operations during sample collection must be properly documented to ensure transparency (and reproducibility) of methods and procedures. Several types of field documents will be used for this purpose by field personnel.

Equipment and Materials

- Field logbook
- Black waterproof ink pen
- Field forms
- Digital camera.

Field Logbooks

During field sampling events, field logbooks are used to record all daily field activities. The purpose of the field logbook is to thoroughly document the sampling event to ensure transparency and reproducibility. The field logbook will contain sediment and soil sampling-related information supplemental to the field data sheets. Any deviations from the project-specific field sampling plan that occur during sampling (e.g., personnel, responsibilities, sample station locations) and the reasons for these changes will be documented in the field logbook.

Sediment and soil samples should be characterized according to the following parameters, and recorded in field logbooks:

- Substrate type (e.g., sand, silt, clay)
- Texture (e.g., fine-grain, coarse, poorly sorted sand)
- Color
- Visual presence of biological structures (e.g., amphipods, plant roots, etc.)
- Presence of shells

- Presence of debris (e.g., twigs, leaves), especially organic debris
- Stratification, if any
- Presence of sheen, if any
- Odor (e.g., hydrogen sulfide), if any.

Other types of information that may be included in the field logbook include the following:

- Project sampling name/type
- Name of person making entries and other field staff
- On-site visitors, if any
- Observations made during sample collection, including collection complications, visible debris, and other details not entered onto the field form
- Any surface vegetation that may be removed from the sampling location prior to sampling
- A record of site health and safety meetings, updates, and related monitoring
- Presence of construction/maintenance activities or man-made features that may influence sediment composition or transport
- The locations of nearby surface water features (e.g., streams, wetlands, oxbows) or anthropogenic influences (e.g., roads, houses, campsite)
- Equipment calibration records (e.g., instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration).

The field supervisor will maintain the field logbook and is responsible for ensuring that the field logbook and all field data forms are correct. Requirements for logbook entries will include the following:

- Entries will be made legibly with black (or dark) waterproof ink
- Unbiased, accurate language will be used
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself)
- Each consecutive day's first entry will be made on a new, blank page
- The field supervisor must sign and date the last page of each daily entry in the field logbook
- When field activity is complete, the logbook will be entered into the technical team project file.

All logbook entries must be completed at the time any observations are made. Logbook corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation. When possible at the end of each day of sampling, backup copies of the pages having entries for the current day should be made. These copies should be stored at a secure location (e.g., the hotel room) and not returned to the field.

Upon completion of the field sampling event, the field supervisor will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

Field Data Forms

Field data forms will be used during this field sampling event to record the relevant sample information collected during a sampling event. These forms will be filled out completely by the sampling team during each sediment and soil collection and will include the following information:

- Project name and date
- Names of all members of the sampling team
- A brief description of the weather
- The time each station had sediment or soil collected
- The station number
- Station location details from the GPS–latitude, longitude, positional accuracy, and elevation
- The sample ID and analysis to be performed
- A list of photograph numbers taken at the site
- Any additional collection comments.

Upon completion of the field sampling event, the field supervisor will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

Photographs

In certain instances, digital photographs of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Photographs should include a measured scale in the picture, when practical (e.g., ruler, pencil, coin, etc.). Photographs may also be taken of sample characteristics and routine sampling activities. Telephoto or wide-angle shots

will not be used because they cannot be used in enforcement proceedings. The following items should be recorded in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work portrayed in the picture
3. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up compact disk (CD) number (if applicable).

Upon completion of the field sampling event, the field supervisor will be responsible for submitting all photographic materials to be copied to CDs. The CDs will be placed in the project files (at the task manager's location). Photo logs and any supporting documentation from the field logbooks will be photocopied and placed in the project files with the disks.

Distribution of Copies

Electronic scans of the field logbooks and field data forms will be made after completion of the field sampling event and stored electronically in the project files for use by project staff. The original field logbooks and forms will be placed in a locked file cabinet at the task manager's location.

Set-up of Locking File Cabinet

Each field event will have its own dedicated section in a locking file cabinet. The section label will include the project name and work order number. The following documents may be included in this folder for each field event:

- Original field logbook(s)
- Original field data forms
- Photograph CDs
- Original signed chain of custody forms.

STANDARD OPERATING PROCEDURE SOP-5

DECONTAMINATION OF SEDIMENT AND SOIL SAMPLING EQUIPMENT

This standard operating procedure (SOP) describes procedures for decontaminating sampling and processing equipment contaminated by inorganic materials. To prevent potential cross contamination of samples, all reusable sediment and soil sampling and processing equipment will be decontaminated before each use. Reusable sampling equipment includes the stainless steel scoops, bowls, spoons, 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 site-specific health and safety plan.

Equipment and Materials

Equipment required for decontamination includes the following:

- Polyethylene or polypropylene tub (to collect solvent rinsate)
- Plastic bucket(s) (e.g., 5-gallon bucket)
- Tap water or site water
- Properly labeled squirt bottles (or large spray bottles if needed)
- Funnels
- Alconox®, Liquinox®, or equivalent industrial detergent
- 10 percent (v/v) nitric acid (reagent grade) for inorganic contaminants
- Baking soda
- Long-handled, hard-bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Personal protective equipment as specified in the health and safety plan.

Decontamination Procedures

Reusable sampling equipment should be decontaminated before and after the sampling effort, between sampling stations, and at any other times specified by the field sampling plan (FSP). The specific procedure for decontaminating reusable sampling equipment is as follows:

1. Rinse the equipment thoroughly with tap or site water to remove any visible sediment or soil or debris.
2. Pour a small amount of concentrated laboratory detergent into a bucket (e.g., about ½-tablespoon per 5-gallon bucket) and fill it halfway with tap or site water. If the detergent is in crystal form, all crystals should be completely dissolved prior to use.
3. Scrub the equipment in the detergent solution using 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 sediment or soil. Remove all particulate matter and surface films.
4. Double rinse the equipment with tap or site water and set right-side-up on a stable surface to drain.
5. Carefully rinse the equipment with 10 percent nitric acid (HNO_3) from a squirt bottle, and let the excess solvent drain into a waste container (which may need to be equipped with a funnel). This solvent acts primarily to remove metal contamination. Ensure that the stream of solvent contacts all of the surfaces of the sampling equipment.
6. Set the equipment in a clean location and allow it to air dry.
7. Rinse with tap or site water. Equipment does not need to be dried before use.
8. If the decontaminated sampling equipment is not to be used immediately, wrap small items in aluminum foil (dull side facing the cleaned area).
9. If the sample collection or processing equipment is cleaned at the laboratory and transported to the site, then the decontaminated equipment will be wrapped in aluminum foil (dull side facing the cleaned area) and stored and transported in a clean plastic bag (e.g., a trash bag) until ready for use, unless the project-specific FSP lists special handling procedures.
10. Transfer decontamination fluids to a sealable container and properly dispose of them.

If the surface of the stainless steel equipment appears to be rusting (possibly due to prolonged contact with organic-rich sediment or soil), it should be given an acid rinse, followed by a site-water rinse at the end of each sampling day to minimize corrosion.

STANDARD OPERATING PROCEDURE SOP-6

SAMPLE LABELING

Scope and Applicability

This standard operating procedure (SOP) describes the general procedures for completing sample labels that will be used for the Bossburg Flat Beach Refined Sediment and Soil Sampling Study. Consult the project-specific field sampling plan (FSP) regarding the rationale behind the sample labeling protocol.

Equipment and Materials

- Sample labels
- Indelible marker
- Tables A1a through A1d of the FSP.

Sample Identification

Sample identifiers will be established before field sampling begins and assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes 1) to identify related samples (i.e., duplicates) to ensure proper data analysis and interpretation; 2) to clearly connect sample results to sampling locations; and 3) to track individual sample containers to ensure that the analytical chemistry laboratory receives all of the material associated with a single sample. The codes used are described below.

Each distinct sample will be assigned a unique identifier based on DU type (which indicates medium sampled), collection method/analysis performed, and station number (where appropriate) as shown below:

- Decision unit number or ferry landing area: SDU-## = sediment DU number; UDU-## = upland (soil) DU number; F-1 = east bank cable ferry landing; F-2 = west bank cable ferry landing.
- Collection method/analysis performed: ICS = incremental composite sample; XRF = X-ray fluorescence sample; COR = coring sample.
- ICS replicate identifier = A, B, or C (ICS samples only)
- XRF station or core number: ## = station number (XRF and core samples only, includes both sediment and upland decision units)

- Core interval: ### = interval number for a core sample (001 = 0 to 15 cm; 002 = 15 to 45 cm; 003 = 45 to 75 cm)
- ER = equipment rinsate blank (equipment blanks only).

Example sample identification numbers (IDs)s are:

- SDU-02-ICS-C = sediment sample collected using incremental composite sampling from sediment DU 2, replicate C
- UDU-05-ICS = soil sample collected using incremental composite sampling from soil DU 5
- UDU-01-XRF-05 = soil sample collected from upland DU 1 for XRF analysis at XRF station 05
- SDU-08-COR-01-001 = sediment core sample collected from sediment DU 8, core number 1, from the 0 to 15 cm interval
- SDU-10-ER = equipment rinsate taken at sediment DU 10.

DU types are as follows:

- Sediment Decision Units: SDU
- Soil (Upland) Decision Units: UDU
- Former Cable Ferry Landing: F-1 (east bank), F-2 (west bank).

DU numbers form the next part of the sample ID, a value between 01 and 10 depending on the area (see Tables A1a through A1d). For the purpose of the sample ID, all DU numbers are two digits (e.g., 01, 07, 10).

Sample type forms the next part of the sample ID, with ICS for incremental composite sample, XRF for X-ray fluorescence, and COR for core samples. For triplicate ICS samples, the sample type will be immediately followed by an A, B, or C to signify the first, second or third sample of the set.

Station numbers form the next part of the ID for XRF samples: a value between 01 and 13 for primary XRF locations and R01 and R08 for reserve XRF locations depending on the DU (see Tables A1c through A1d), and a value between 001 and 003 for core locations.

Interval numbers form the next part of the IS (core samples only), as a three digit value:

- 001 = surface interval (0 to 15 cm)
- 002 = intermediate subsurface interval (15 to 45 cm)
- 003 = deepest subsurface interval (45 to 75 cm)

Field duplicate samples will be assigned unique identifiers in the field using fictitious station ID numbers that will be clearly document in the field notes. These samples will not be identifies as field duplicates to the laboratory.

Equipment rinsate blanks are collected to identify possible contamination from the sampling environment or sampling equipment (e.g., stainless-steel scoops, bowls). Equipment rinsate blanks will be generated once a day for each kind of sampling equipment used. After equipment decontamination is complete, an equipment rinsate blank will be collected by running distilled/deionized water over the sampling equipment. The samples will be collected in a certified-clean glass container provided by the analytical laboratory.

Sample Labels

Sample ID information will be entered onto the sample label with an indelible marker. Other information that will be entered onto the sample label includes:

- Samplers' initials
- Date
- Time
- Preservative (if applicable).

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 sample labels will be placed on each sample container. Sample packaging is discussed in SOP-9 and SOP-10.

STANDARD OPERATING PROCEDURE SOP-7

X-RAY FLUORESCENCE (XRF) SURFACE SAMPLE COLLECTION

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface sediment and soil samples (i.e., 0 to 15 cm below ground surface) for X-ray fluorescence (XRF) analysis of lead concentrations for the Bossburg Flat Beach Refined Sediment and Soil Sampling Study. The study quality assurance project plan describes the sampling rationale behind each of the decision units (DUs) to be sampled. The field sampling plan (FSP) lists each sampling location and the analytical analyses to be performed. The procedures listed below may be modified in the field by the field supervisor and field personnel, based on field and site conditions, after appropriate annotations have been made in the field logbook.

Equipment and Materials

This procedure will allow accurate, representative samples to be collected, but requires vigilant care and precision by each sample team member. The following is a list of equipment and materials needed by the sampling team:

- Handheld global positioning system (GPS) device
- Innov-X alpha model a-4000s hand-held XRF unit or similar
- Tape measure
- Survey stakes or flags
- Maps
- Camera and digital storage card
- Field logbook
- Pens and pencils
- Chain-of-custody records and custody seals
- Field data sheets
- Sample labels
- 5-gallon plastic buckets
- Resealable plastic bags

- Cooler(s)
- Wet ice
- Canvas or plastic sheet on which to work with collected samples
- 2 mm sieve
- Disposable nitrile gloves for handling samples
- Radios (for communication)
- Project-specific FSP and health and safety plan (HSP).

Procedures for XRF Surface Sample Collection

The steps below detail the sample collection procedures for this XRF sampling effort.

1. Transport field personnel and sampling equipment to the DU for XRF sampling.
2. Locate each XRF location using a handheld GPS and convey sampling equipment and personnel to this location.
3. A cultural resources monitor will inspect and approve each XRF sample location prior to any sediment or soil disturbance.
4. Document the vegetation and any anthropogenic changes in the vicinity of the increment location in the field notebook. Take digital photographs of the increment location (record in the photo log).
5. Select a location to collect the sample within 2 m of the GPS increment location specified in Tables A1c and A1d. If a sample is inaccessible, move 2 m north of the GPS location, move 2 m west, then south and east until a sample is obtained. The actual increment location may be shifted from the planned GPS location to target sampleable substrate and avoid obstacles such as woody vegetation or rocks.
6. Clear large surface debris (e.g., woody debris, duff, vegetation, rocks) from the increment location. Retain organic matter overlying mineral soil.
7. Collect a sample from each XRF location (see Tables A1c and A1d) using a decontaminated soil punch or equivalent sampling device.
    a. XRF samples will be collected using a 4-cm-diameter soil punch (or equivalent) from the 0 to 15 cm depth interval.
    b. All XRF samples collected at a location should be collected as close as possible to the planned station location.
8. Sticks, twigs, rocks, and other large material will be manually removed prior to weighing.

9. Allow the cultural resources representative to inspect the each XRF sample in the quart-sized bag(s).
    a. If the XRF sample passes cultural resources review, continue sample collection.
    b. If the XRF sample does not pass cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.
10. The XRF sample will be weighed before drying and the weight (before drying) will be recorded on the sample analysis form.
11. Each XRF sample will be spread out in a decontaminated, shallow, disposable aluminum pan (or equivalent) and allowed to air dry. In accordance with EPA Method 6200 (Section 11.5), the sample will be considered dry when a constant weight is obtained.
12. The dried XRF sample will be weighed and the weight (after drying) will be recorded on the sample analysis form.
13. The XRF sample will be sieved using a decontaminated 2 mm sieve.
14. Following sieving, the sample will be mixed using ASTM (2006) or a comparable method to ensure full homogenization.
15. The sieved and mixed XRF sample will be placed in a clear plastic bag on a level surface and the soil will be slightly compacted to reduce application-related error (USEPA 2007).
16. The probe window of the XRF unit will be placed directly against the plastic bag during measurement.
17. The XRF analysis will be performed for 120 seconds and the reading for lead will be recorded on the sample analysis form.
18. The bag containing the sieved XRF sample will be turned over and a second XRF reading will be conducted for 120 seconds. The resulting lead concentration will be recorded on the sample analysis form.
19. The bag containing the sieved XRF sample will be turned over again and a third XRF reading will be conducted for 120 seconds. The resulting lead concentration will be recorded on the sample analysis form.
20. The average of the three determinations will be calculated. If all three determinations do not fall within 35 percent of the average value, the sample will be homogenized again and steps 14 through 17 will be repeated.

21. At 20 percent of XRF stations (with individual locations for be determined in the field in consultation with EPA oversight personnel), sieved XRF samples (a minimum of 35 g) will be properly labeled for confirmatory lead analysis.
22. Confirmatory samples will be transferred to sample coolers and store on ice at 4°C and shipped to the analytical laboratory along with all appropriate documentation.
23. After field XRF analysis is complete, any remaining sample will be disposed of in a manner consistent with other investigation-derived waste.

References:

ASTM (American Society for Testing and Materials). 2006. ASTM D6051-96 Standard guide for composite sampling and field subsampling for environmental waste management activities.

USEPA (U.S. Environmental Protection Agency). 2007. Field portable x-ray fluorescence spectrometry for the determination of elemental concentrations of soil and sediment. 32 pp.

STANDARD OPERATING PROCEDURE SOP-8

HANDLING AND REPORTING OF CULTURAL RESOURCES

Scope and Applicability

This standard operating procedure (SOP) describes the procedures to be followed by all Teck American Incorporated (TAI) field personnel, including subcontractors, if potential discoveries, including inadvertent discoveries, of cultural materials and deposits, and/or Indian burials and human remains occur during execution of the sediment and soil sampling effort. Cultural materials and deposits (including sacred objects, funerary objects, and objects of cultural patrimony) as well as Indian burials and human remains are defined in the Native American Graves Protection and Repatriation Act (NAGPRA).

The procedures detailed below were developed to ensure compliance with the National Historic Preservation Act and the applicable requirements, procedures, and standards of the National Park Service (NPS), Bureau of Reclamation (USBR), Confederated Tribes of the Colville Reservation (CCT), and the Spokane Tribe of Indians (STI). Detailed information regarding existing discovery protocols for these entities, as well as implementing regulations, notification requirements, archaeological monitoring requirements, and other cultural resource coordination activities for the remedial investigation and feasibility study (RI/FS) are provided in the cultural resources coordination plan (CRCP).

Discoveries When an Archaeological Monitor is 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 slowing or halting ground-disturbing activity is to allow the archaeological monitor/tribal representative to confirm and/or make a preliminary assessment of the discovery. At the discretion of the archaeological monitor or tribal representative, the discovery and the material in which it is contained may be returned to a location distinct from, but nearby, the original location of discovery. Any such relocation will be coordinated with the field 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 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 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 until a more extensive evaluation and documentation of the discovery can be made.

Notification of any cultural resources that have the potential to delay or halt sampling activities (i.e., human remains or items covered under NAGPRA) must be provided as soon as possible to the U.S. Environmental Protection Agency (EPA) for further coordination with the consulting parties.

Discovery of Human Remains

Native peoples in the 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 must be left undisturbed. If inadvertent disturbances 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 must 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. The protocol and notification procedures to be followed for any potential discoveries of human remains are provided in protocols of the NPS, USBR, CCT, and STI (Attachment 1 to the CRCP). Any discoveries within the boundaries of the Colville or the Spokane reservations must also be reported immediately to the respective tribe.

The TAI field team will assist the archaeological monitor and tribal representative in securing the location of the discovery.

Other conditions for responses to discoveries of archaeological materials may be defined in the Archeological Resources Protection Act permit(s) issued for the sampling program. As detailed in the CRCP, responses to any discoveries of burials must also comply with provisions of NAGPRA and its implementing regulations, as well as the existing protocols of the NPS, USBR, CCT, and STI (Attachment 1 to the CRCP).

Discoveries When an Archaeological Monitor is not Present

As previously stated, an archaeological monitor and/or tribal representative(s) will be present during all sampling activities. In the event, however, that suspected or evident artifacts or other archaeological deposits are encountered when an archaeological monitor or tribal representative is not present, the immediate vicinity of the discovery will be secured. The discovery will be mapped and photographed in place, but the discovery will be left as found (other than appropriate measures to secure the find and maintain security). In consultation with the land-managing agency or appropriate tribe, as well as other interested parties, TAI will arrange for the location of the discovery to be examined by a professional archaeologist and tribal representative in a timely manner. If the archaeologist confirms the presence of artifacts or other archaeological deposits, the procedures defined above for discoveries made during ground-disturbing activity monitored by an archaeologist will be implemented. The archaeologist will prepare appropriate State of Washington archaeological forms to document the find.

To ensure proper recognition of artifacts and other cultural items or deposits, all TAI field personnel will be trained by a professional archaeologist to recognize these materials prior to the initiation of any sediment and soil sampling.

Confidentiality

In accordance with state and federal law, all field personnel are required to keep the discovery of any found or suspected human remains, other cultural items, and potential historic properties confidential. Personnel will be instructed that they are prohibited from contacting the media or any third party, or otherwise sharing information regarding the discovery with any member of the public, and that they must immediately notify the field supervisor of any inquiry from the media or public. The field supervisor will then notify TAI of any such inquiries. To the extent permitted by law, prior to any release of information, TAI in coordination with EPA and 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.

STANDARD OPERATING PROCEDURE SOP-9

SAMPLE CUSTODY

Scope and Applicability

This standard operating procedure (SOP) describes procedures for custody management of environmental samples during the Bossburg Flat Beach Refined Sediment and Soil Study. The procedure outlined herein will be used in conjunction with SOP-4, which covers field documentation; SOP-6, which covers sample labeling; and SOP-10, which covers sample packaging and shipping.

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 the custody of a designated person unless the samples have been transferred to a secure area (i.e., locked up and custody sealed) or transferred to the 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, etc.).

Materials and Methods

- COC forms may be produced in an electronic format using a database program (e.g., FORMS II Lite), in which case a computer and printer would be needed as well
- Custody seals
- Shipping air bills.

Chain-of-Custody Forms

The COC form is critical because it documents 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 samples that are shipped.

The COC form will be completed after each field collection activity and before the samples are shipped to the laboratory. Project-assigned sample 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. Two COC form copies will be sent to the laboratory along with the sample(s). Copies of the COC form will be placed into a plastic re-sealable bag and secured to the inside top of each cooler. Another copy will be retained by the field supervisor for filing in the project files by the task manager 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 electronically for all samples on a secure computer. 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 the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.
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.
5. 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 two copies of the COC forms are signed, they should be sealed inside the transfer container. The other signed copy will be retained by the field supervisor.

6. 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.
7. Upon completion of the field sampling event, the field supervisor will be responsible for submitting all COC forms to be copied.

Custody Seal

As security against unauthorized handling of the samples during shipping, three custody seals will be affixed to each sample cooler. The custody seals will be placed across the front and on each side of the cooler prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

Shipped Air Bills

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), an air bill 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 air bills to the task manager. The air bill number (or tracking number) should be noted on the applicable COC form before they are sealed inside the cooler.

Acknowledgement of Sample Receipt

In most cases, on the day samples are received by the testing laboratory, the laboratory will confirm receipt with the task analytical chemistry laboratory coordinator. This confirmation may be via e-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 task analytical chemistry laboratory coordinator, the laboratory will be called immediately. Decisions made during any telephone conversation should be documented in writing and archived in the project file by the task manager. If necessary, corrections should be made to the COC form and the corrected version of the COC form should be sent to the laboratory (either via e-mail or facsimile) by the task analytical chemistry laboratory coordinator.

STANDARD OPERATING PROCEDURE SOP-10

SAMPLE STORAGE, PACKAGING, AND SHIPPING

Scope and Applicability

This standard operating procedure (SOP) presents the method to be used when packaging samples that will be either hand-delivered or shipped by commercial carrier to the analytical chemistry laboratory. Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations.

Equipment and Materials

Specific equipment or supplies necessary to properly package and ship environmental samples include the following:

- Field sampling plan (FSP) for the Upper Columbia River soil study
- Project-specific field logbook(s)
- Resealable airtight bags (assorted sizes)
- Wet ice in doubled, sealable bags; frozen Blue Ice®; or dry ice
- 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)
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 inch] thick) for cooler lining
- Paper towels
- "Fragile," "This End Up," "Handle With Care" or "Perishable" labels
- Mailing labels
- Airbills for overnight shipment.

Procedure

In some cases, samples may be transferred from the field to a secure, local storage facility where they can be refrigerated. 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, shipping regulations for "restricted articles" [e.g., dry ice]) 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 with wet ice at 4°C until they are packaged for shipping to the offsite analytical chemistry laboratory.

Sample Preparation

The following steps will be followed to ensure the proper transfer of samples from the field to the laboratory:

<u>At the sample collection site</u>

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 SOP-6.
2. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
3. Store each sample container in an individual sealable plastic bag that allows the sample label to be read.
4. Place a sufficient amount of wet ice in the sample cooler to maintain the temperature inside the cooler (e.g., 4°C) because the samples have a required storage temperature.
5. Store all sample containers in the coolers on wet ice until ready for shipping.

<u>To prepare samples and coolers for shipping</u>

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 plastic bucket 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, leaving sufficient room for ice to keep the samples cold (i.e., 4°C).

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 3 to the FSP).

5. Make sure all applicable laboratory quality control sample designations have been made on the COC forms. X-ray fluorescence (XRF) increment composite sampling (ICS) samples that will be archived for possible future analysis are to be clearly identified on the COC form and also labeled as "Do Not Analyze: Hold and Archive for Possible Future Analysis" because some laboratories interpret "archive" to mean continue holding the residual sample after analysis.

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. Add enough ice to keep the samples refrigerated during overnight shipping (i.e., 4°C) because the samples have a required storage temperature. Always overestimate the amount of ice that may be required. Place the ice in a resealable plastic bag and then in a second sealable plastic bag to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice 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 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.

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," "Handle With Care," and "Perishable." 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 at 4°C 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.

ATTACHMENT A3

EXAMPLES OF VARIOUS FIELD FORMS

CHAIN OF CUSTODY FORM

Page ____ of ____

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:

CHAIN OF CUSTODY FORM

Page ____ of ____

Example

Project: TAI UCR Soil Sampling

Samplers: Field S. Ampler, Helper S. Amplers

Project Contact: Project Manager

Office: Bellevue, Wa

Phone: 555-555-5555

Ship to:

Lab Name: Analytical Laboratory

Address: 111 Laboratory Lane

Seattle, WA 55555

Contact: Lab Mananger

Phone: 555-555-5555

Soil Sample No.	Date	Time	Matrix	Preservative (if any)	ANALYSES REQUESTED: Conventional Parameters	EPA TAL Metals	All Metal COIs	All Organic COIs		Extra Container	Archive	Comments
RF1-001	2010-06-01	1300	SO	None	x	x				N	N	None
RF1-002					x	x				N	N	None
RF1-003					x	x				N	N	None
RF1-004					x	x				N	N	None
RF1-005					x	x				N	N	None
RF1-006					x		x	x		N	N	None
RF1-007					x		x	x		N	N	None
RF1-008					x		x	x		N	N	None
RF1-009					x		x	x		N	N	None
RF1-010					x		x	x		N	N	None

Analysis Turn Time: (Normal) Rush Rush Results Needed By:

Shipped by: F. Sampler Shipping Tracking No.: 123456787463

Condition of Samples Upon Receipt: Custody Seal Intact?

Matrix Code:
SO - Soil
Other:

Relinquished by: Field S. Ampler *(signature)* **Date/Time:** 2010-06-01 1644 **Received by:** UPS *(signature)* **Date/Time:** 2010-06-01 1644

Relinquished by: *(signature)* **Date/Time:** **Received by:** *(signature)* **Date/Time:**

Special Intructions:

Custody Seal

CUSTODY SEAL

Example

Date: 2010-06-01 Time: 1630

Sampler Signature: *Field S. Ampler*

Sample Label

Example

Soil

Sample No: RF1-005 Date: 2010-06-01

Sampler: FSA Time: 0912

Preservative: None

	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:

SEDIMENT OR SOIL FIELD COLLECTION 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: _____

_____

XRF Sample Collection Field Form

Project Name:_____ Project No.:_____ Page:_____

Date:_____ Sampling Crew:_____

Weather:_____

Time:_____ Station ID:_____

Latitude:_____ Longitude:_____ Elevation:_____

Site Description (Ground cover/Vegetation):_____

_____

Photograph Number(s):_____

_____

Comments:_____

_____

Sample Start Depth (cm):_____ Sample End Depth (cm):_____

Sample Weight, before air drying (grams):_____

Sample Weight, after air drying (grams):_____

Field XRF Pb Concentration Measurement 1 (mg/kg):_____

Field XRF Pb Concentration Measurement 2 (mg/kg):_____

Field XRF Pb Concentration Measurement 3 (mg/kg):_____

Sample Selected for Confirmatory Analysis at Lab? □ Yes □ No

ATTACHMENT A4

ARCHAEOLOGICAL MONITORING PROTOCOL

CONTENTS

ACRONYMS AND ABBREVIATIONS

CCT	Confederated Tribes of the Colville Reservation
CRCP	cultural resources coordination plan
EPA	U.S. Environmental Protection Agency
NAGPRA	Native American Graves Protection and Repatriation Act
NPS	National Park Service
RI/FS	remedial investigation and feasibility study
STI	Spokane Tribe of Indians
Teck	Teck American Incorporated
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation

INTRODUCTION

This protocol provides a summary of procedures to be followed by all Teck American Incorporated (TAI) technical team field personnel, including subcontractors, should potential discoveries, of cultural materials and deposits, and/or Indian burials and human remains occur during execution of field sampling programs and other activities associated with the Upper Columbia River (UCR) Site remedial investigation and feasibility study (RI/FS). Cultural materials and deposits (including sacred objects, funerary objects, and objects of cultural patrimony) as well as Indian burials and human remains are defined in the Native American Graves Protection and Repatriation Act (NAGPRA).

The procedures detailed below were developed to ensure compliance with the National Historic Preservation Act and the applicable requirements, procedures, and standards of the National Park Service (NPS), U.S. Bureau of Reclamation (USBR), Confederated Tribes of the Colville Reservation (CCT), and the Spokane Tribe of Indians (STI). Detailed information regarding existing discovery protocols for these entities, as well as implementing regulations, notification requirements, archaeological monitoring requirements, and other cultural resource coordination activities for the RI/FS are provided in the draft cultural resources coordination plan (CRCP).

DISCOVERIES WHEN AN ARCHAEOLOGICAL MONITOR IS 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 cleanup activity is to allow the archaeological monitor/Tribal representative 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 still be within the sampling location. Such relocation will be coordinated with the field 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 Teck technical team will remain onsite 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 cultural resources that have the potential to delay or halt sampling activities (i.e., human remains or those items covered under NAGPRA) must be provided as soon as possible to the U.S. Environmental Protection Agency (EPA) for further coordination with the consulting parties.

DISCOVERY OF HUMAN REMAINS

Native peoples in the 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. The protocol and notification procedures to be followed for any potential discoveries of human remains are provided in protocols of the NPS, USBR, CCT, and STI (Attachment 1 to the CRCP). Any discoveries within the boundaries of the Colville or the Spokane reservations must also be reported immediately to the respective Tribe.

The Teck technical team will assist the archaeological monitor and Tribal representative in securing the location of the discovery.

Other conditions for responses to discoveries of archaeological materials may be defined in the Archeological Resources Protection Act permit(s) issued for the sampling program. As detailed in the CRCP, responses to any discoveries of burials must also comply with provisions of NAGPRA and its implementing regulations, as well as the existing protocols of the NPS, USBR, CCT, and STI (Attachment 1 to the CRCP).

DISCOVERIES WHEN AN ARCHAEOLOGICAL MONITOR IS NOT PRESENT

As previously stated, an archaeological monitor and/or Tribal representative(s) will be present during all sampling activities. In the event, however, that suspected or evident artifacts or other archaeological deposits are encountered when an archaeological monitor or Tribal representative is not present, the immediate vicinity of the discovery will be secured. The discovery will be mapped and photographed in place but will be otherwise left as found (other than appropriate measures to secure the find and maintain security). In consultation with the land-managing agency or appropriate Tribe, as well as other interested parties, Teck will arrange for the location of the discovery to be examined by a professional archaeologist and Tribal representative in a timely manner. If the archaeologist confirms the presence of artifacts or other archaeological deposits, the procedures defined above for discoveries made during ground-disturbing activity monitored by an archaeologist will be implemented. The archaeologist will prepare appropriate State of Washington archaeological forms to document the find.

To ensure proper recognition of artifacts and other cultural items or deposits, all Teck field personnel will be provided with training in recognizing these materials by a professional archaeologist prior to the initiation of any sediment and soil sampling.

CONFIDENTIALITY

In accordance with state and federal law, all field personnel are required to keep the discovery of any found or suspected human remains, other cultural items, and potential historic properties confidential. Personnel are instructed that they are prohibited from contacting the media or any third party or otherwise sharing information regarding the discovery with any member of the public, and that they should immediately notify the field supervisor of any inquiry from the media or public. The field supervisor will then notify Teck of any such inquiries. To the extent permitted by law prior to any release of information, Teck, in coordination with EPA and 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.

APPENDIX B

CULTURAL RESOURCES COORDINATION PLAN

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ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
ARPA	Archeological Resources Protection Act of 1979
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
EPA	U.S. Environmental Protection Agency
FOIA	Freedom of Information Act
Lake Roosevelt	Franklin D. Roosevelt Lake
MOA	Memorandum of Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
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)
cm/sec	centimeter(s) per second
ft	feet/foot
ft/sec	feet per second
gal	gallon(s)
in.	inch(es)
L	liter(s)
m	meter(s)

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) with emphasis placed for sampling activities associated with the Bossburg Flat Beach refined sediment and soil study.

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 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.

The Site is located wholly within Washington State and includes approximately 150 river miles of the Columbia River extending from the U.S.-Canada border to the Grand Coulee Dam. 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. To meet the NHPA requirements, EPA must ensure that sampling and other activities would avoid, minimize, or mitigate any adverse effects to 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 and its potential physical effects; and 4) a plan for coordination and consultation with all affected parties to address known and likely impacts to cultural resources in implementing the proposed work.

1.2 CULTURAL SETTING

The broader context of the cultural development of the upper Columbia region[1] provides the critical framework for understanding the importance of the 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.

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 resources. 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.

[1] The phrase "upper Columbia region" herein refers to the drainage of the upper Columbia River from around Grand Coulee to the Arrow Lakes area in British Columbia. The upper Columbia region includes, but is not limited to the Site as defined in the Settlement Agreement. This distinction is important because general patterns of cultural development in the upper Columbia region as a whole provide the framework for addressing the significance of the cultural resources within the Site boundaries.

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, Washington, 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 the 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 was 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 the home of the twelve tribes that comprise the Confederated Tribes of the Colville Reservation; the Spokane Reservation is the home of the Spokane Tribe of Indians.

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 upper Columbia River 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 RI/FS would occur primarily on federal and Tribal lands. Federal and Tribal laws and regulations addressing cultural resources will therefore provide the primary legal framework for this coordination plan. It is possible, however, that implementation of the RI/FS may require activities on private or non-federal, non-Tribal public lands. This overview therefore includes a brief description of relevant state laws and executive orders. Ferry, Lincoln, and Stevens counties, which border the UCR, do not appear to have any ordinances addressing cultural resources that would be relevant to the Site RI/FS.

Relevant federal, Tribal, and state laws and regulations directly addressing cultural resources are briefly outlined below, as well as pertinent executive orders issued by the President of the United States and the Governor of Washington.

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 and therefore complying with the NHPA requirements is the responsibility of EPA. The Archeological Resources Protection Act of 1979 (ARPA) 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 United States," 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 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 archeological 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 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 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 *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 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) actions.[2] 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 to significant resources must be either avoided or mitigated. Any proposed mitigation measures must be incorporated into the remedial design process.

2.1.2 Archeological 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 archeological resources from federal and Indian lands is also prohibited. Individuals convicted of

[2] As stated in the June 2, 2006 Settlement Agreement (USEPA 2006), "The Parties intend that this RI/FS, while not being carried out under an administrative order or judicial order issued pursuant to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), will be consistent with the National Contingency Plan ('NCP'), 40 CFR Part 300."

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."[3] 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 United States."

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] Cultural affiliation is defined in the implementing regulations [43 CFR 10.2(e)] and refers to a relationship of shared group identity, which can be reasonably traced historically or prehistorically between a present day Indian tribe or Native Hawaiian organization and an identifiable earlier group.

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 30 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 U.S. 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 of Historic Places 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 impacting 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 U.S. 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 Confederated Tribes of the Colville Reservation (CCT) and the Spokane Tribe of Indians (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 or non-federal 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 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 and 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 to historic and cultural resources are to be addressed in the State Environmental Policy Act process.

3 PROPOSED SAMPLING PROGRAM

A summary of the proposed sampling locations (coordinates) are provided within Tables B3-1a through B3-1d; with a detailed description of sampling techniques provided within the Quality Assurance Project Plan (QAPP). As indicated within the QAPP, sediment sampling activities will be completed to depths no greater than approximately 6 in. below ground surface using a decontaminated stainless-steel spade or shovel (or equivalent utensil; Lexan).

During this work, up to 879 primary and 232 reserve surface sediment and soil sampling locations between RM 710 and 716 have been identified for sample retrieval, see Figures B3-1 through B3-8. A detailed list of sampling station coordinates are provided within Tables B3-1a through B3-1d. In the event that samples cannot be retrieved from a primary sampling area, the nearest alternative sampling location will be sampled.

At each sampling station, whole sediments from the top 6 in. (15 centimeters) will be collected using a decontaminated, stainless-steel spade or shovel (or equivalent utensil; Lexan). A stainless-steel ruler will be used to ensure that sediment from the top 15 cm is collected. Samples will be placed into a decontaminated, stainless-steel bowl and homogenized using a stainless-steel spoon or other stainless-steel mixing implement until the sediment attains a visually uniform color and texture. Following cultural inspection and clearance, a decontaminated Lexan sampling scoop or similar device (e.g., stainless steel trowel or spoon) will be used to collect sediment for analytical testing per the quality assurance project plan. Sediment samples will then be placed in labeled, laboratory-cleaned sample containers with Teflon®-lined lids.

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.

The two chief challenges in meeting this objective are 1) the iterative process of remedial investigations; and 2) the high density of cultural resources in the study area. The iterative process is a challenge because there are likely to be several rounds of sampling (and associated actions) that extend over several years. Coordination and consultation must therefore also be an iterative process as methods and locations are defined for each round of sampling.

The high density of cultural resources is a challenge because it is highly likely that every round of intrusive sampling will occur at the identified location of one or more cultural resource(s). At the same time, the high density is potentially misleading by suggesting that all cultural resources in the UCR have been identified. Most—if not all—of the Lake Roosevelt lands have been surveyed for cultural resources in the past. 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 both known locations of cultural resources and locations where no cultural resources are presently recorded.

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 NPS, the USBR, the CCT, the STI, and the Washington SHPO (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 specialist or a professional archaeologist will be present on-site to monitor sediment sampling conducted at a known cultural resource or within 100 m (330 ft) of a known resource. The protocol for this monitoring is defined below.

4.2.1 Archaeological Monitoring in the Sampling Program

To assure compliance with the NHPA and the applicable requirements, procedures, and standards of the NPS, USBR, 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.

Notification of Planned Sediment and Soil Sampling

Teck American Incorporated (TAI) shall notify EPA at least 15 days in advance of any sample collection activity, unless shorter notice is agreed to by EPA. Notification to EPA may be provided by e-mail or by letter. As for all RI/FS activities at the Site involving sediment collection or ground penetration/disturbance, TAI shall 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. Further, sediment sampling cannot be performed at the Site without 1) clearance of proposed sediment sample locations by tribal and federal/state cultural resources coordinators, and; 2) approval by EPA.

The names and contact information for potentially affected parties (i.e., representatives of the federal land-managing agencies and Tribes) are provided in Attachment B1 of this plan. TAI will work with EPA to establish a procedure for timely notification of these parties.

Professional Archaeologist and Tribal Representative On-Site

An archeological monitor and/or Tribal representative will be present on-site when 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, 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 cleanup 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 Technical 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. All telephone notification of discoveries must be promptly followed by notification in writing (via e-mail or conventional mail).

Discovery of Human Remains

Native peoples in the 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. To comply with 43 CFR 10.4(b), any discoveries of human remains must be reported to the NPS and USBR immediately by telephone, followed by written notification. Any discoveries within the boundaries of the CCT or the STI reservations must also be reported immediately to the respective Tribe.

TAI will notify EPA for further coordination with consulting parties (consisting minimally of the NPS, USBR, CCT, STI, and the Washington SHPO). The TAI Technical 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 Technical 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 Technical Team will remain on-site until an archaeologist or Tribal representatives 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 NPS, USBR, CCT, and STI (copies of these protocols are provided in Attachment B1).

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 facility or facilities will be designated by the NPS and USBR in consultation with the Tribes for items recovered from federal lands. 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,[4] a professional archaeologist will prepare a confidential[5] written report and 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

[4] Sampling or other RI/FS activities that do not require coordination under this plan will not result in generation of this reporting requirement.

[5] Refer to Section 5.3, "Confidentiality."

may be appropriate to address results of the monitoring or how well existing coordination procedures worked.

The draft report will be provided to EPA for review and dissemination to the consulting parties for review and comment.

4.3 CONFIDENTIALITY

TAI 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.

5 REFERENCES

NPS (National Park Service). 1983 (with updates). Archeology and historic preservation: secretary of the interior's standards and guidelines [as amended and annotated]. National Park Service, Department of Interior. Available at: http://www.nps.gov/history/local-law/arch_stnds_9.htm

USEPA (United States Environmental Protection Agency). 1989. CERCLA compliance with other laws manual: Part II. Clean Air Act and other environmental statutes and state requirements. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

USEPA. 2006. Settlement agreement for implementation of remedial investigation and feasibility study at the Upper Columbia River Site. June 2, 2006. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

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.

FIGURES

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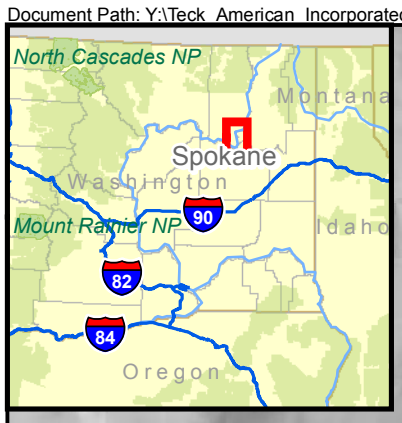

Ferry Landing Area

Hackley Parcel

SDU-8

SDU-1

716

YAM Area

SDU-2

Tailings Pond Outlet

Young America Mill Site

UDU-5

SDU-3

Young America Mine Site

SDU-9

F-1

UDU-6

F-2

UDU-1-4

Historic Ferry Site

SDU-10

715

SDU-4

Bossburg Area

Bossburg

714

713

25

712

Bear

Evans

Left Bank River Mile 711

Powell

SDU-5

711

Evans Campground Beach

SDU-6

Evans Campground Beach

710

SDU-7

Left Bank River Mile 710

709

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure B3-1. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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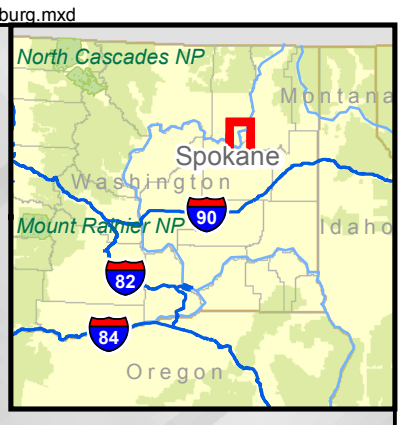

SDU-1
SDU-8
SDU-2
716
YAM Area
Young America Mill Site
Tailings Pond Outlet
(location uncertain)
UDU-5
Young America Mine Site
SDU-3
715
UDU-1
F-1
UDU-4
Historic
Ferry Site
1 inch = 175 feet
1 inch = 53 meters
Bossburg
Area
SDU-3
UDU- 1
UDU-3
Historic
Ferry Site
F-1
UDU-4
UDU-2
Bossburg
Flat
Beach
SDU-9
715
SDU-4
Hackley
Parcel
F-2
Ferry
Landing
Area
UDU-6
SDU-10

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 200 400 600 Feet

0 50 100 150 Meters

Figure B3-2. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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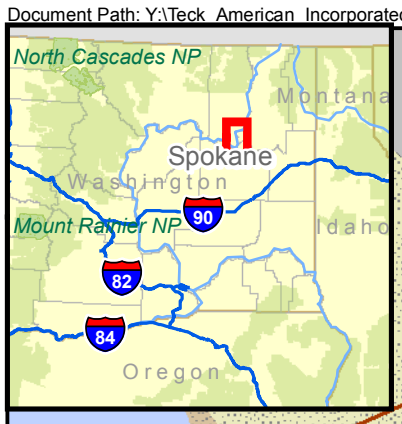

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 350 700 1,050 Feet

0 100 200 300 Meters

N

Figure B3-3. Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, ICS Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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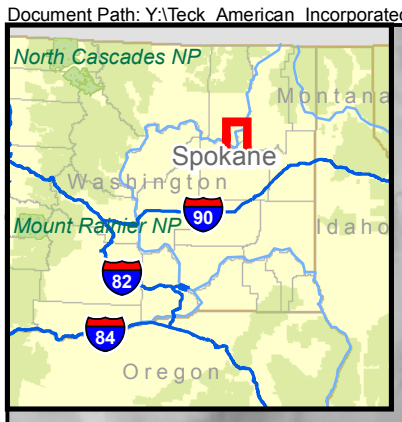

YAM Area

SDU-8

716

SDU-1

SDU-2

UDU-5

Tailings Pond Outlet

Young America Mill Site

Young America Mine Site

Hackley Parcel

SDU-9

SDU-3

UDU-1

UDU-6

UDU-4

Historic Ferry Site

Ferry Landing Area

SDU-4

UDU-3

UDU-2

SDU-10

715

Bossburg Area

Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714

713

25

712

Evans

Bear

Left Bank River Mile 711

SDU-5

Powell

711

Evans Campground Beach

SDU-6

SDU-7

710

Left Bank River Mile 710

709

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see ICS detail figure)
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure B3-4. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations

Upper Columbia River, WA

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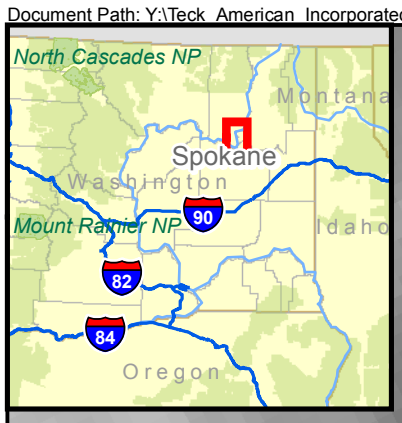

SDU-8
SDU-1
SDU-2
SDU-3
SDU-9
SDU-10
YAM Area
Young America Mill Site
UDU-5
Tailings Pond Outlet
(location uncertain)
716
715
Bossburg Area
UDU-1
UDU-2
UDU-3
UDU-4
UDU-6
F-1
F-2
Historic Ferry Site
Hackley Parcel
Ferry Landing Area

Legend

- Sites
- Culvert Location

Proposed Sample Stations

- Replicate A
- Replicate B
- Replicate C
- Reserve Station

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30%
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

1 inch = 164 feet
1 inch = 50 meters

HDR

0 200 400 600 Feet
0 50 100 150 Meters

Figure B3-5. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, ICS Soil (Upland) Decision Units, and Proposed Stations

Upper Columbia River, WA

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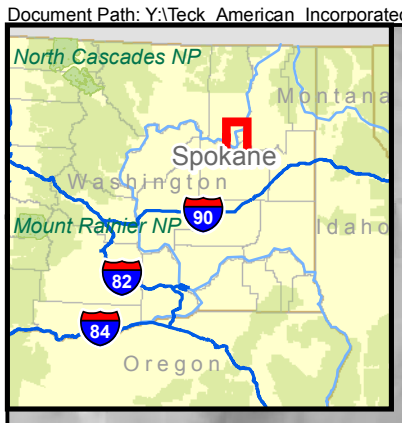

SDU-8
716
SDU-1
YAM Area
Tailings Pond Outlet
Young America Mill Site
SDU-2
UDU-5
Young America Mine Site
Hackley Parcel
SDU-9
F-1
SDU-3
UDU-6
F-2
Historic Ferry Site
UDU-1 - 4
Ferry Landing Area
SDU-10
715
SDU-4
Bossburg Area
Bossburg

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

714
713
25
Evans
Bear
712
Left Bank River Mile 711
SDU-5
Powell
711
Evans Campground Beach
SDU-6
710
SDU-7
Left Bank River Mile 710
709

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30% (see XRF detail figure)
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 1,000 2,000 3,000 Feet

0 250 500 750 Meters

N

Figure B3-6. Bossburg to Evans: RM 716 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

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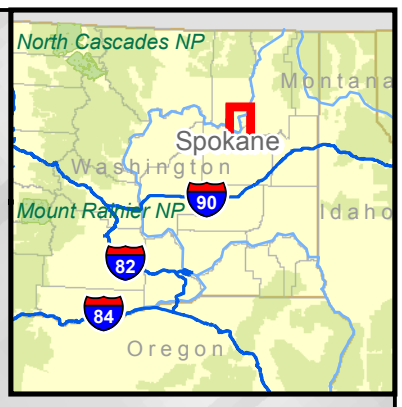


SDU-1
SDU-8
SDU-2
716
SDU-3
UDU-1
UDU-5
UDU-2
UDU-4
UDU-3
SDU-04
F-1
F-2
SDU-9
SDU-10
UDU-6
715
Young America Mill Site
Tailings Pond Outlet
Young America Mine Site
YAM Area
Bossburg Area
Bossburg Flat Beach
Historic Ferry Site
Ferry Landing Area

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

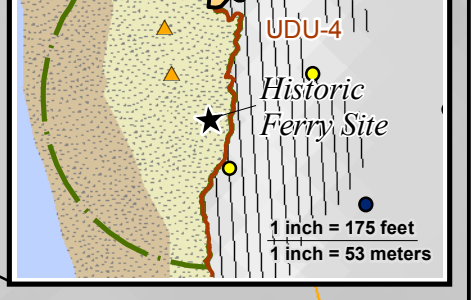
- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Hackley Parcel
- Area w/Slope < 30%
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands



NOTE 1: In Upland (Soil) DU 5, XRF stations were located throughout the Sediment Decision Unit (DU), without limitation with respect to slope. If field conditions at a proposed location prove to be unsafe (e.g., slope > 30%), stations would be relocated in the field in consultation with EPA oversight staff.

NOTE 2: Cores will be collected from all soil and sediment sampling areas except Sediment DU 10.

HDR

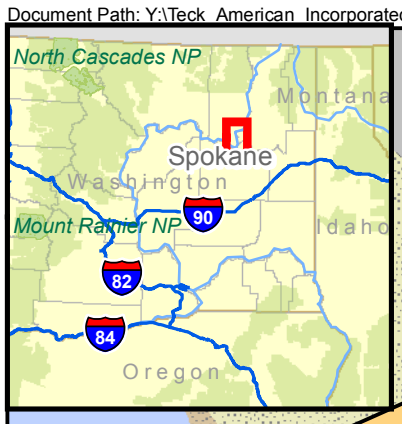
0 200 400 600 Feet

0 50 100 150 Meters

Figure B3-7. Bossburg Flat Area: RM 716 to RM 715 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

Document Path: Y:\Teck_American_Incorporated\UpperColumbiaRiver_RIFS\Task_D109_Finalize_Bossburg_QAPP\GIS\Maps\d9_Bossburg-Beach_XRF_Decision Units_Evans.mxd



N

Evans Campground Beach

SDU-5

Powell

Left Bank River Mile 711

SDU-6

711

710

1 inch = 250 feet

1 inch = 76 meters

Evans Campground Beach

SDU-6

Evans Campground Beach

Left Bank River Mile 710

SDU-7

NOTE: Cores will be collected from all soil and sediment sampling areas except Sediment Decision Unit (DU) 10.

Legend

- Sites
- Culvert Location

Proposed XRF Sampling Stations

- Primary
- Reserve

Targeted Sample Area

- Sediment Decision Unit (SDU)
- Upland Decision Unit (UDU)
- Proposed Core Sample Area
- Railroads
- Populated Places

Lead from Prior Studies

- Above 400 mg/kg
- Below 400 mg/kg
- 716 River Mile
- Sediment Exposed at Drawdown to 1,280 feet (Summer)
- Sediment Exposed at Drawdown to 1,250 feet (Spring)

Full Pool Water Level

- Water
- Islands

HDR

0 350 700 1,050 Feet

0 100 200 300 Meters

N

Figure B3-8. Evans Campground Beach: RM 711 to RM 710 Lead from Prior Studies, XRF Upland and Sediment Decision Units, and Proposed Stations

Upper Columbia River, WA

3 !+$S

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-01	423630.84	5401600.76	48.7627	-118.0392	Primary
SDU-01-02	423639.10	5401572.94	48.7625	-118.0391	Primary
SDU-01-03	423561.09	5401621.46	48.7629	-118.0401	Primary
SDU-01-04	423487.54	5401630.90	48.7630	-118.0411	Primary
SDU-01-05	423606.19	5401524.37	48.7620	-118.0395	Primary
SDU-01-06	423467.76	5401598.51	48.7627	-118.0414	Primary
SDU-01-07	423546.63	5401564.98	48.7624	-118.0403	Primary
SDU-01-08	423470.32	5401675.20	48.7634	-118.0414	Primary
SDU-01-09	423483.19	5401602.38	48.7627	-118.0412	Primary
SDU-01-10	423618.44	5401607.41	48.7628	-118.0394	Primary
SDU-01-11	423578.57	5401478.54	48.7616	-118.0399	Primary
SDU-01-12	423591.34	5401567.34	48.7624	-118.0397	Primary
SDU-01-13	423500.83	5401536.39	48.7621	-118.0410	Primary
SDU-01-14	423446.28	5401580.60	48.7625	-118.0417	Primary
SDU-01-15	423497.63	5401547.32	48.7622	-118.0410	Primary
SDU-01-16	423546.64	5401622.76	48.7629	-118.0403	Primary
SDU-01-17	423474.37	5401652.35	48.7632	-118.0413	Primary
SDU-01-18	423554.86	5401525.29	48.7620	-118.0402	Primary
SDU-01-19	423574.63	5401659.35	48.7632	-118.0400	Primary
SDU-01-20	423539.40	5401588.88	48.7626	-118.0404	Primary
SDU-01-21	423504.09	5401608.43	48.7628	-118.0409	Primary
SDU-01-22	423556.23	5401551.04	48.7623	-118.0402	Primary
SDU-01-23	423547.92	5401690.13	48.7635	-118.0403	Primary
SDU-01-24	423588.63	5401546.53	48.7622	-118.0398	Primary
SDU-01-25	423563.43	5401574.67	48.7625	-118.0401	Primary
SDU-01-26	423483.66	5401615.73	48.7628	-118.0412	Primary
SDU-01-27	423592.55	5401520.85	48.7620	-118.0397	Primary
SDU-01-28	423529.44	5401541.81	48.7622	-118.0406	Primary
SDU-01-29	423577.03	5401458.95	48.7614	-118.0399	Primary
SDU-01-30	423450.75	5401658.18	48.7632	-118.0417	Primary
SDU-01-R01	423544.63	5401479.69	48.7616	-118.0403	Reserve
SDU-01-R02	423608.25	5401595.82	48.7627	-118.0395	Reserve
SDU-01-R03	423620.19	5401632.54	48.7630	-118.0393	Reserve
SDU-01-R04	423497.83	5401690.92	48.7635	-118.0410	Reserve
SDU-01-R05	423520.31	5401721.62	48.7638	-118.0407	Reserve
SDU-01-R06	423563.06	5401500.20	48.7618	-118.0401	Reserve
Sediment Decision Unit 2					
SDU-02A-01	423365.94	5401507.17	48.7619	-118.0428	Primary
SDU-02A-02	423475.31	5401421.06	48.7611	-118.0413	Primary
SDU-02A-03	423440.99	5401312.01	48.7601	-118.0417	Primary
SDU-02A-04	423329.14	5401424.80	48.7611	-118.0433	Primary
SDU-02A-05	423413.96	5401404.55	48.7609	-118.0421	Primary
SDU-02A-06	423457.30	5401408.51	48.7610	-118.0415	Primary
SDU-02A-07	423306.22	5401432.62	48.7612	-118.0436	Primary
SDU-02A-08	423319.02	5401437.62	48.7612	-118.0434	Primary
SDU-02A-09	423363.13	5401531.17	48.7621	-118.0428	Primary
SDU-02A-10	423325.42	5401502.85	48.7618	-118.0433	Primary
SDU-02A-11	423355.87	5401381.48	48.7607	-118.0429	Primary
SDU-02A-12	423439.20	5401459.26	48.7614	-118.0418	Primary
SDU-02A-13	423357.78	5401431.33	48.7612	-118.0429	Primary
SDU-02A-14	423299.76	5401506.93	48.7618	-118.0437	Primary
SDU-02A-15	423282.13	5401438.13	48.7612	-118.0439	Primary
SDU-02A-16	423371.31	5401377.48	48.7607	-118.0427	Primary
SDU-02A-17	423369.97	5401426.20	48.7611	-118.0427	Primary
SDU-02A-18	423461.29	5401323.65	48.7602	-118.0414	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02A-19	423331.38	5401445.01	48.7613	-118.0432	Primary
SDU-02A-20	423325.13	5401475.38	48.7616	-118.0433	Primary
SDU-02A-21	423524.50	5401394.79	48.7609	-118.0406	Primary
SDU-02A-22	423376.85	5401528.78	48.7620	-118.0426	Primary
SDU-02A-23	423445.76	5401480.31	48.7616	-118.0417	Primary
SDU-02A-24	423311.87	5401476.04	48.7616	-118.0435	Primary
SDU-02A-25	423304.27	5401486.04	48.7617	-118.0436	Primary
SDU-02A-26	423459.10	5401368.29	48.7606	-118.0415	Primary
SDU-02A-27	423423.30	5401421.21	48.7611	-118.0420	Primary
SDU-02A-28	423377.53	5401505.95	48.7618	-118.0426	Primary
SDU-02A-29	423448.50	5401285.48	48.7599	-118.0416	Primary
SDU-02A-30	423359.02	5401571.04	48.7624	-118.0429	Primary
SDU-02B-01	423323.59	5401524.36	48.7620	-118.0434	Primary
SDU-02B-02	423413.07	5401381.78	48.7607	-118.0421	Primary
SDU-02B-03	423439.73	5401460.96	48.7614	-118.0418	Primary
SDU-02B-04	423413.88	5401430.31	48.7612	-118.0421	Primary
SDU-02B-05	423456.45	5401393.37	48.7608	-118.0415	Primary
SDU-02B-06	423466.72	5401430.14	48.7612	-118.0414	Primary
SDU-02B-07	423347.04	5401550.69	48.7622	-118.0430	Primary
SDU-02B-08	423374.44	5401419.78	48.7611	-118.0426	Primary
SDU-02B-09	423386.57	5401403.06	48.7609	-118.0425	Primary
SDU-02B-10	423353.11	5401440.82	48.7613	-118.0429	Primary
SDU-02B-11	423357.31	5401352.98	48.7605	-118.0429	Primary
SDU-02B-12	423362.70	5401521.73	48.7620	-118.0428	Primary
SDU-02B-13	423394.21	5401419.01	48.7611	-118.0424	Primary
SDU-02B-14	423396.68	5401453.70	48.7614	-118.0424	Primary
SDU-02B-15	423450.07	5401358.94	48.7605	-118.0416	Primary
SDU-02B-16	423337.37	5401373.60	48.7606	-118.0431	Primary
SDU-02B-17	423380.44	5401449.89	48.7613	-118.0426	Primary
SDU-02B-18	423457.99	5401377.57	48.7607	-118.0415	Primary
SDU-02B-19	423462.29	5401418.77	48.7611	-118.0415	Primary
SDU-02B-20	423382.92	5401364.71	48.7606	-118.0425	Primary
SDU-02B-21	423413.29	5401367.63	48.7606	-118.0421	Primary
SDU-02B-22	423344.28	5401361.70	48.7605	-118.0430	Primary
SDU-02B-23	423422.26	5401514.36	48.7619	-118.0420	Primary
SDU-02B-24	423281.10	5401417.25	48.7610	-118.0439	Primary
SDU-02B-25	423369.61	5401562.31	48.7624	-118.0427	Primary
SDU-02B-26	423331.75	5401451.68	48.7614	-118.0432	Primary
SDU-02B-27	423423.41	5401395.22	48.7609	-118.0420	Primary
SDU-02B-28	423425.99	5401353.00	48.7605	-118.0419	Primary
SDU-02B-29	423306.62	5401407.49	48.7609	-118.0436	Primary
SDU-02B-30	423497.47	5401354.65	48.7605	-118.0410	Primary
SDU-02C-01	423496.55	5401381.42	48.7607	-118.0410	Primary
SDU-02C-02	423437.23	5401489.51	48.7617	-118.0418	Primary
SDU-02C-03	423408.38	5401337.72	48.7603	-118.0422	Primary
SDU-02C-04	423426.25	5401301.17	48.7600	-118.0419	Primary
SDU-02C-05	423473.39	5401444.37	48.7613	-118.0413	Primary
SDU-02C-06	423279.65	5401482.77	48.7616	-118.0440	Primary
SDU-02C-07	423343.15	5401404.70	48.7609	-118.0431	Primary
SDU-02C-08	423406.67	5401497.62	48.7618	-118.0422	Primary
SDU-02C-09	423358.81	5401463.19	48.7615	-118.0429	Primary
SDU-02C-10	423398.72	5401528.36	48.7620	-118.0423	Primary
SDU-02C-11	423362.77	5401481.91	48.7616	-118.0428	Primary
SDU-02C-12	423386.12	5401505.30	48.7618	-118.0425	Primary
SDU-02C-13	423380.70	5401380.75	48.7607	-118.0426	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 2 (continued)					
SDU-02C-14	423397.73	5401391.88	48.7608	-118.0423	Primary
SDU-02C-15	423429.17	5401362.27	48.7606	-118.0419	Primary
SDU-02C-16	423463.59	5401464.10	48.7615	-118.0414	Primary
SDU-02C-17	423409.76	5401478.77	48.7616	-118.0422	Primary
SDU-02C-18	423445.55	5401465.20	48.7615	-118.0417	Primary
SDU-02C-19	423514.50	5401376.57	48.7607	-118.0407	Primary
SDU-02C-20	423391.13	5401347.70	48.7604	-118.0424	Primary
SDU-02C-21	423516.19	5401396.67	48.7609	-118.0407	Primary
SDU-02C-22	423375.89	5401518.96	48.7620	-118.0426	Primary
SDU-02C-23	423290.97	5401500.76	48.7618	-118.0438	Primary
SDU-02C-24	423327.71	5401534.89	48.7621	-118.0433	Primary
SDU-02C-25	423274.81	5401428.67	48.7611	-118.0440	Primary
SDU-02C-26	423345.92	5401390.29	48.7608	-118.0430	Primary
SDU-02C-27	423471.62	5401356.39	48.7605	-118.0413	Primary
SDU-02C-28	423485.43	5401413.10	48.7610	-118.0411	Primary
SDU-02C-29	423453.30	5401373.60	48.7607	-118.0416	Primary
SDU-02C-30	423425.35	5401335.23	48.7603	-118.0419	Primary
SDU-02A-R01	423374.93	5401429.92	48.7612	-118.0426	Reserve
SDU-02A-R02	423486.85	5401335.36	48.7603	-118.0411	Reserve
SDU-02A-R03	423476.84	5401346.80	48.7604	-118.0412	Reserve
SDU-02A-R04	423503.11	5401380.10	48.7607	-118.0409	Reserve
SDU-02A-R05	423424.54	5401316.00	48.7601	-118.0419	Reserve
SDU-02A-R06	423397.51	5401464.10	48.7615	-118.0423	Reserve
SDU-02B-R01	423496.79	5401362.83	48.7606	-118.0410	Reserve
SDU-02B-R02	423406.71	5401433.83	48.7612	-118.0422	Reserve
SDU-02B-R03	423408.76	5401364.48	48.7606	-118.0422	Reserve
SDU-02B-R04	423484.81	5401381.81	48.7607	-118.0411	Reserve
SDU-02B-R05	423374.79	5401420.33	48.7611	-118.0426	Reserve
SDU-02B-R06	423318.66	5401424.85	48.7611	-118.0434	Reserve
SDU-02C-R01	423438.64	5401417.08	48.7611	-118.0418	Reserve
SDU-02C-R02	423497.63	5401423.54	48.7611	-118.0410	Reserve
SDU-02C-R03	423341.29	5401564.27	48.7624	-118.0431	Reserve
SDU-02C-R04	423374.17	5401370.09	48.7606	-118.0426	Reserve
SDU-02C-R05	423438.02	5401318.49	48.7602	-118.0418	Reserve
SDU-02C-R06	423443.37	5401298.27	48.7600	-118.0417	Reserve
Sediment Decision Unit 3					
SDU-03A-01	423075.43	5401081.95	48.7580	-118.0467	Primary
SDU-03A-02	423046.12	5401075.30	48.7579	-118.0471	Primary
SDU-03A-03	422893.02	5400942.44	48.7567	-118.0491	Primary
SDU-03A-04	422977.57	5401017.64	48.7574	-118.0480	Primary
SDU-03A-05	422953.98	5400993.74	48.7572	-118.0483	Primary
SDU-03A-06	423083.50	5401091.50	48.7581	-118.0465	Primary
SDU-03A-07	422881.53	5400934.65	48.7566	-118.0493	Primary
SDU-03A-08	422965.42	5401004.46	48.7573	-118.0481	Primary
SDU-03A-09	422930.98	5400977.64	48.7570	-118.0486	Primary
SDU-03A-10	422948.57	5400993.52	48.7572	-118.0484	Primary
SDU-03A-11	422960.74	5401013.46	48.7574	-118.0482	Primary
SDU-03A-12	422938.71	5400982.31	48.7571	-118.0485	Primary
SDU-03A-13	423025.31	5401056.61	48.7578	-118.0473	Primary
SDU-03A-14	422886.41	5400944.45	48.7567	-118.0492	Primary
SDU-03A-15	423025.66	5401050.24	48.7577	-118.0473	Primary
SDU-03A-16	422911.29	5400957.94	48.7569	-118.0489	Primary
SDU-03A-17	422925.42	5400985.25	48.7571	-118.0487	Primary
SDU-03A-18	422902.56	5400957.13	48.7568	-118.0490	Primary
SDU-03A-19	422984.99	5401015.02	48.7574	-118.0479	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03A-20	423001.20	5401035.84	48.7576	-118.0477	Primary
SDU-03A-21	422889.97	5400951.48	48.7568	-118.0492	Primary
SDU-03A-22	422927.40	5400971.82	48.7570	-118.0486	Primary
SDU-03A-23	423078.13	5401090.09	48.7581	-118.0466	Primary
SDU-03A-24	422876.63	5400940.09	48.7567	-118.0493	Primary
SDU-03A-25	423070.75	5401093.52	48.7581	-118.0467	Primary
SDU-03A-26	423067.38	5401085.69	48.7580	-118.0468	Primary
SDU-03A-27	423001.95	5401028.31	48.7575	-118.0476	Primary
SDU-03A-28	422990.07	5401023.10	48.7575	-118.0478	Primary
SDU-03A-29	423091.79	5401096.58	48.7581	-118.0464	Primary
SDU-03A-30	423036.86	5401056.28	48.7578	-118.0472	Primary
SDU-03B-01	422980.84	5401019.31	48.7574	-118.0479	Primary
SDU-03B-02	422986.69	5401023.93	48.7575	-118.0479	Primary
SDU-03B-03	423021.41	5401046.16	48.7577	-118.0474	Primary
SDU-03B-04	423028.20	5401060.50	48.7578	-118.0473	Primary
SDU-03B-05	423010.08	5401036.69	48.7576	-118.0475	Primary
SDU-03B-06	423044.95	5401075.95	48.7579	-118.0471	Primary
SDU-03B-07	422892.87	5400942.88	48.7567	-118.0491	Primary
SDU-03B-08	422920.20	5400964.51	48.7569	-118.0487	Primary
SDU-03B-09	423022.73	5401051.03	48.7577	-118.0474	Primary
SDU-03B-10	422875.01	5400940.13	48.7567	-118.0494	Primary
SDU-03B-11	423033.15	5401055.81	48.7578	-118.0472	Primary
SDU-03B-12	423040.98	5401066.34	48.7578	-118.0471	Primary
SDU-03B-13	423036.73	5401059.31	48.7578	-118.0472	Primary
SDU-03B-14	422934.26	5400982.52	48.7571	-118.0486	Primary
SDU-03B-15	422963.54	5401012.84	48.7574	-118.0482	Primary
SDU-03B-16	422921.44	5400975.30	48.7570	-118.0487	Primary
SDU-03B-17	422895.74	5400952.35	48.7568	-118.0491	Primary
SDU-03B-18	423049.97	5401077.13	48.7579	-118.0470	Primary
SDU-03B-19	422939.29	5400979.13	48.7571	-118.0485	Primary
SDU-03B-20	423085.85	5401098.64	48.7581	-118.0465	Primary
SDU-03B-21	422904.97	5400959.70	48.7569	-118.0490	Primary
SDU-03B-22	423013.70	5401048.80	48.7577	-118.0475	Primary
SDU-03B-23	422960.67	5401006.12	48.7573	-118.0482	Primary
SDU-03B-24	422993.20	5401021.39	48.7574	-118.0478	Primary
SDU-03B-25	423084.30	5401089.64	48.7581	-118.0465	Primary
SDU-03B-26	422926.24	5400982.51	48.7571	-118.0487	Primary
SDU-03B-27	422967.08	5401001.65	48.7573	-118.0481	Primary
SDU-03B-28	422898.58	5400958.01	48.7569	-118.0490	Primary
SDU-03B-29	422976.05	5401012.38	48.7574	-118.0480	Primary
SDU-03B-30	422948.63	5400999.49	48.7572	-118.0484	Primary
SDU-03C-01	423036.26	5401060.71	48.7578	-118.0472	Primary
SDU-03C-02	422986.55	5401024.92	48.7575	-118.0479	Primary
SDU-03C-03	422972.23	5401015.58	48.7574	-118.0480	Primary
SDU-03C-04	423036.74	5401066.10	48.7578	-118.0472	Primary
SDU-03C-05	422885.36	5400945.57	48.7567	-118.0492	Primary
SDU-03C-06	423019.90	5401042.05	48.7576	-118.0474	Primary
SDU-03C-07	423067.91	5401079.04	48.7580	-118.0468	Primary
SDU-03C-08	423008.31	5401036.05	48.7576	-118.0476	Primary
SDU-03C-09	423050.36	5401069.60	48.7579	-118.0470	Primary
SDU-03C-10	423087.50	5401096.02	48.7581	-118.0465	Primary
SDU-03C-11	422949.80	5400997.88	48.7572	-118.0483	Primary
SDU-03C-12	422924.52	5400976.81	48.7570	-118.0487	Primary
SDU-03C-13	423050.22	5401075.12	48.7579	-118.0470	Primary
SDU-03C-14	422954.65	5401009.87	48.7573	-118.0483	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 3 (continued)					
SDU-03C-15	423010.72	5401042.77	48.7576	-118.0475	Primary
SDU-03C-16	423023.40	5401056.87	48.7578	-118.0474	Primary
SDU-03C-17	423063.68	5401084.22	48.7580	-118.0468	Primary
SDU-03C-18	422899.61	5400958.32	48.7569	-118.0490	Primary
SDU-03C-19	422957.60	5401001.92	48.7573	-118.0482	Primary
SDU-03C-20	423078.03	5401099.88	48.7582	-118.0466	Primary
SDU-03C-21	422906.54	5400959.69	48.7569	-118.0489	Primary
SDU-03C-22	423079.92	5401093.28	48.7581	-118.0466	Primary
SDU-03C-23	422978.65	5401010.81	48.7573	-118.0480	Primary
SDU-03C-24	422917.15	5400964.56	48.7569	-118.0488	Primary
SDU-03C-25	423070.91	5401086.41	48.7580	-118.0467	Primary
SDU-03C-26	422935.28	5400985.60	48.7571	-118.0485	Primary
SDU-03C-27	422887.12	5400939.38	48.7567	-118.0492	Primary
SDU-03C-28	423055.82	5401077.23	48.7579	-118.0469	Primary
SDU-03C-29	423031.02	5401063.65	48.7578	-118.0473	Primary
SDU-03C-30	422962.43	5401012.22	48.7574	-118.0482	Primary
SDU-03A-R01	423003.03	5401040.73	48.7576	-118.0476	Reserve
SDU-03A-R02	422978.85	5401022.65	48.7574	-118.0480	Reserve
SDU-03A-R03	423035.59	5401059.68	48.7578	-118.0472	Reserve
SDU-03A-R04	422889.18	5400947.17	48.7568	-118.0492	Reserve
SDU-03A-R05	422916.93	5400972.62	48.7570	-118.0488	Reserve
SDU-03A-R06	422987.08	5401027.19	48.7575	-118.0478	Reserve
SDU-03B-R01	422962.46	5401001.83	48.7573	-118.0482	Reserve
SDU-03B-R02	422994.03	5401028.52	48.7575	-118.0478	Reserve
SDU-03B-R03	423072.83	5401083.40	48.7580	-118.0467	Reserve
SDU-03B-R04	422896.05	5400947.54	48.7568	-118.0491	Reserve
SDU-03B-R05	422936.79	5400975.25	48.7570	-118.0485	Reserve
SDU-03B-R06	423062.05	5401082.13	48.7580	-118.0468	Reserve
SDU-03C-R01	422896.00	5400951.21	48.7568	-118.0491	Reserve
SDU-03C-R02	423048.80	5401077.52	48.7580	-118.0470	Reserve
SDU-03C-R03	422907.49	5400955.91	48.7568	-118.0489	Reserve
SDU-03C-R04	422954.83	5400996.30	48.7572	-118.0483	Reserve
SDU-03C-R05	422981.92	5401019.90	48.7574	-118.0479	Reserve
SDU-03C-R06	422958.40	5401003.23	48.7573	-118.0482	Reserve
Sediment Decision Unit 4					
SDU-04-01	422603.47	5400657.78	48.7541	-118.0530	Primary
SDU-04-02	422672.21	5400762.34	48.7551	-118.0521	Primary
SDU-04-03	422678.61	5400778.72	48.7552	-118.0520	Primary
SDU-04-04	422626.54	5400658.95	48.7541	-118.0527	Primary
SDU-04-05	422630.71	5400680.62	48.7543	-118.0526	Primary
SDU-04-06	422620.95	5400688.83	48.7544	-118.0528	Primary
SDU-04-07	422669.67	5400744.43	48.7549	-118.0521	Primary
SDU-04-08	422609.61	5400644.67	48.7540	-118.0529	Primary
SDU-04-09	422658.77	5400732.51	48.7548	-118.0523	Primary
SDU-04-10	422656.04	5400748.44	48.7549	-118.0523	Primary
SDU-04-11	422679.08	5400749.70	48.7550	-118.0520	Primary
SDU-04-12	422682.58	5400762.14	48.7551	-118.0519	Primary
SDU-04-13	422652.93	5400723.17	48.7547	-118.0523	Primary
SDU-04-14	422639.31	5400711.80	48.7546	-118.0525	Primary
SDU-04-15	422596.57	5400622.09	48.7538	-118.0531	Primary
SDU-04-16	422616.68	5400628.55	48.7539	-118.0528	Primary
SDU-04-17	422632.22	5400700.46	48.7545	-118.0526	Primary
SDU-04-18	422615.51	5400613.02	48.7537	-118.0528	Primary
SDU-04-19	422617.81	5400676.91	48.7543	-118.0528	Primary
SDU-04-20	422608.85	5400682.01	48.7543	-118.0529	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 4 (continued)					
SDU-04-21	422641.10	5400689.90	48.7544	-118.0525	Primary
SDU-04-22	422668.91	5400730.41	48.7548	-118.0521	Primary
SDU-04-23	422585.81	5400626.22	48.7538	-118.0532	Primary
SDU-04-24	422696.57	5400771.48	48.7552	-118.0517	Primary
SDU-04-25	422606.88	5400670.63	48.7542	-118.0530	Primary
SDU-04-26	422590.00	5400640.17	48.7540	-118.0532	Primary
SDU-04-27	422619.44	5400651.33	48.7541	-118.0528	Primary
SDU-04-28	422595.71	5400650.41	48.7541	-118.0531	Primary
SDU-04-29	422607.79	5400622.30	48.7538	-118.0529	Primary
SDU-04-30	422618.06	5400666.60	48.7542	-118.0528	Primary
SDU-04-R01	422631.97	5400705.38	48.7546	-118.0526	Reserve
SDU-04-R02	422680.35	5400762.15	48.7551	-118.0520	Reserve
SDU-04-R03	422684.79	5400788.72	48.7553	-118.0519	Reserve
SDU-04-R04	422595.15	5400640.26	48.7540	-118.0531	Reserve
SDU-04-R05	422600.39	5400652.06	48.7541	-118.0530	Reserve
SDU-04-R06	422609.92	5400643.39	48.7540	-118.0529	Reserve
Sediment Decision Unit 5					
SDU-05-01	424472.26	5395156.32	48.7049	-118.0266	Primary
SDU-05-02	424399.92	5395020.87	48.7036	-118.0275	Primary
SDU-05-03	424464.46	5395247.37	48.7057	-118.0267	Primary
SDU-05-04	424423.78	5394887.57	48.7024	-118.0272	Primary
SDU-05-05	424366.56	5395269.89	48.7059	-118.0280	Primary
SDU-05-06	424405.11	5395202.62	48.7053	-118.0275	Primary
SDU-05-07	424749.82	5395036.86	48.7038	-118.0228	Primary
SDU-05-08	424647.43	5395143.85	48.7048	-118.0242	Primary
SDU-05-09	424415.33	5395097.09	48.7043	-118.0273	Primary
SDU-05-10	424335.38	5395243.99	48.7056	-118.0284	Primary
SDU-05-11	424501.84	5395031.62	48.7037	-118.0261	Primary
SDU-05-12	424386.76	5395194.71	48.7052	-118.0277	Primary
SDU-05-13	424449.75	5395051.43	48.7039	-118.0269	Primary
SDU-05-14	424420.63	5395085.72	48.7042	-118.0273	Primary
SDU-05-15	424621.07	5395155.26	48.7049	-118.0245	Primary
SDU-05-16	424308.62	5395258.43	48.7058	-118.0288	Primary
SDU-05-17	424339.88	5395210.75	48.7053	-118.0284	Primary
SDU-05-18	424700.88	5395037.45	48.7038	-118.0234	Primary
SDU-05-19	424508.57	5395400.73	48.7071	-118.0261	Primary
SDU-05-20	424326.13	5395031.86	48.7037	-118.0285	Primary
SDU-05-21	424485.03	5395041.34	48.7038	-118.0264	Primary
SDU-05-22	424414.23	5394867.40	48.7023	-118.0273	Primary
SDU-05-23	424408.72	5395150.39	48.7048	-118.0274	Primary
SDU-05-24	424636.47	5395017.45	48.7036	-118.0243	Primary
SDU-05-25	424443.82	5395267.29	48.7059	-118.0270	Primary
SDU-05-26	424441.21	5394892.32	48.7025	-118.0269	Primary
SDU-05-27	424469.89	5395323.25	48.7064	-118.0266	Primary
SDU-05-28	424563.41	5394993.91	48.7034	-118.0253	Primary
SDU-05-29	424541.10	5394951.78	48.7030	-118.0256	Primary
SDU-05-30	424244.37	5395132.02	48.7046	-118.0297	Primary
SDU-05-R01	424362.83	5395131.72	48.7046	-118.0280	Reserve
SDU-05-R02	424569.42	5395348.39	48.7066	-118.0253	Reserve
SDU-05-R03	424293.31	5395212.92	48.7054	-118.0290	Reserve
SDU-05-R04	424699.09	5395181.36	48.7051	-118.0235	Reserve
SDU-05-R05	424717.13	5395166.72	48.7050	-118.0232	Reserve
SDU-05-R06	424431.62	5395109.47	48.7044	-118.0271	Reserve

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6					
SDU-06A-01	425237.10	5393946.60	48.6941	-118.0160	Primary
SDU-06A-02	425260.79	5393962.50	48.6942	-118.0156	Primary
SDU-06A-03	425306.90	5393826.09	48.6930	-118.0150	Primary
SDU-06A-04	425212.58	5394072.57	48.6952	-118.0163	Primary
SDU-06A-05	425302.20	5393747.94	48.6923	-118.0150	Primary
SDU-06A-06	425241.84	5393997.48	48.6945	-118.0159	Primary
SDU-06A-07	425240.79	5394049.61	48.6950	-118.0159	Primary
SDU-06A-08	425301.44	5393654.36	48.6915	-118.0150	Primary
SDU-06A-09	425235.94	5394038.05	48.6949	-118.0160	Primary
SDU-06A-10	425308.23	5393728.40	48.6921	-118.0149	Primary
SDU-06A-11	425155.57	5394142.98	48.6958	-118.0171	Primary
SDU-06A-12	425241.44	5393964.60	48.6942	-118.0159	Primary
SDU-06A-13	425285.11	5393850.98	48.6932	-118.0153	Primary
SDU-06A-14	425254.96	5393984.99	48.6944	-118.0157	Primary
SDU-06A-15	425304.43	5393763.16	48.6924	-118.0150	Primary
SDU-06A-16	425265.24	5393952.89	48.6941	-118.0156	Primary
SDU-06A-17	425285.91	5393728.64	48.6921	-118.0153	Primary
SDU-06A-18	425227.67	5394008.93	48.6946	-118.0161	Primary
SDU-06A-19	425260.46	5393887.43	48.6935	-118.0156	Primary
SDU-06A-20	425219.56	5394025.89	48.6948	-118.0162	Primary
SDU-06A-21	425164.40	5394137.83	48.6958	-118.0170	Primary
SDU-06A-22	425314.92	5393749.94	48.6923	-118.0149	Primary
SDU-06A-23	425282.19	5393883.95	48.6935	-118.0153	Primary
SDU-06A-24	425298.79	5393737.84	48.6922	-118.0151	Primary
SDU-06A-25	425140.07	5394162.97	48.6960	-118.0173	Primary
SDU-06A-26	425283.25	5393830.25	48.6930	-118.0153	Primary
SDU-06A-27	425190.68	5394114.67	48.6956	-118.0166	Primary
SDU-06A-28	425230.13	5394052.57	48.6950	-118.0161	Primary
SDU-06A-29	425302.40	5393816.28	48.6929	-118.0150	Primary
SDU-06A-30	425314.38	5393791.67	48.6927	-118.0149	Primary
SDU-06B-01	425304.62	5393706.64	48.6919	-118.0150	Primary
SDU-06B-02	425268.86	5393883.04	48.6935	-118.0155	Primary
SDU-06B-03	425303.49	5393734.42	48.6922	-118.0150	Primary
SDU-06B-04	425129.61	5394178.10	48.6961	-118.0175	Primary
SDU-06B-05	425299.29	5393658.80	48.6915	-118.0151	Primary
SDU-06B-06	425233.42	5394055.71	48.6951	-118.0160	Primary
SDU-06B-07	425283.67	5393741.30	48.6922	-118.0153	Primary
SDU-06B-08	425280.23	5393697.19	48.6918	-118.0153	Primary
SDU-06B-09	425189.41	5394112.80	48.6956	-118.0166	Primary
SDU-06B-10	425281.00	5393877.57	48.6935	-118.0153	Primary
SDU-06B-11	425247.28	5393905.12	48.6937	-118.0158	Primary
SDU-06B-12	425146.94	5394155.76	48.6959	-118.0172	Primary
SDU-06B-13	425233.43	5394008.61	48.6946	-118.0160	Primary
SDU-06B-14	425307.64	5393819.14	48.6929	-118.0150	Primary
SDU-06B-15	425278.77	5393850.64	48.6932	-118.0154	Primary
SDU-06B-16	425306.09	5393746.44	48.6923	-118.0150	Primary
SDU-06B-17	425119.17	5394180.12	48.6962	-118.0176	Primary
SDU-06B-18	425248.74	5393997.16	48.6945	-118.0158	Primary
SDU-06B-19	425257.04	5394003.81	48.6946	-118.0157	Primary
SDU-06B-20	425208.21	5394095.44	48.6954	-118.0164	Primary
SDU-06B-21	425128.37	5394167.15	48.6960	-118.0175	Primary
SDU-06B-22	425205.78	5394080.26	48.6953	-118.0164	Primary
SDU-06B-23	425264.51	5393902.69	48.6937	-118.0156	Primary
SDU-06B-24	425181.28	5394119.78	48.6956	-118.0167	Primary
SDU-06B-25	425177.10	5394109.13	48.6955	-118.0168	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 6 (continued)					
SDU-06B-26	425242.88	5394049.36	48.6950	-118.0159	Primary
SDU-06B-27	425291.01	5393687.28	48.6918	-118.0152	Primary
SDU-06B-28	425232.92	5394036.92	48.6949	-118.0160	Primary
SDU-06B-29	425250.89	5393972.82	48.6943	-118.0158	Primary
SDU-06B-30	425296.41	5393674.08	48.6916	-118.0151	Primary
SDU-06C-01	425179.08	5394130.63	48.6957	-118.0168	Primary
SDU-06C-02	425248.90	5393985.52	48.6944	-118.0158	Primary
SDU-06C-03	425222.01	5394019.88	48.6947	-118.0162	Primary
SDU-06C-04	425298.36	5393857.65	48.6933	-118.0151	Primary
SDU-06C-05	425305.17	5393823.03	48.6930	-118.0150	Primary
SDU-06C-06	425284.21	5393859.37	48.6933	-118.0153	Primary
SDU-06C-07	425308.08	5393770.28	48.6925	-118.0150	Primary
SDU-06C-08	425200.47	5394087.32	48.6953	-118.0165	Primary
SDU-06C-09	425286.97	5393834.38	48.6931	-118.0153	Primary
SDU-06C-10	425236.99	5393923.04	48.6939	-118.0160	Primary
SDU-06C-11	425238.97	5394048.14	48.6950	-118.0159	Primary
SDU-06C-12	425271.97	5393861.58	48.6933	-118.0155	Primary
SDU-06C-13	425257.58	5393912.89	48.6938	-118.0157	Primary
SDU-06C-14	425300.88	5393758.94	48.6924	-118.0151	Primary
SDU-06C-15	425245.67	5393960.28	48.6942	-118.0158	Primary
SDU-06C-16	425226.60	5394048.28	48.6950	-118.0161	Primary
SDU-06C-17	425296.62	5393694.12	48.6918	-118.0151	Primary
SDU-06C-18	425132.36	5394167.39	48.6961	-118.0174	Primary
SDU-06C-19	425254.84	5393938.91	48.6940	-118.0157	Primary
SDU-06C-20	425316.94	5393778.98	48.6926	-118.0148	Primary
SDU-06C-21	425285.57	5393684.21	48.6917	-118.0152	Primary
SDU-06C-22	425144.99	5394157.40	48.6960	-118.0172	Primary
SDU-06C-23	425240.17	5393972.44	48.6943	-118.0159	Primary
SDU-06C-24	425302.51	5393680.03	48.6917	-118.0150	Primary
SDU-06C-25	425270.69	5393904.41	48.6937	-118.0155	Primary
SDU-06C-26	425221.76	5394067.60	48.6952	-118.0162	Primary
SDU-06C-27	425281.64	5393716.23	48.6920	-118.0153	Primary
SDU-06C-28	425247.81	5393907.84	48.6937	-118.0158	Primary
SDU-06C-29	425260.74	5393901.19	48.6937	-118.0156	Primary
SDU-06C-30	425304.38	5393669.32	48.6916	-118.0150	Primary
SDU-06A-R01	425297.78	5393780.57	48.6926	-118.0151	Reserve
SDU-06A-R02	425287.93	5393841.90	48.6931	-118.0152	Reserve
SDU-06A-R03	425231.23	5393992.52	48.6945	-118.0160	Reserve
SDU-06A-R04	425222.32	5394046.74	48.6950	-118.0162	Reserve
SDU-06A-R05	425241.90	5394041.02	48.6949	-118.0159	Reserve
SDU-06A-R06	425261.90	5393897.51	48.6936	-118.0156	Reserve
SDU-06B-R01	425231.53	5394017.61	48.6947	-118.0160	Reserve
SDU-06B-R02	425253.58	5393908.84	48.6937	-118.0157	Reserve
SDU-06B-R03	425239.13	5393930.63	48.6939	-118.0159	Reserve
SDU-06B-R04	425296.03	5393776.17	48.6926	-118.0151	Reserve
SDU-06B-R05	425286.98	5393715.15	48.6920	-118.0152	Reserve
SDU-06B-R06	425253.86	5393989.99	48.6945	-118.0157	Reserve
SDU-06C-R01	425130.93	5394169.67	48.6961	-118.0174	Reserve
SDU-06C-R02	425244.17	5393926.48	48.6939	-118.0159	Reserve
SDU-06C-R03	425221.45	5394018.80	48.6947	-118.0162	Reserve
SDU-06C-R04	425286.78	5393869.34	48.6934	-118.0153	Reserve
SDU-06C-R05	425278.37	5393893.31	48.6936	-118.0154	Reserve
SDU-06C-R06	425305.67	5393775.93	48.6925	-118.0150	Reserve

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 7					
SDU-07-01	425077.64	5392770.80	48.6835	-118.0179	Primary
SDU-07-02	425210.03	5392999.75	48.6856	-118.0161	Primary
SDU-07-03	425030.99	5392686.86	48.6827	-118.0185	Primary
SDU-07-04	425181.35	5392975.27	48.6853	-118.0165	Primary
SDU-07-05	425236.70	5393072.85	48.6862	-118.0158	Primary
SDU-07-06	425164.23	5392836.20	48.6841	-118.0167	Primary
SDU-07-07	425202.40	5392890.15	48.6846	-118.0162	Primary
SDU-07-08	425264.42	5392991.46	48.6855	-118.0154	Primary
SDU-07-09	425284.81	5393065.24	48.6862	-118.0151	Primary
SDU-07-10	425164.80	5392929.98	48.6849	-118.0168	Primary
SDU-07-11	425088.97	5392862.42	48.6843	-118.0178	Primary
SDU-07-12	425087.51	5392605.44	48.6820	-118.0177	Primary
SDU-07-13	425209.07	5393035.23	48.6859	-118.0162	Primary
SDU-07-14	425034.15	5392787.04	48.6836	-118.0185	Primary
SDU-07-15	425178.39	5392894.00	48.6846	-118.0166	Primary
SDU-07-16	425114.58	5392712.44	48.6830	-118.0174	Primary
SDU-07-17	425086.99	5392660.43	48.6825	-118.0178	Primary
SDU-07-18	425170.58	5392885.44	48.6845	-118.0167	Primary
SDU-07-19	425106.88	5392865.95	48.6843	-118.0175	Primary
SDU-07-20	424992.39	5392677.63	48.6826	-118.0190	Primary
SDU-07-21	425113.22	5392881.56	48.6845	-118.0174	Primary
SDU-07-22	425132.89	5392775.78	48.6835	-118.0172	Primary
SDU-07-23	425161.15	5392963.30	48.6852	-118.0168	Primary
SDU-07-24	425174.55	5392936.93	48.6850	-118.0166	Primary
SDU-07-25	425174.08	5392968.19	48.6853	-118.0166	Primary
SDU-07-26	425224.75	5392888.06	48.6846	-118.0159	Primary
SDU-07-27	425191.76	5392845.42	48.6842	-118.0164	Primary
SDU-07-28	424999.21	5392703.30	48.6829	-118.0190	Primary
SDU-07-29	425272.38	5393065.08	48.6862	-118.0153	Primary
SDU-07-30	425185.91	5393055.14	48.6861	-118.0165	Primary
SDU-07-R01	425196.60	5392975.83	48.6853	-118.0163	Reserve
SDU-07-R02	425172.43	5392993.92	48.6855	-118.0167	Reserve
SDU-07-R03	425227.45	5392964.95	48.6852	-118.0159	Reserve
SDU-07-R04	425196.50	5392781.77	48.6836	-118.0163	Reserve
SDU-07-R05	425062.81	5392712.29	48.6830	-118.0181	Reserve
SDU-07-R06	425026.79	5392713.56	48.6830	-118.0186	Reserve

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 8					
SDU-08-01	423137.23	5401825.68	48.7647	-118.0460	Primary
SDU-08-02	423122.43	5401770.43	48.7642	-118.0461	Primary
SDU-08-03	423096.57	5401801.20	48.7645	-118.0465	Primary
SDU-08-04	422964.72	5401616.42	48.7628	-118.0483	Primary
SDU-08-05	423181.79	5401905.36	48.7654	-118.0454	Primary
SDU-08-06	423175.50	5401868.59	48.7651	-118.0454	Primary
SDU-08-07	423021.23	5401655.32	48.7631	-118.0475	Primary
SDU-08-08	423083.58	5401787.43	48.7643	-118.0467	Primary
SDU-08-09	423038.21	5401677.32	48.7633	-118.0473	Primary
SDU-08-10	423004.77	5401681.57	48.7634	-118.0477	Primary
SDU-08-11	423051.14	5401715.43	48.7637	-118.0471	Primary
SDU-08-12	422961.54	5401635.13	48.7630	-118.0483	Primary
SDU-08-13	423093.90	5401742.45	48.7639	-118.0465	Primary
SDU-08-14	423072.56	5401725.41	48.7638	-118.0468	Primary
SDU-08-15	423220.95	5401956.02	48.7659	-118.0448	Primary
SDU-08-16	423204.67	5401900.27	48.7654	-118.0450	Primary
SDU-08-17	423202.82	5401851.71	48.7649	-118.0451	Primary
SDU-08-18	423184.71	5401844.72	48.7649	-118.0453	Primary
SDU-08-19	423082.90	5401771.82	48.7642	-118.0467	Primary
SDU-08-20	422985.97	5401651.68	48.7631	-118.0480	Primary
SDU-08-21	422998.70	5401666.89	48.7632	-118.0478	Primary
SDU-08-22	422983.81	5401633.63	48.7629	-118.0480	Primary
SDU-08-23	422995.59	5401639.76	48.7630	-118.0478	Primary
SDU-08-24	423064.95	5401770.25	48.7642	-118.0469	Primary
SDU-08-25	423187.20	5401832.73	48.7648	-118.0453	Primary
SDU-08-26	423126.09	5401823.44	48.7647	-118.0461	Primary
SDU-08-27	423009.37	5401655.00	48.7631	-118.0477	Primary
SDU-08-28	423082.57	5401745.40	48.7640	-118.0467	Primary
SDU-08-29	423149.46	5401809.79	48.7645	-118.0458	Primary
SDU-08-30	423021.35	5401666.76	48.7632	-118.0475	Primary
SDU-08-R01	422976.97	5401609.49	48.7627	-118.0481	Reserve
SDU-08-R02	423057.06	5401756.68	48.7641	-118.0470	Reserve
SDU-08-R03	423176.33	5401834.68	48.7648	-118.0454	Reserve
SDU-08-R04	423065.18	5401767.58	48.7642	-118.0469	Reserve
SDU-08-R05	423145.88	5401833.85	48.7648	-118.0458	Reserve
SDU-08-R06	422981.75	5401645.70	48.7631	-118.0480	Reserve
Sediment Decision Unit 9					
SDU-09A-01	422438.53	5401031.99	48.7575	-118.0550	Primary
SDU-09A-02	422435.61	5401082.55	48.7579	-118.0550	Primary
SDU-09A-03	422359.09	5400890.04	48.7562	-118.0560	Primary
SDU-09A-04	422459.44	5401040.60	48.7575	-118.0550	Primary
SDU-09A-05	422294.12	5400879.79	48.7561	-118.0570	Primary
SDU-09A-06	422360.19	5400968.44	48.7569	-118.0560	Primary
SDU-09A-07	422458.27	5401072.98	48.7578	-118.0550	Primary
SDU-09A-08	422409.52	5401039.95	48.7575	-118.0560	Primary
SDU-09A-09	422341.44	5400925.96	48.7565	-118.0570	Primary
SDU-09A-10	422362.03	5400928.07	48.7565	-118.0560	Primary
SDU-09A-11	422443.05	5401115.47	48.7582	-118.0550	Primary
SDU-09A-12	422348.84	5400915.49	48.7564	-118.0570	Primary
SDU-09A-13	422337.51	5400903.97	48.7563	-118.0570	Primary
SDU-09A-14	422344.59	5400889.35	48.7562	-118.0570	Primary
SDU-09A-15	422487.93	5401080.46	48.7579	-118.0550	Primary
SDU-09A-16	422440.11	5401010.42	48.7573	-118.0550	Primary
SDU-09A-17	422342.37	5400864.29	48.7559	-118.0570	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09A-18	422321.97	5400863.90	48.7559	-118.0570	Primary
SDU-09A-19	422375.45	5400953.30	48.7567	-118.0560	Primary
SDU-09A-20	422417.33	5401057.80	48.7577	-118.0560	Primary
SDU-09A-21	422445.59	5401065.74	48.7578	-118.0550	Primary
SDU-09A-22	422401.03	5400997.91	48.7572	-118.0560	Primary
SDU-09A-23	422359.64	5400939.42	48.7566	-118.0560	Primary
SDU-09A-24	422450.74	5401108.37	48.7582	-118.0550	Primary
SDU-09A-25	422393.67	5401022.95	48.7574	-118.0560	Primary
SDU-09A-26	422377.37	5400902.52	48.7563	-118.0560	Primary
SDU-09A-27	422431.15	5401041.07	48.7575	-118.0550	Primary
SDU-09A-28	422382.92	5400982.83	48.7570	-118.0560	Primary
SDU-09A-29	422391.52	5400933.20	48.7566	-118.0560	Primary
SDU-09A-30	422466.63	5401084.77	48.7579	-118.0550	Primary
SDU-09B-01	422320.10	5400924.13	48.7565	-118.0570	Primary
SDU-09B-02	422308.02	5400885.43	48.7561	-118.0570	Primary
SDU-09B-03	422437.38	5401072.65	48.7578	-118.0550	Primary
SDU-09B-04	422320.73	5400935.45	48.7566	-118.0570	Primary
SDU-09B-05	422413.76	5400989.91	48.7571	-118.0560	Primary
SDU-09B-06	422357.80	5400910.63	48.7564	-118.0560	Primary
SDU-09B-07	422462.23	5401069.10	48.7578	-118.0550	Primary
SDU-09B-08	422400.99	5400973.01	48.7569	-118.0560	Primary
SDU-09B-09	422431.53	5401081.29	48.7579	-118.0550	Primary
SDU-09B-10	422329.21	5400896.69	48.7562	-118.0570	Primary
SDU-09B-11	422323.32	5400874.28	48.7560	-118.0570	Primary
SDU-09B-12	422366.94	5400964.34	48.7568	-118.0560	Primary
SDU-09B-13	422324.64	5400885.39	48.7561	-118.0570	Primary
SDU-09B-14	422451.48	5401044.15	48.7576	-118.0550	Primary
SDU-09B-15	422345.08	5400961.08	48.7568	-118.0570	Primary
SDU-09B-16	422424.15	5401034.93	48.7575	-118.0560	Primary
SDU-09B-17	422348.50	5400942.34	48.7566	-118.0570	Primary
SDU-09B-18	422339.95	5400913.09	48.7564	-118.0570	Primary
SDU-09B-19	422383.49	5400936.87	48.7566	-118.0560	Primary
SDU-09B-20	422341.52	5400899.74	48.7563	-118.0570	Primary
SDU-09B-21	422396.25	5401000.31	48.7572	-118.0560	Primary
SDU-09B-22	422401.36	5401032.24	48.7575	-118.0560	Primary
SDU-09B-23	422373.90	5400945.55	48.7567	-118.0560	Primary
SDU-09B-24	422309.09	5400900.00	48.7563	-118.0570	Primary
SDU-09B-25	422299.01	5400907.77	48.7563	-118.0570	Primary
SDU-09B-26	422429.03	5401059.76	48.7577	-118.0550	Primary
SDU-09B-27	422373.08	5400934.64	48.7566	-118.0560	Primary
SDU-09B-28	422356.37	5400966.52	48.7569	-118.0560	Primary
SDU-09B-29	422381.12	5400995.76	48.7571	-118.0560	Primary
SDU-09B-30	422385.48	5400918.26	48.7564	-118.0560	Primary
SDU-09C-01	422349.71	5400897.78	48.7562	-118.0560	Primary
SDU-09C-02	422490.96	5401078.82	48.7579	-118.0550	Primary
SDU-09C-03	422374.27	5400897.82	48.7563	-118.0560	Primary
SDU-09C-04	422394.93	5400966.39	48.7569	-118.0560	Primary
SDU-09C-05	422358.47	5400883.12	48.7561	-118.0560	Primary
SDU-09C-06	422420.57	5401037.18	48.7575	-118.0560	Primary
SDU-09C-07	422434.49	5401092.46	48.7580	-118.0550	Primary
SDU-09C-08	422377.57	5400915.02	48.7564	-118.0560	Primary
SDU-09C-09	422321.96	5400904.98	48.7563	-118.0570	Primary
SDU-09C-10	422341.91	5400939.09	48.7566	-118.0570	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 9 (continued)					
SDU-09C-11	422453.61	5401076.71	48.7579	-118.0550	Primary
SDU-09C-12	422422.20	5401050.20	48.7576	-118.0560	Primary
SDU-09C-13	422439.88	5401032.04	48.7575	-118.0550	Primary
SDU-09C-14	422325.50	5400926.00	48.7565	-118.0570	Primary
SDU-09C-15	422371.04	5400978.88	48.7570	-118.0560	Primary
SDU-09C-16	422405.05	5400955.57	48.7568	-118.0560	Primary
SDU-09C-17	422439.53	5401113.76	48.7582	-118.0550	Primary
SDU-09C-18	422364.18	5400959.89	48.7568	-118.0560	Primary
SDU-09C-19	422299.31	5400907.67	48.7563	-118.0570	Primary
SDU-09C-20	422341.83	5400911.94	48.7564	-118.0570	Primary
SDU-09C-21	422472.29	5401056.88	48.7577	-118.0550	Primary
SDU-09C-22	422388.56	5400915.08	48.7564	-118.0560	Primary
SDU-09C-23	422371.78	5400925.60	48.7565	-118.0560	Primary
SDU-09C-24	422352.34	5400917.24	48.7564	-118.0560	Primary
SDU-09C-25	422393.03	5401018.85	48.7573	-118.0560	Primary
SDU-09C-26	422384.28	5400984.19	48.7570	-118.0560	Primary
SDU-09C-27	422435.43	5401016.37	48.7573	-118.0550	Primary
SDU-09C-28	422362.12	5400898.09	48.7563	-118.0560	Primary
SDU-09C-29	422318.41	5400876.13	48.7560	-118.0570	Primary
SDU-09C-30	422362.09	5400933.78	48.7566	-118.0560	Primary
SDU-09A-R01	422404.48	5400989.88	48.7571	-118.0560	Reserve
SDU-09A-R02	422321.41	5400886.16	48.7561	-118.0570	Reserve
SDU-09A-R03	422343.19	5400892.22	48.7562	-118.0570	Reserve
SDU-09A-R04	422354.02	5400936.84	48.7566	-118.0560	Reserve
SDU-09A-R05	422411.28	5400970.01	48.7569	-118.0560	Reserve
SDU-09A-R06	422446.78	5401103.33	48.7581	-118.0550	Reserve
SDU-09B-R01	422396.84	5401011.27	48.7573	-118.0560	Reserve
SDU-09B-R02	422434.43	5401080.58	48.7579	-118.0550	Reserve
SDU-09B-R03	422313.79	5400879.69	48.7561	-118.0570	Reserve
SDU-09B-R04	422318.50	5400925.12	48.7565	-118.0570	Reserve
SDU-09B-R05	422366.08	5400894.94	48.7562	-118.0560	Reserve
SDU-09B-R06	422362.47	5400919.53	48.7564	-118.0560	Reserve
SDU-09C-R01	422383.59	5400961.60	48.7568	-118.0560	Reserve
SDU-09C-R02	422319.09	5400866.51	48.7560	-118.0570	Reserve
SDU-09C-R03	422326.39	5400887.55	48.7562	-118.0570	Reserve
SDU-09C-R04	422408.36	5401032.90	48.7575	-118.0560	Reserve
SDU-09C-R05	422401.70	5400969.92	48.7569	-118.0560	Reserve
SDU-09C-R06	422462.22	5401094.58	48.7580	-118.0550	Reserve
Sediment Decision Unit 10					
SDU-10-01	422121.36	5400672.62	48.7542	-118.0596	Primary
SDU-10-02	422238.00	5400804.41	48.7554	-118.0580	Primary
SDU-10-03	422100.04	5400634.56	48.7538	-118.0598	Primary
SDU-10-04	422139.78	5400663.87	48.7541	-118.0593	Primary
SDU-10-05	422130.00	5400651.00	48.7540	-118.0594	Primary
SDU-10-06	422266.05	5400779.23	48.7552	-118.0576	Primary
SDU-10-07	422226.71	5400755.86	48.7550	-118.0581	Primary
SDU-10-08	422113.35	5400595.63	48.7535	-118.0597	Primary
SDU-10-09	422165.15	5400677.78	48.7542	-118.0590	Primary
SDU-10-10	422104.99	5400659.23	48.7541	-118.0598	Primary
SDU-10-11	422165.70	5400721.01	48.7546	-118.0590	Primary
SDU-10-12	422165.60	5400702.18	48.7545	-118.0590	Primary
SDU-10-13	422182.00	5400720.14	48.7546	-118.0587	Primary
SDU-10-14	422208.57	5400755.72	48.7550	-118.0584	Primary
SDU-10-15	422216.02	5400767.96	48.7551	-118.0583	Primary
SDU-10-16	422184.58	5400743.91	48.7548	-118.0587	Primary

Table B3-1a. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 10 (continued)					
SDU-10-17	422090.19	5400640.86	48.7539	-118.0600	Primary
SDU-10-18	422152.81	5400657.01	48.7541	-118.0591	Primary
SDU-10-19	422121.40	5400621.25	48.7537	-118.0595	Primary
SDU-10-20	422191.34	5400715.34	48.7546	-118.0586	Primary
SDU-10-21	422132.41	5400626.67	48.7538	-118.0594	Primary
SDU-10-22	422180.66	5400755.08	48.7549	-118.0588	Primary
SDU-10-23	422148.21	5400712.80	48.7546	-118.0592	Primary
SDU-10-24	422255.98	5400794.06	48.7553	-118.0577	Primary
SDU-10-25	422180.22	5400730.27	48.7547	-118.0588	Primary
SDU-10-26	422202.82	5400718.57	48.7546	-118.0585	Primary
SDU-10-27	422162.81	5400650.63	48.7540	-118.0590	Primary
SDU-10-28	422220.23	5400740.72	48.7548	-118.0582	Primary
SDU-10-29	422238.06	5400791.04	48.7553	-118.0580	Primary
SDU-10-30	422193.58	5400691.80	48.7544	-118.0586	Primary
SDU-10-R01	422113.36	5400613.03	48.7537	-118.0597	Reserve
SDU-10-R02	422245.19	5400815.12	48.7555	-118.0579	Reserve
SDU-10-R03	422136.24	5400710.38	48.7545	-118.0594	Reserve
SDU-10-R04	422077.60	5400642.89	48.7539	-118.0601	Reserve
SDU-10-R05	422222.90	5400761.89	48.7550	-118.0582	Reserve
SDU-10-R06	422163.66	5400653.81	48.7540	-118.0590	Reserve

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-01	422967.34	5400915.40	48.7565	-118.0481	Primary
UDU-01-02	422955.26	5400946.77	48.7568	-118.0483	Primary
UDU-01-03	422945.62	5400955.22	48.7568	-118.0484	Primary
UDU-01-04	422943.96	5400925.29	48.7566	-118.0484	Primary
UDU-01-05	422895.35	5400941.05	48.7567	-118.0491	Primary
UDU-01-06	423017.29	5400912.54	48.7565	-118.0474	Primary
UDU-01-07	422984.73	5400905.79	48.7564	-118.0479	Primary
UDU-01-08	422963.84	5400902.64	48.7564	-118.0481	Primary
UDU-01-09	422925.69	5400930.53	48.7566	-118.0487	Primary
UDU-01-10	422927.83	5400966.67	48.7569	-118.0486	Primary
UDU-01-11	423035.90	5400903.59	48.7564	-118.0472	Primary
UDU-01-12	422974.13	5400894.28	48.7563	-118.0480	Primary
UDU-01-13	422915.94	5400935.29	48.7567	-118.0488	Primary
UDU-01-14	422992.44	5400900.71	48.7564	-118.0477	Primary
UDU-01-15	423051.29	5400883.99	48.7562	-118.0469	Primary
UDU-01-16	422966.32	5400886.82	48.7562	-118.0481	Primary
UDU-01-17	422989.13	5400934.05	48.7567	-118.0478	Primary
UDU-01-18	422932.72	5400942.02	48.7567	-118.0486	Primary
UDU-01-19	422966.59	5400930.13	48.7566	-118.0481	Primary
UDU-01-20	422908.95	5400950.70	48.7568	-118.0489	Primary
UDU-01-21	422927.93	5400945.48	48.7567	-118.0486	Primary
UDU-01-22	423045.32	5400902.67	48.7564	-118.0470	Primary
UDU-01-23	422906.92	5400935.89	48.7567	-118.0489	Primary
UDU-01-24	423058.08	5400890.19	48.7563	-118.0469	Primary
UDU-01-25	423032.94	5400860.12	48.7560	-118.0472	Primary
UDU-01-26	422954.63	5400929.51	48.7566	-118.0483	Primary
UDU-01-27	422996.30	5400925.16	48.7566	-118.0477	Primary
UDU-01-28	422960.38	5400933.13	48.7566	-118.0482	Primary
UDU-01-29	422942.22	5400970.97	48.7570	-118.0484	Primary
UDU-01-30	423032.78	5400892.90	48.7563	-118.0472	Primary
UDU-01-R01	422965.88	5400899.88	48.7563	-118.0481	Reserve
UDU-01-R02	423005.70	5400897.64	48.7563	-118.0476	Reserve
UDU-01-R03	422958.12	5400943.42	48.7567	-118.0482	Reserve
UDU-01-R04	422930.55	5400907.93	48.7564	-118.0486	Reserve
UDU-01-R05	423025.23	5400888.39	48.7562	-118.0473	Reserve
UDU-01-R06	422993.08	5400876.69	48.7561	-118.0477	Reserve
UDU-01-R07	423014.27	5400874.52	48.7561	-118.0474	Reserve
UDU-01-R08	423043.48	5400897.61	48.7563	-118.0471	Reserve
UDU-01-R09	422969.07	5400905.07	48.7564	-118.0481	Reserve
Soil Decision Unit 2					
UDU-02-01	422911.81	5400849.36	48.7559	-118.0488	Primary
UDU-02-02	422949.09	5400833.24	48.7557	-118.0483	Primary
UDU-02-03	422938.06	5400852.22	48.7559	-118.0485	Primary
UDU-02-04	422912.11	5400839.41	48.7558	-118.0488	Primary
UDU-02-05	422927.78	5400787.13	48.7553	-118.0486	Primary
UDU-02-06	422930.40	5400841.87	48.7558	-118.0486	Primary
UDU-02-07	422950.39	5400812.33	48.7556	-118.0483	Primary
UDU-02-08	422968.00	5400803.33	48.7555	-118.0481	Primary
UDU-02-09	422886.32	5400822.88	48.7556	-118.0492	Primary
UDU-02-10	422939.01	5400792.12	48.7554	-118.0485	Primary
UDU-02-11	422969.93	5400841.56	48.7558	-118.0480	Primary
UDU-02-12	422939.33	5400822.38	48.7556	-118.0485	Primary
UDU-02-13	422921.34	5400860.71	48.7560	-118.0487	Primary
UDU-02-14	422963.46	5400883.55	48.7562	-118.0481	Primary
UDU-02-15	422968.14	5400866.15	48.7560	-118.0481	Primary

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 2 (continued)					
UDU-02-16	422964.12	5400859.33	48.7560	-118.0481	Primary
UDU-02-17	422947.68	5400797.36	48.7554	-118.0483	Primary
UDU-02-18	422945.11	5400871.44	48.7561	-118.0484	Primary
UDU-02-19	422926.00	5400807.27	48.7555	-118.0486	Primary
UDU-02-20	423004.22	5400844.00	48.7558	-118.0476	Primary
UDU-02-21	422913.14	5400819.74	48.7556	-118.0488	Primary
UDU-02-22	422974.44	5400855.24	48.7559	-118.0480	Primary
UDU-02-23	422964.86	5400828.39	48.7557	-118.0481	Primary
UDU-02-24	422949.58	5400824.71	48.7557	-118.0483	Primary
UDU-02-25	422899.16	5400830.06	48.7557	-118.0490	Primary
UDU-02-26	422921.44	5400803.64	48.7555	-118.0487	Primary
UDU-02-27	422966.51	5400798.08	48.7554	-118.0481	Primary
UDU-02-28	423020.27	5400841.39	48.7558	-118.0474	Primary
UDU-02-29	422928.01	5400854.85	48.7559	-118.0486	Primary
UDU-02-30	422935.44	5400804.26	48.7555	-118.0485	Primary
Soil Decision Unit 3					
UDU-03-01	422892.25	5400764.18	48.7551	-118.0491	Primary
UDU-03-02	422854.90	5400796.94	48.7554	-118.0496	Primary
UDU-03-03	422852.40	5400816.50	48.7556	-118.0496	Primary
UDU-03-04	422911.52	5400792.37	48.7554	-118.0488	Primary
UDU-03-05	422790.75	5400866.19	48.7560	-118.0505	Primary
UDU-03-06	422802.50	5400821.16	48.7556	-118.0503	Primary
UDU-03-07	422937.20	5400762.24	48.7551	-118.0485	Primary
UDU-03-08	422915.29	5400768.98	48.7552	-118.0488	Primary
UDU-03-09	422901.24	5400748.33	48.7550	-118.0490	Primary
UDU-03-10	422806.34	5400858.57	48.7560	-118.0503	Primary
UDU-03-11	422830.28	5400806.13	48.7555	-118.0499	Primary
UDU-03-12	422838.87	5400807.38	48.7555	-118.0498	Primary
UDU-03-13	422913.69	5400738.38	48.7549	-118.0488	Primary
UDU-03-14	422901.66	5400784.75	48.7553	-118.0490	Primary
UDU-03-15	422898.88	5400795.71	48.7554	-118.0490	Primary
UDU-03-16	422888.59	5400779.57	48.7553	-118.0491	Primary
UDU-03-17	422788.37	5400817.94	48.7556	-118.0505	Primary
UDU-03-18	422894.04	5400777.49	48.7552	-118.0491	Primary
UDU-03-19	422769.70	5400835.32	48.7557	-118.0508	Primary
UDU-03-20	422761.02	5400835.05	48.7557	-118.0509	Primary
UDU-03-21	422871.39	5400787.09	48.7553	-118.0494	Primary
UDU-03-22	422847.35	5400802.20	48.7554	-118.0497	Primary
UDU-03-23	422778.84	5400826.71	48.7557	-118.0506	Primary
UDU-03-24	422859.20	5400779.26	48.7552	-118.0495	Primary
UDU-03-25	422786.43	5400823.02	48.7556	-118.0505	Primary
UDU-03-26	422863.15	5400800.89	48.7554	-118.0495	Primary
UDU-03-27	422906.27	5400778.41	48.7552	-118.0489	Primary
UDU-03-28	422776.67	5400848.69	48.7559	-118.0507	Primary
UDU-03-29	422871.61	5400801.14	48.7554	-118.0494	Primary
UDU-03-30	422914.23	5400756.47	48.7550	-118.0488	Primary
UDU-03-R01	422833.37	5400797.67	48.7554	-118.0499	Reserve
UDU-03-R02	422926.86	5400776.22	48.7552	-118.0486	Reserve
UDU-03-R03	422817.82	5400827.18	48.7557	-118.0501	Reserve
UDU-03-R04	422814.07	5400812.37	48.7555	-118.0502	Reserve
UDU-03-R05	422890.39	5400762.84	48.7551	-118.0491	Reserve

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4					
UDU-04A-01	422878.64	5400824.23	48.7557	-118.0493	Primary
UDU-04A-02	422898.34	5400906.71	48.7564	-118.0490	Primary
UDU-04A-03	422823.69	5400875.82	48.7561	-118.0500	Primary
UDU-04A-04	422872.16	5400903.81	48.7564	-118.0494	Primary
UDU-04A-05	422862.76	5400857.90	48.7560	-118.0495	Primary
UDU-04A-06	422875.06	5400863.05	48.7560	-118.0493	Primary
UDU-04A-07	422868.28	5400921.33	48.7565	-118.0494	Primary
UDU-04A-08	422838.11	5400872.40	48.7561	-118.0498	Primary
UDU-04A-09	422885.87	5400846.83	48.7559	-118.0492	Primary
UDU-04A-10	422910.53	5400904.91	48.7564	-118.0489	Primary
UDU-04A-11	422883.05	5400833.88	48.7557	-118.0492	Primary
UDU-04A-12	422858.62	5400846.89	48.7559	-118.0496	Primary
UDU-04A-13	422862.40	5400879.60	48.7561	-118.0495	Primary
UDU-04A-14	422862.71	5400825.41	48.7557	-118.0495	Primary
UDU-04A-15	422903.05	5400847.05	48.7559	-118.0490	Primary
UDU-04A-16	422869.79	5400820.65	48.7556	-118.0494	Primary
UDU-04A-17	422810.06	5400867.22	48.7560	-118.0502	Primary
UDU-04A-18	422876.86	5400852.17	48.7559	-118.0493	Primary
UDU-04A-19	422871.87	5400835.55	48.7558	-118.0494	Primary
UDU-04A-20	422904.92	5400900.17	48.7563	-118.0489	Primary
UDU-04A-21	422872.16	5400868.44	48.7560	-118.0494	Primary
UDU-04A-22	422883.35	5400860.28	48.7560	-118.0492	Primary
UDU-04A-23	422864.18	5400834.67	48.7557	-118.0495	Primary
UDU-04A-24	422846.05	5400859.90	48.7560	-118.0497	Primary
UDU-04A-25	422883.25	5400931.67	48.7566	-118.0492	Primary
UDU-04A-26	422837.15	5400863.00	48.7560	-118.0499	Primary
UDU-04A-27	422913.84	5400887.55	48.7562	-118.0488	Primary
UDU-04A-28	422902.24	5400889.33	48.7562	-118.0490	Primary
UDU-04A-29	422905.23	5400855.55	48.7559	-118.0489	Primary
UDU-04A-30	422944.70	5400893.69	48.7563	-118.0484	Primary
UDU-04B-01	422878.76	5400925.21	48.7566	-118.0493	Primary
UDU-04B-02	422874.71	5400860.00	48.7560	-118.0493	Primary
UDU-04B-03	422837.21	5400862.35	48.7560	-118.0499	Primary
UDU-04B-04	422876.36	5400840.19	48.7558	-118.0493	Primary
UDU-04B-05	422841.72	5400874.93	48.7561	-118.0498	Primary
UDU-04B-06	422864.33	5400831.46	48.7557	-118.0495	Primary
UDU-04B-07	422897.74	5400850.65	48.7559	-118.0490	Primary
UDU-04B-08	422895.51	5400868.13	48.7560	-118.0491	Primary
UDU-04B-09	422850.13	5400835.97	48.7558	-118.0497	Primary
UDU-04B-10	422836.48	5400849.59	48.7559	-118.0499	Primary
UDU-04B-11	422847.57	5400909.96	48.7564	-118.0497	Primary
UDU-04B-12	422916.35	5400897.61	48.7563	-118.0488	Primary
UDU-04B-13	422833.90	5400891.38	48.7562	-118.0499	Primary
UDU-04B-14	422827.67	5400855.53	48.7559	-118.0500	Primary
UDU-04B-15	422873.32	5400897.43	48.7563	-118.0494	Primary
UDU-04B-16	422825.94	5400892.72	48.7563	-118.0500	Primary
UDU-04B-17	422868.38	5400851.78	48.7559	-118.0494	Primary
UDU-04B-18	422921.22	5400899.70	48.7563	-118.0487	Primary
UDU-04B-19	422813.08	5400875.39	48.7561	-118.0502	Primary
UDU-04B-20	422829.27	5400884.78	48.7562	-118.0500	Primary
UDU-04B-21	422933.24	5400885.71	48.7562	-118.0486	Primary
UDU-04B-22	422924.24	5400869.45	48.7561	-118.0487	Primary
UDU-04B-23	422879.93	5400892.91	48.7563	-118.0493	Primary
UDU-04B-24	422852.64	5400868.10	48.7560	-118.0496	Primary
UDU-04B-25	422857.32	5400844.02	48.7558	-118.0496	Primary

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04B-26	422880.70	5400931.37	48.7566	-118.0493	Primary
UDU-04B-27	422907.44	5400908.77	48.7564	-118.0489	Primary
UDU-04B-28	422875.50	5400885.56	48.7562	-118.0493	Primary
UDU-04B-29	422880.83	5400912.64	48.7564	-118.0493	Primary
UDU-04B-30	422881.51	5400886.71	48.7562	-118.0493	Primary
UDU-04C-01	422912.40	5400905.50	48.7564	-118.0488	Primary
UDU-04C-02	422851.22	5400876.76	48.7561	-118.0497	Primary
UDU-04C-03	422910.52	5400916.28	48.7565	-118.0489	Primary
UDU-04C-04	422870.17	5400874.81	48.7561	-118.0494	Primary
UDU-04C-05	422889.10	5400881.26	48.7562	-118.0492	Primary
UDU-04C-06	422806.48	5400871.79	48.7561	-118.0503	Primary
UDU-04C-07	422850.89	5400843.34	48.7558	-118.0497	Primary
UDU-04C-08	422859.01	5400826.11	48.7557	-118.0496	Primary
UDU-04C-09	422871.64	5400856.16	48.7559	-118.0494	Primary
UDU-04C-10	422867.61	5400834.83	48.7557	-118.0494	Primary
UDU-04C-11	422865.66	5400881.95	48.7562	-118.0495	Primary
UDU-04C-12	422860.29	5400836.24	48.7558	-118.0495	Primary
UDU-04C-13	422895.47	5400925.09	48.7566	-118.0491	Primary
UDU-04C-14	422835.30	5400875.73	48.7561	-118.0499	Primary
UDU-04C-15	422926.00	5400906.80	48.7564	-118.0487	Primary
UDU-04C-16	422904.10	5400921.45	48.7565	-118.0490	Primary
UDU-04C-17	422915.42	5400881.07	48.7562	-118.0488	Primary
UDU-04C-18	422872.16	5400901.36	48.7563	-118.0494	Primary
UDU-04C-19	422907.50	5400880.45	48.7562	-118.0489	Primary
UDU-04C-20	422840.44	5400864.85	48.7560	-118.0498	Primary
UDU-04C-21	422880.06	5400848.18	48.7559	-118.0493	Primary
UDU-04C-22	422924.22	5400872.64	48.7561	-118.0487	Primary
UDU-04C-23	422811.25	5400879.83	48.7561	-118.0502	Primary
UDU-04C-24	422882.13	5400867.86	48.7560	-118.0492	Primary
UDU-04C-25	422857.41	5400890.96	48.7562	-118.0496	Primary
UDU-04C-26	422815.53	5400885.95	48.7562	-118.0502	Primary
UDU-04C-27	422862.67	5400867.15	48.7560	-118.0495	Primary
UDU-04C-28	422902.78	5400849.76	48.7559	-118.0490	Primary
UDU-04C-29	422902.43	5400900.85	48.7563	-118.0490	Primary
UDU-04C-30	422826.99	5400866.97	48.7560	-118.0500	Primary
UDU-04A-R01	422897.00	5400837.28	48.7558	-118.0490	Reserve
UDU-04A-R02	422871.43	5400813.95	48.7556	-118.0494	Reserve
UDU-04A-R03	422877.75	5400858.83	48.7560	-118.0493	Reserve
UDU-04A-R04	422935.65	5400901.18	48.7564	-118.0485	Reserve
UDU-04A-R05	422892.90	5400901.77	48.7564	-118.0491	Reserve
UDU-04A-R06	422922.92	5400911.89	48.7564	-118.0487	Reserve
UDU-04A-R07	422884.20	5400883.67	48.7562	-118.0492	Reserve
UDU-04B-R01	422883.10	5400894.57	48.7563	-118.0492	Reserve
UDU-04B-R02	422847.26	5400842.06	48.7558	-118.0497	Reserve
UDU-04B-R03	422857.63	5400820.76	48.7556	-118.0496	Reserve
UDU-04B-R04	422890.48	5400925.93	48.7566	-118.0491	Reserve
UDU-04B-R05	422931.06	5400878.29	48.7561	-118.0486	Reserve
UDU-04B-R06	422882.95	5400825.30	48.7557	-118.0492	Reserve
UDU-04B-R07	422895.48	5400868.84	48.7561	-118.0491	Reserve
UDU-04B-R08	422904.04	5400912.12	48.7564	-118.0490	Reserve
UDU-04B-R09	422890.13	5400886.67	48.7562	-118.0491	Reserve
UDU-04B-R10	422890.89	5400852.63	48.7559	-118.0491	Reserve
UDU-04B-R11	422889.98	5400915.22	48.7565	-118.0491	Reserve
UDU-04C-R01	422893.42	5400903.23	48.7564	-118.0491	Reserve
UDU-04C-R02	422883.83	5400865.41	48.7560	-118.0492	Reserve

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 4 (continued)					
UDU-04C-R03	422912.54	5400880.27	48.7562	-118.0488	Reserve
UDU-04C-R04	422831.85	5400868.62	48.7560	-118.0499	Reserve
UDU-04C-R05	422904.54	5400892.94	48.7563	-118.0489	Reserve
UDU-04C-R06	422889.47	5400881.65	48.7562	-118.0491	Reserve
UDU-04C-R07	422933.73	5400877.36	48.7561	-118.0485	Reserve
UDU-04C-R08	422875.23	5400842.69	48.7558	-118.0493	Reserve
Soil Decision Unit 5					
UDU-05-01	423463.26	5401280.87	48.7598	-118.0414	Primary
UDU-05-02	423525.67	5401328.97	48.7603	-118.0406	Primary
UDU-05-03	423510.63	5401339.05	48.7604	-118.0408	Primary
UDU-05-04	423475.46	5401305.23	48.7601	-118.0413	Primary
UDU-05-05	423525.17	5401320.54	48.7602	-118.0406	Primary
UDU-05-06	423500.09	5401337.34	48.7603	-118.0409	Primary
UDU-05-07	423615.60	5401470.38	48.7616	-118.0394	Primary
UDU-05-08	423586.69	5401433.79	48.7612	-118.0398	Primary
UDU-05-09	423575.27	5401403.66	48.7609	-118.0399	Primary
UDU-05-10	423496.16	5401313.37	48.7601	-118.0410	Primary
UDU-05-11	423565.65	5401433.61	48.7612	-118.0401	Primary
UDU-05-12	423522.21	5401335.27	48.7603	-118.0406	Primary
UDU-05-13	423550.70	5401380.42	48.7607	-118.0402	Primary
UDU-05-14	423568.33	5401383.52	48.7608	-118.0400	Primary
UDU-05-15	423486.88	5401320.83	48.7602	-118.0411	Primary
UDU-05-16	423540.07	5401372.72	48.7607	-118.0404	Primary
UDU-05-17	423584.79	5401415.64	48.7611	-118.0398	Primary
UDU-05-18	423519.73	5401320.92	48.7602	-118.0407	Primary
UDU-05-19	423570.79	5401397.62	48.7609	-118.0400	Primary
UDU-05-20	423572.33	5401425.68	48.7611	-118.0400	Primary
UDU-05-21	423506.13	5401294.12	48.7600	-118.0408	Primary
UDU-05-22	423545.65	5401344.77	48.7604	-118.0403	Primary
UDU-05-23	423515.72	5401325.87	48.7602	-118.0407	Primary
UDU-05-24	423522.61	5401362.14	48.7606	-118.0406	Primary
UDU-05-25	423548.58	5401357.54	48.7605	-118.0403	Primary
UDU-05-26	423596.43	5401464.28	48.7615	-118.0396	Primary
UDU-05-27	423518.96	5401330.85	48.7603	-118.0407	Primary
UDU-05-28	423573.14	5401420.46	48.7611	-118.0399	Primary
UDU-05-29	423548.48	5401399.48	48.7609	-118.0403	Primary
UDU-05-30	423580.11	5401410.54	48.7610	-118.0398	Primary
UDU-05-R01	423506.01	5401303.30	48.7600	-118.0408	Reserve
UDU-05-R02	423486.11	5401295.23	48.7600	-118.0411	Reserve
UDU-05-R03	423586.71	5401419.31	48.7611	-118.0398	Reserve
UDU-05-R04	423498.72	5401297.55	48.7600	-118.0409	Reserve
UDU-05-R05	423496.70	5401277.82	48.7598	-118.0410	Reserve
UDU-05-R06	423521.10	5401327.20	48.7603	-118.0406	Reserve
UDU-05-R07	423495.67	5401289.29	48.7599	-118.0410	Reserve
UDU-05-R08	423517.03	5401307.16	48.7601	-118.0407	Reserve
UDU-05-R09	423567.99	5401433.86	48.7612	-118.0400	Reserve
UDU-05-R10	423482.40	5401287.26	48.7599	-118.0412	Reserve
UDU-05-R11	423609.73	5401449.79	48.7614	-118.0395	Reserve
UDU-05-R12	423516.08	5401316.63	48.7602	-118.0407	Reserve
UDU-05-R13	423545.81	5401354.89	48.7605	-118.0403	Reserve
UDU-05-R14	423580.96	5401412.31	48.7610	-118.0398	Reserve
UDU-05-R15	423524.69	5401323.40	48.7602	-118.0406	Reserve
UDU-05-R16	423499.34	5401285.49	48.7599	-118.0409	Reserve
UDU-05-R17	423620.17	5401479.74	48.7616	-118.0393	Reserve
UDU-05-R18	423612.30	5401465.85	48.7615	-118.0394	Reserve

Table B3-1b. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: Incremental Composite Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-R19	423508.42	5401311.18	48.7601	-118.0408	Reserve
UDU-05-R20	423565.05	5401384.35	48.7608	-118.0400	Reserve
UDU-05-R21	423472.76	5401274.12	48.7598	-118.0413	Reserve
UDU-05-R22	423506.73	5401296.89	48.7600	-118.0408	Reserve
UDU-05-R23	423486.96	5401301.70	48.7600	-118.0411	Reserve
Soil Decision Unit 6					
UDU-06-01	422184.22	5400810.96	48.7554	-118.0587	Primary
UDU-06-02	422240.14	5400910.05	48.7563	-118.0580	Primary
UDU-06-03	422238.46	5400870.89	48.7560	-118.0580	Primary
UDU-06-04	422212.12	5400905.85	48.7563	-118.0584	Primary
UDU-06-05	422207.91	5400880.79	48.7561	-118.0584	Primary
UDU-06-06	422176.13	5400805.14	48.7554	-118.0588	Primary
UDU-06-07	422189.41	5400789.71	48.7553	-118.0587	Primary
UDU-06-08	422165.00	5400811.30	48.7554	-118.0590	Primary
UDU-06-09	422208.53	5400865.41	48.7559	-118.0584	Primary
UDU-06-10	422226.83	5400870.44	48.7560	-118.0582	Primary
UDU-06-11	422220.48	5400897.54	48.7562	-118.0583	Primary
UDU-06-12	422194.45	5400828.32	48.7556	-118.0586	Primary
UDU-06-13	422238.77	5400845.55	48.7558	-118.0580	Primary
UDU-06-14	422204.71	5400795.15	48.7553	-118.0584	Primary
UDU-06-15	422218.37	5400882.67	48.7561	-118.0583	Primary
UDU-06-16	422198.57	5400838.07	48.7557	-118.0585	Primary
UDU-06-17	422276.25	5400930.53	48.7565	-118.0575	Primary
UDU-06-18	422166.79	5400825.57	48.7556	-118.0590	Primary
UDU-06-19	422223.27	5400880.21	48.7561	-118.0582	Primary
UDU-06-20	422207.41	5400822.84	48.7556	-118.0584	Primary
UDU-06-21	422274.31	5400900.49	48.7563	-118.0575	Primary
UDU-06-22	422184.72	5400842.82	48.7557	-118.0587	Primary
UDU-06-23	422248.91	5400859.62	48.7559	-118.0579	Primary
UDU-06-24	422224.06	5400839.33	48.7557	-118.0582	Primary
UDU-06-25	422154.02	5400783.74	48.7552	-118.0591	Primary
UDU-06-26	422186.26	5400799.10	48.7553	-118.0587	Primary
UDU-06-27	422221.62	5400828.80	48.7556	-118.0582	Primary
UDU-06-28	422193.69	5400855.42	48.7558	-118.0586	Primary
UDU-06-29	422280.89	5400898.44	48.7562	-118.0574	Primary
UDU-06-30	422207.52	5400845.08	48.7558	-118.0584	Primary
UDU-06-R01	422260.55	5400883.36	48.7561	-118.0577	Reserve
UDU-06-R02	422202.16	5400852.63	48.7558	-118.0585	Reserve
UDU-06-R03	422274.17	5400916.47	48.7564	-118.0575	Reserve
UDU-06-R04	422206.47	5400885.39	48.7561	-118.0584	Reserve
UDU-06-R05	422224.21	5400875.78	48.7560	-118.0582	Reserve
UDU-06-R06	422216.76	5400846.91	48.7558	-118.0583	Reserve

Table B3-1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 1					
SDU-01-XRF-01	423555.56	5401691.38	48.7635	-118.0402	Primary
SDU-01-XRF-02	423473.06	5401636.38	48.7630	-118.0413	Primary
SDU-01-XRF-03	423528.06	5401636.38	48.7630	-118.0406	Primary
SDU-01-XRF-04	423583.06	5401636.38	48.7630	-118.0399	Primary
SDU-01-XRF-05	423445.56	5401581.38	48.7625	-118.0417	Primary
SDU-01-XRF-06	423555.56	5401581.38	48.7625	-118.0402	Primary
SDU-01-XRF-07	423610.56	5401581.38	48.7626	-118.0395	Primary
SDU-01-XRF-08	423528.06	5401526.38	48.7620	-118.0406	Primary
SDU-01-XRF-09	423555.56	5401471.38	48.7616	-118.0402	Primary
SDU-01-XRF-R01	423500.56	5401691.38	48.7635	-118.0410	Reserve
SDU-01-XRF-R02	423418.06	5401636.38	48.7630	-118.0421	Reserve
SDU-01-XRF-R03	423638.06	5401636.38	48.7630	-118.0391	Reserve
SDU-01-XRF-R04	423500.56	5401581.38	48.7625	-118.0410	Reserve
SDU-01-XRF-R05	423583.06	5401526.38	48.7621	-118.0398	Reserve
Sediment Decision Unit 2					
SDU-02-XRF-01	423325.30	5401483.86	48.7616	-118.0433	Primary
SDU-02-XRF-02	423380.30	5401483.86	48.7616	-118.0426	Primary
SDU-02-XRF-03	423435.30	5401483.86	48.7617	-118.0418	Primary
SDU-02-XRF-04	423352.80	5401428.86	48.7611	-118.0429	Primary
SDU-02-XRF-05	423462.80	5401428.86	48.7612	-118.0414	Primary
SDU-02-XRF-06	423380.30	5401373.86	48.7607	-118.0426	Primary
SDU-02-XRF-07	423435.30	5401373.86	48.7607	-118.0418	Primary
SDU-02-XRF-08	423490.30	5401373.86	48.7607	-118.0411	Primary
SDU-02-XRF-R01	423352.80	5401538.86	48.7621	-118.0430	Reserve
SDU-02-XRF-R02	423297.80	5401428.86	48.7611	-118.0437	Reserve
SDU-02-XRF-R03	423407.80	5401428.86	48.7612	-118.0422	Reserve
SDU-02-XRF-R04	423407.80	5401318.86	48.7602	-118.0422	Reserve
SDU-02-XRF-R05	423462.80	5401318.86	48.7602	-118.0414	Reserve
Sediment Decision Unit 3					
SDU-03-XRF-01	423086.79	5401100.46	48.7582	-118.0465	Primary
SDU-03-XRF-02	423029.29	5401055.46	48.7577	-118.0473	Primary
SDU-03-XRF-03	422971.79	5401010.46	48.7573	-118.0481	Primary
SDU-03-XRF-04	422914.29	5400965.46	48.7569	-118.0488	Primary
SDU-03-XRF-R01	423061.79	5401080.46	48.7580	-118.0468	Reserve
SDU-03-XRF-R02	422996.79	5401030.46	48.7575	-118.0477	Reserve
SDU-03-XRF-R03	422939.29	5400985.46	48.7571	-118.0485	Reserve
SDU-03-XRF-R04	422881.79	5400940.46	48.7567	-118.0493	Reserve
Sediment Decision Unit 4					
SDU-04-XRF-01	422692.19	5400781.16	48.7552	-118.0518	Primary
SDU-04-XRF-02	422650.19	5400721.16	48.7547	-118.0524	Primary
SDU-04-XRF-03	422632.19	5400685.16	48.7544	-118.0526	Primary
SDU-04-XRF-04	422596.19	5400613.16	48.7537	-118.0531	Primary
SDU-04-XRF-R01	422674.19	5400745.16	48.7549	-118.0520	Reserve
SDU-04-XRF-R02	422614.19	5400649.16	48.7540	-118.0528	Reserve
Sediment Decision Unit 5					
SDU-05-XRF-01	424294.01	5395316.60	48.7063	-118.0290	Primary
SDU-05-XRF-02	424544.01	5395316.60	48.7063	-118.0256	Primary
SDU-05-XRF-03	424356.51	5395191.60	48.7052	-118.0281	Primary
SDU-05-XRF-04	424606.51	5395191.60	48.7052	-118.0247	Primary
SDU-05-XRF-05	424419.01	5395066.60	48.7041	-118.0273	Primary

Table B3-1c. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Sediment

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Sediment Decision Unit 5 (continued)					
SDU-05-XRF-06	424544.01	5395066.60	48.7041	-118.0256	Primary
SDU-05-XRF-07	424669.01	5395066.60	48.7041	-118.0239	Primary
SDU-05-XRF-08	424356.51	5394941.60	48.7029	-118.0281	Primary
SDU-05-XRF-09	424606.51	5394941.60	48.7030	-118.0247	Primary
SDU-05-XRF-R01	424419.01	5395316.60	48.7063	-118.0273	Reserve
SDU-05-XRF-R02	424231.51	5395191.60	48.7052	-118.0298	Reserve
SDU-05-XRF-R03	424481.51	5395191.60	48.7052	-118.0264	Reserve
SDU-05-XRF-R04	424294.01	5395066.60	48.7040	-118.0290	Reserve
SDU-05-XRF-R05	424481.51	5394941.60	48.7029	-118.0264	Reserve
Sediment Decision Unit 6					
SDU-06-XRF-01	425126.24	5394173.90	48.6961	-118.0175	Primary
SDU-06-XRF-02	425223.74	5394068.90	48.6952	-118.0162	Primary
SDU-06-XRF-03	425246.24	5393933.90	48.6940	-118.0158	Primary
SDU-06-XRF-04	425306.24	5393813.90	48.6929	-118.0150	Primary
SDU-06-XRF-05	425298.74	5393678.90	48.6917	-118.0151	Primary
SDU-06-XRF-R01	425178.74	5394128.90	48.6957	-118.0168	Reserve
SDU-06-XRF-R02	425238.74	5394008.90	48.6946	-118.0159	Reserve
SDU-06-XRF-R03	425276.24	5393873.90	48.6934	-118.0154	Reserve
SDU-06-XRF-R04	425298.74	5393738.90	48.6922	-118.0151	Reserve
Sediment Decision Unit 7					
SDU-07-XRF-01	425254.78	5393031.17	48.6858	-118.0155	Primary
SDU-07-XRF-02	425194.78	5392911.17	48.6848	-118.0163	Primary
SDU-07-XRF-03	425134.78	5392791.17	48.6837	-118.0171	Primary
SDU-07-XRF-04	425074.78	5392671.17	48.6826	-118.0179	Primary
SDU-07-XRF-R01	425224.78	5392971.17	48.6853	-118.0159	Reserve
SDU-07-XRF-R02	425164.78	5392851.17	48.6842	-118.0167	Reserve
SDU-07-XRF-R03	425104.78	5392731.17	48.6831	-118.0175	Reserve
Sediment Decision Unit 8					
SDU-08-XRF-01	423209.27	5401902.00	48.7654	-118.0450	Primary
SDU-08-XRF-02	423131.27	5401824.00	48.7647	-118.0460	Primary
SDU-08-XRF-03	423072.77	5401746.00	48.7640	-118.0468	Primary
SDU-08-XRF-04	422994.77	5401668.00	48.7633	-118.0479	Primary
SDU-08-XRF-R01	423170.27	5401863.00	48.7650	-118.0455	Reserve
SDU-08-XRF-R02	423111.77	5401785.00	48.7643	-118.0463	Reserve
SDU-08-XRF-R03	423033.77	5401707.00	48.7636	-118.0473	Reserve
Sediment Decision Unit 9					
SDU-09-XRF-01	422480.15	5401083.34	48.7579	-118.0548	Primary
SDU-09-XRF-02	422419.13	5401027.18	48.7574	-118.0556	Primary
SDU-09-XRF-03	422373.05	5400950.09	48.7567	-118.0562	Primary
SDU-09-XRF-04	422326.96	5400873.00	48.7560	-118.0568	Primary
SDU-09-XRF-R01	422449.64	5401055.26	48.7577	-118.0552	Reserve
SDU-09-XRF-R02	422403.56	5400978.17	48.7570	-118.0558	Reserve
SDU-09-XRF-R03	422342.54	5400922.01	48.7565	-118.0566	Reserve
Sediment Decision Unit 10					
SDU-10-XRF-01	422246.13	5400805.54	48.7554	-118.0579	Primary
SDU-10-XRF-02	422198.11	5400743.74	48.7548	-118.0585	Primary
SDU-10-XRF-03	422150.09	5400681.94	48.7543	-118.0592	Primary
SDU-10-XRF-04	422102.07	5400620.14	48.7537	-118.0598	Primary
SDU-10-XRF-R01	422222.12	5400774.64	48.7551	-118.0582	Reserve
SDU-10-XRF-R02	422174.10	5400712.84	48.7546	-118.0588	Reserve
SDU-10-XRF-R03	422126.08	5400651.04	48.7540	-118.0595	Reserve

Table B3-1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 1					
UDU-01-XRF-01	422896.73	5400940.79	48.7567	-118.0491	Primary
UDU-01-XRF-02	422931.73	5400940.79	48.7567	-118.0486	Primary
UDU-01-XRF-03	422966.73	5400940.79	48.7567	-118.0481	Primary
UDU-01-XRF-04	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-01-XRF-05	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-01-XRF-06	422914.23	5400905.79	48.7564	-118.0488	Primary
UDU-01-XRF-07	422949.23	5400905.79	48.7564	-118.0483	Primary
UDU-01-XRF-R01	422984.23	5400905.79	48.7564	-118.0479	Reserve
Soil Decision Unit 2					
UDU-02-XRF-01	422931.73	5400870.79	48.7561	-118.0486	Primary
UDU-02-XRF-02	422966.73	5400870.79	48.7561	-118.0481	Primary
UDU-02-XRF-03	422949.23	5400835.79	48.7558	-118.0483	Primary
UDU-02-XRF-04	422984.23	5400835.79	48.7558	-118.0478	Primary
UDU-02-XRF-05	422931.73	5400800.79	48.7554	-118.0486	Primary
UDU-02-XRF-06	422966.73	5400800.79	48.7555	-118.0481	Primary
UDU-02-XRF-R01	422914.23	5400835.79	48.7558	-118.0488	Reserve
UDU-02-XRF-R02	423019.23	5400835.79	48.7558	-118.0474	Reserve
Soil Decision Unit 3					
UDU-03-XRF-01	422879.23	5400765.79	48.7551	-118.0493	Primary
UDU-03-XRF-02	422774.23	5400835.79	48.7557	-118.0507	Primary
UDU-03-XRF-03	422809.23	5400835.79	48.7557	-118.0502	Primary
UDU-03-XRF-04	422844.23	5400835.79	48.7558	-118.0498	Primary
UDU-03-XRF-05	422826.73	5400800.79	48.7554	-118.0500	Primary
UDU-03-XRF-06	422861.73	5400800.79	48.7554	-118.0495	Primary
UDU-03-XRF-07	422896.73	5400800.79	48.7554	-118.0490	Primary
UDU-03-XRF-08	422914.23	5400765.79	48.7551	-118.0488	Primary
UDU-03-XRF-R01	422949.23	5400765.79	48.7551	-118.0483	Reserve
Soil Decision Unit 4					
UDU-04-XRF-01	422844.23	5400905.79	48.7564	-118.0498	Primary
UDU-04-XRF-02	422879.23	5400905.79	48.7564	-118.0493	Primary
UDU-04-XRF-03	422826.73	5400870.79	48.7561	-118.0500	Primary
UDU-04-XRF-04	422896.73	5400870.79	48.7561	-118.0490	Primary
UDU-04-XRF-05	422879.23	5400835.79	48.7558	-118.0493	Primary
UDU-04-XRF-R01	422861.73	5400870.79	48.7561	-118.0495	Reserve
UDU-04-XRF-R02	422914.23	5400905.79	48.7564	-118.0488	Reserve
Soil Decision Unit 5					
UDU-05-XRF-01	423595.75	5401448.21	48.7614	-118.0396	Primary
UDU-05-XRF-02	423562.75	5401426.21	48.7612	-118.0401	Primary
UDU-05-XRF-03	423584.75	5401426.21	48.7612	-118.0398	Primary
UDU-05-XRF-04	423551.75	5401404.21	48.7610	-118.0402	Primary
UDU-05-XRF-05	423573.75	5401404.21	48.7610	-118.0399	Primary
UDU-05-XRF-06	423540.75	5401382.21	48.7608	-118.0404	Primary
UDU-05-XRF-07	423562.75	5401382.21	48.7608	-118.0401	Primary
UDU-05-XRF-08	423551.75	5401360.21	48.7606	-118.0402	Primary
UDU-05-XRF-09	423540.75	5401338.21	48.7604	-118.0404	Primary
UDU-05-XRF-10	423485.75	5401316.21	48.7602	-118.0411	Primary
UDU-05-XRF-11	423507.75	5401316.21	48.7602	-118.0408	Primary
UDU-05-XRF-12	423496.75	5401294.21	48.7600	-118.0410	Primary
UDU-05-XRF-13	423485.75	5401272.21	48.7598	-118.0411	Primary
UDU-05-XRF-R01	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R02	423529.75	5401360.21	48.7606	-118.0405	Reserve
UDU-05-XRF-R03	423518.75	5401338.21	48.7604	-118.0407	Reserve
UDU-05-XRF-R04	423474.75	5401294.21	48.7600	-118.0413	Reserve
UDU-05-XRF-R05	423606.75	5401470.21	48.7616	-118.0395	Reserve
UDU-05-XRF-R06	423529.75	5401360.21	48.7606	-118.0405	Reserve

Table B3-1d. Proposed Station Locations for Bossburg Flat Beach Refined Sediment and Soil Collection: XRF Sampling Sites for Soil

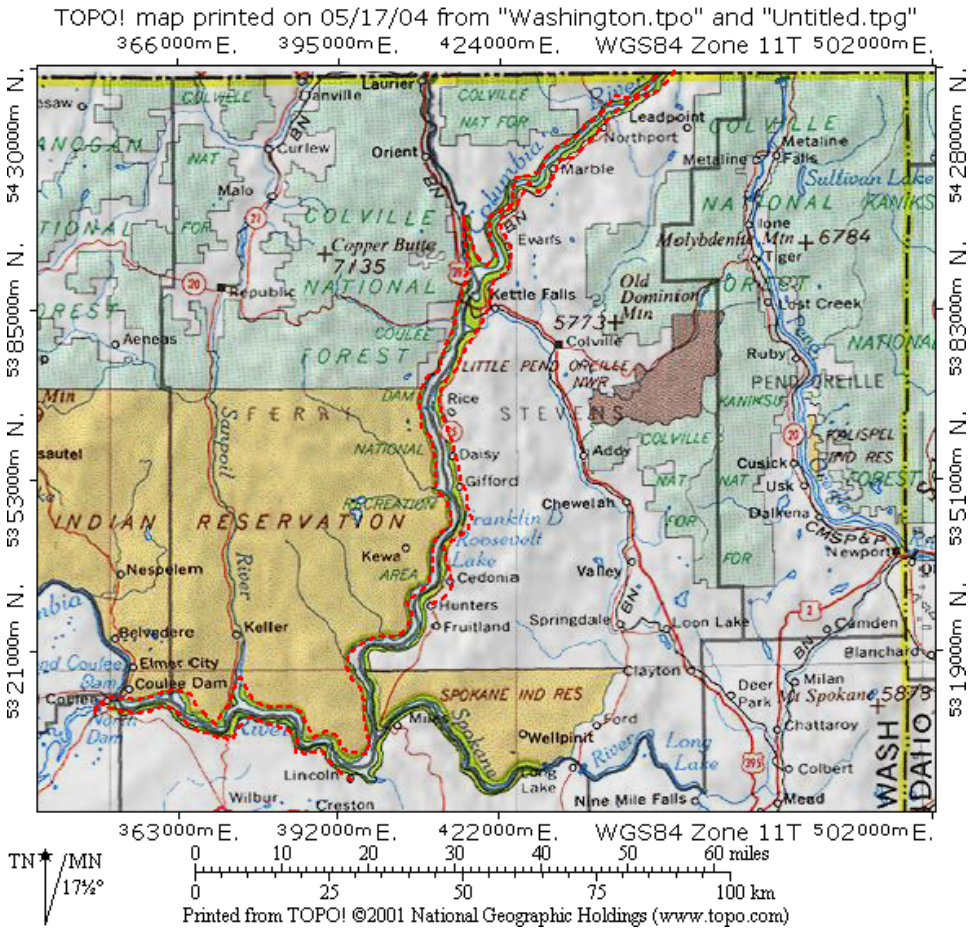
Station ID	X UTM 11N	Y UTM 11N	Latitude	Longitude	Sample Type
Soil Decision Unit 5 (continued)					
UDU-05-XRF-R07	423518.75	5401338.21	48.7604	-118.0407	Reserve
UDU-05-XRF-R08	423474.75	5401294.21	48.7600	-118.0413	Reserve
Soil Decision Unit 6					
UDU-06-XRF-01	422281.43	5400935.14	48.7566	-118.0574	Primary
UDU-06-XRF-02	422251.68	5400895.96	48.7562	-118.0578	Primary
UDU-06-XRF-03	422216.89	5400862.07	48.7559	-118.0583	Primary
UDU-06-XRF-04	422187.13	5400822.90	48.7556	-118.0587	Primary
UDU-06-XRF-05	422154.20	5400786.40	48.7552	-118.0591	Primary
UDU-06-XRF-R01	422261.53	5400920.83	48.7564	-118.0577	Reserve
UDU-06-XRF-R02	422231.77	5400881.66	48.7561	-118.0581	Reserve
UDU-06-XRF-R03	422202.01	5400842.49	48.7557	-118.0585	Reserve
UDU-06-XRF-R04	422172.25	5400803.31	48.7554	-118.0589	Reserve

ATTACHMENT B1

PROTOCOLS AND PROCEDURES 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, National Park Service, and the Bureau of Reclamation

This protocol is intended to cover NAGPRA items exposed by inadvertent discoveries or intentional excavations within the boundaries of lands managed by the National Park Service/Lake Roosevelt National Recreation Area. 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 Confederated Tribes of the Colville Reservation (CCT). Funding of actions is not covered under this protocol.



Map of Lake Roosevelt National Recreation Area

This protocol covers those areas highlighted in red within the recreation area, which is the yellow highlighted portion of the Lake Roosevelt shoreline.

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 Tribal Historic Preservation Officer and the National Park Service's designated official.

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.* A National Park Service law enforcement officer will be immediately notified.

4. The Colville Tribal Historic Preservation Officer and the archaeologists working for the Colville Tribes and the Park Service (numbers listed below) will also be contacted immediately after law enforcement. For NAGPRA discoveries associated with the Lake Roosevelt shoreline, the Reclamation archaeologist must also be contacted. Live phone contact is required; backup staff are identified if the primary contacts are unavailable. Phone contact will be followed up by written confirmation, e-mail is acceptable. E-mail should not include detailed (site specific information) 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 archeological 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 phone 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 at jon.meyer@colvilletribes.com. In the event that neither Mr. Moura or Mr. Meyer cannot be contacted, then Eric Oosahwee-Voss, CCT Archaeologist will be contacted at (509) 634-2690 (office) or (509) 631-1173 (cell) and at eric.oosahwee-voss@colvilletribes.com. Mr. Meyer or Mr. Oosahwee-Voss 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.

    - Ray DePuydt, Park Archeologist for the Lake Roosevelt National Recreation Area, is the primary contact for the NPS. Mr. DePuydt's phone number is (509) 738-6266, ext. 101 or (509) 631 4673, and his FAX is (509) 633-3862, and internet address is ray_depuydt@nps.gov. If Mr. DePuydt cannot be contacted in person, then contact Ken Hyde at (509) 633-9441 ext 128.

- Derek Beery, Power Office Archaeologist, is Reclamation's contact. His phone number is (509) 633-9233 [receptionist], FAX 633-9138, and internet address is dbeery@usbr.gov. If Derek Beery is not available, contact Sean Hess, Regional Archaeologist (208) 378-5316, FAX (208) 378-5305, and internet address is shess@usbr.gov.

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, NPS, and Reclamation 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. The Reclamation contract language for burials recovered in the shoreline of the National Recreation Area will also apply and should agree with the written plan of action and these protocols.

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 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. The Reclamation contract language for burials recovered in the shoreline of the NRA will also apply and should agree with the written plan of action and these protocols. If NAGPRA items are to be excavated or removed by personnel other than those employed by the CCT or the U.S. government, 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-inch 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, which may be Reclamation or the NPS. 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.

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 Sec. 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 43CFR Part 10.2 (d).

2. The specific information used to determine custody pursuant to Sec. 10.6:
   - ✓ Traditional association (this is where 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.

APPENDIX C

ALS ENVIRONMENTAL QUALITY ASSURANCE MANUAL

QUALITY ASSURANCE MANUAL

ALS Environmental
Kelso Facility
1317 South 13th Avenue
Kelso, WA 98626
360-577-7222 (T)
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QUALITY ASSURANCE MANUAL

ALS-KELSO

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Technical Director, Org. GC – Loren Portwood

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2.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

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 CE-GEN001, Laboratory Ethics and Data Integrity (corporate) and in this Quality Assurance Manual (QAM). ALS Environmental, 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. ALS Environmental, Kelso 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 QAM 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.

3.0 PROGRAM DESCRIPTION

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 of Columbia Analytical:

> "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

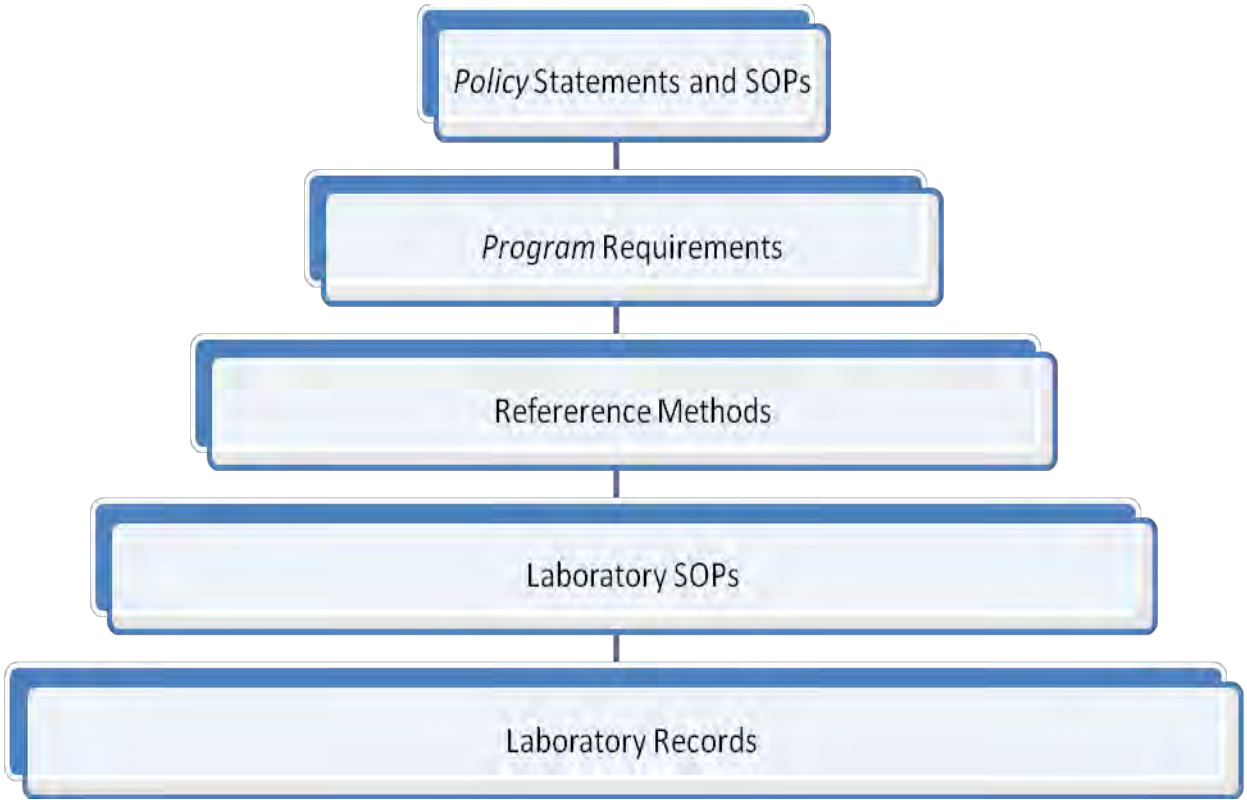
In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager with corporate oversight by the Manager of Quality Assurance, USA. These systems 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. Figure 3-1 shows the relationships of the quality systems and associated documentation. Quality systems include:

- Standard Operating Procedures
- Sample Management and Chain of Custody procedures
- Statistical Control Charting
- Standards Traceability
- Ethics Training
- Document Control
- Corrective Action Program
- Management Reviews
- Demonstration of Capability

The effectiveness of the quality system is assessed in several ways, including:

- Internal and External Audits covering all aspects of the organization
- Annual Management Reviews
- Analysis of Customer Feedback
- Internal and External Proficiency Testing

Figure 3-1
Relationships of Quality Management Systems and Documentation



3.2 Facilities, Equipment, and Security

ALS Environmental, Kelso 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 Environmental, 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
- AA Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography/High Performance Liquid Chromatography Laboratory
- Gas Chromatography/Mass Spectrometry Laboratory (2)
- Semi-volatile Organics Drinking Water Laboratories (2)
- 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
- Information Technology (IT) and LIMS

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Figure 3-2 shows the facility floor plan. 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. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

3.3 Technical Elements of the Quality Assurance Program

The laboratory's technical procedures are based upon procedures published by various agencies or organizations (See Section 17). The Quality Assurance Program provides to the laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained by the QA department. This includes method approvals and audit administration. In addition, internal

audits are performed to assess compliance with policies and procedures. SOPs are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A and SOPs in Appendix F.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventive maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

3.4 Operational Assessments and Service to the Client

The laboratory uses a number of systems to assess its daily operations. In addition to the routine quality control (QC) measurements, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients including; on-time performance, customer complaints, training reports and non-conformity reports. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

ALS Environmental, Kelso utilizes a number of different methods to ensure that adequate resources are available for service demands. Senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. 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 cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Project Plans (QAPPs) if available. Status/production meetings are also conducted regularly with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, or project requirements.

When a customer 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 QA PM 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 shall afford 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. CE-GEN010, *Handling Customer Feedback* is in place for these events.

3.5 Document Control and Records

Procedures for control and maintenance of documents are described in 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, Kelso documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QA PM, 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 CE-QA007, *Making Entries into Logbooks and onto Benchsheets*. The entries made into laboratory logbooks 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 ADM-ARCH, *Data Archiving.*

External documents relative to the management system are managed by the QA PM. 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.

3.6 Subcontracting

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 CE-QA004, *Qualification of Subcontract Laboratories.* The Quality Assurance staff is responsible for maintaining a list of qualified subcontract laboratories.

3.7 Procurement

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

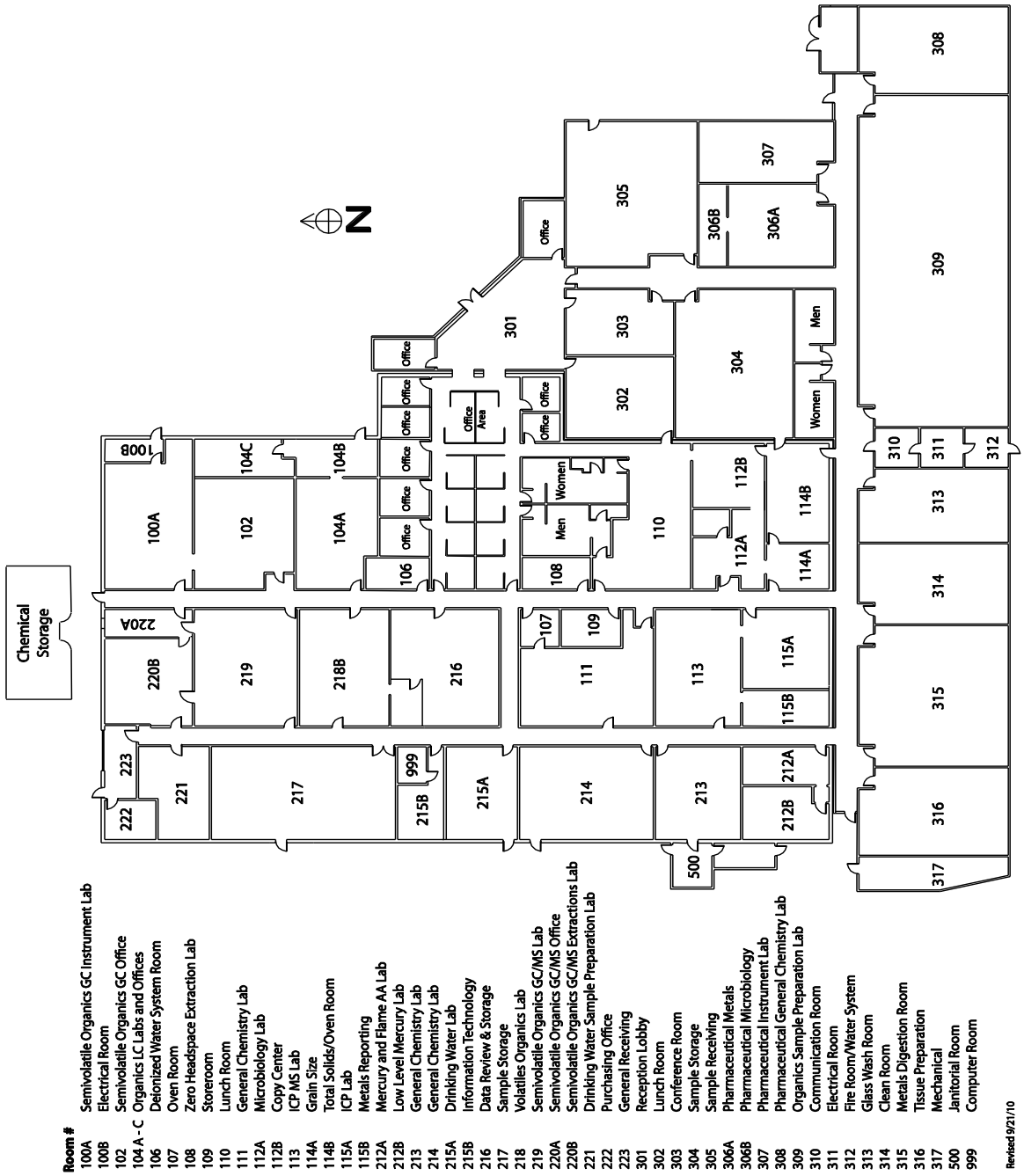
assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. CE-QA012, *Quality of Reagents and Standards* and ADM-RLT, *Reagent and Standards Login and Tracking* provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in CE-GEN007, *Procurement and Control of Laboratory Services and Supplies*. Also, refer to section 9.4 for a discussion of reference materials.

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 ADM-RLT, *Reagent and Standards Login and Tracking*.

3.8 Review of Requests, Tenders and Contracts (Procedures for Accepting New Work)

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.

Figure 3-2
ALS Environmental, Kelso 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

4.0 PROFESSIONAL CONDUCT, DATA INTEGRITY, AND ETHICS

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.

4.1 Professional Conduct

To promote quality, ALS, Kelso requires certain standards of conduct and ethical performance among employees. The following examples of documented CAS 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.
- It is the responsibility of all ALS Environmental, Kelso 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 proprietary company/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.

4.2 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 are described in the Policy for Internal Quality Assurance Audits and details are listed in laboratory administrative SOPs. 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.

4.3 Laboratory Data Integrity and Ethics Training

Each employee receives in-depth core Data Integrity/Ethics Training. New employees are given a QA and Ethics orientation within the first month of hire, followed by the core training within 1 year of hire. On an ongoing basis, all employees receive semi-annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA PM to ensure that the training is conducted as described.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

4.4 Management and Employee Commitment

ALS Environmental, 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.

All employees are required to sign and adhere to the requirements set forth in the ALS Environmental *Confidentiality Agreement* and *Code of Conduct Policy*.

5.0 ORGANIZATION AND RESPONSIBILITIES

The ALS Environmental, Kelso staff, consisting of approximately 150 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.

CAS is committed to providing an environment that encourages excellence. All employees share the responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 5-1 lists the ALS Environmental, Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B.

- 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 the financial performance of the (Location) facility. 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.
- The **Quality Assurance Manager (QAM)** has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities within the laboratory, ensuring that all personnel understand their contributions to the quality system, ensuring communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, evaluating the effectiveness of training; and monitor trends and continually improve the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews can all are used to support quality system implementation. The QAM is responsible for ensuring compliance with NELAC standards (and ISO, DoD QSM, etc. as applicable). The QAM works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QAM is responsible 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 such as metrological records, archived logbooks, PT results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; and performing internal QA audits.

  The QAM reports directly to the Laboratory Director and also reports indirectly to the 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 QAMs regulatory compliance efforts (NELAC, ISO, DOD, etc). The Manager of Quality

Assurance, USA performs annual internal audits at each laboratory; maintains a database of laboratory certification/accreditation programs; approves company-wide SOPs; maintains a database of approved subcontract laboratories; provides assistance to the laboratory QA staff and laboratory managers; prepares a quarterly QA activity report; etc.

- 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).
- In the event that work is stopped in response to quality problems, only the Laboratory Director or Quality Assurance Manager has the authority to resume work.

- The **Environmental Health and Safety Officer** (EH&S) 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 ALS Kelso's EH&S Director.
- The **Client Services Manager** is responsible for the Client Services Department defined for the laboratory (i.e. Project Managers, electronic deliverables, etc.) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. Sample management handles all activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.
- 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, contract, and regulatory-specific requirements. This entails coordinating with the ALS Environmental, Kelso laboratory and administrative staff to ensure that client-specific needs are understood and that the services ALS Environmental, Kelso provides are properly executed and satisfy the requirements of the client.
- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a QC program meeting department needs. Each **Department Manager and Supervisor** has the responsibility to ensure that QC functions are carried out as planned, and to guarantee 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. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.
- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory, and by assisting in the archival of all laboratory results. The sample management office staff is also responsible for the proper disposal of samples after analysis.
- **Information Technology** (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) generation, and data back-up, archival and integrity operations.

Table 5-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Jeff Grindstaff, B.S.	23	Laboratory Director
Suzanne LeMay, B.S.	25	Quality Assurance Program Manager
Lynda Huckestein, B.S.	23	Client Services Manager Sample Management Office Manager
Jeff Coronado, B.S.	22	Metals Department Manager
Harvey Jacky, B.S.	23	General Chemistry Department Manager
Loren Portwood	23	Semi-Volatile Organics Department Manager
Jon James, B.A.	21	HPLC, GC/MS Organics Department Manager
Christina Kerksieck, B.S.	4	Microbiology Technical Manager
Eileen Arnold, B.A.	30	Environmental Health and Safety Officer
Mike Sullivan, B.S.	12	Information Technology

6.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. CAS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major computing equipment.

6.1 Software Quality Assurance Plan

ALS Environmental, Kelso has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the *ALS Information Management Policy*. The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of this plan are policies for software validation and control.

6.2 IT Support

The local ALS Environmental, Kelso Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the *ALS Information Management Policy*.

In addition to the local IT department, ALS Environmental, Corporate IT provides support for network-wide systems. ALS Environmental also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

6.3 Information Management Systems

ALS Environmental, Kelso has various systems in place to address specific data management needs. The ALS Environmental, Kelso Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system defines sample identification, analysis specifications, and provides a means of sample tracking. This system is used during sample login to generate the internal service request. Included on the service request is a summary of client information, sample identification, required analyses, work instructions, deliverable requirements. The LIMS is used to track the status of a sample and is important in maintaining internal chain of custody.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows2003® domain). This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from

many available computer stations, improving efficiency and flexibility. The server is also used for data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats, including Staged Electronic Data Deliverable (SEDD) format.

6.4 Backup and Security

ALS Environmental, Kelso laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential backups are performed on all file server information once per day, Sunday through Thursday. Full backups are performed each Friday night. Tapes are physically stored in a locked media cabinet within a locked, temperature controlled computer room, with every other full backup also securely stored offsite.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-ALS Environmental, Kelso access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS Environmental, Kelso uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

7.0 SAMPLE MANAGEMENT

7.1 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 Environmental, 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

ALS Environmental, Kelso 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 *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 7-1 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 Environmental, Kelso routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased as precleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for the sample containers are available to clients if requested. 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 foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), 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 7-1 shows the chain-of-custody form routinely used at ALS Environmental, Kelso and included with sample kits. For large sample container shipments, the containers may be shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to Columbia Analytical. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

If any returning shipping cooler exhibits an odor or other abnormality after receipt and subsequent decontamination by laboratory personnel, a second, more vigorous decontamination process is employed. Containers exhibiting an odor or abnormality after the second decontamination process are promptly and properly discarded. ALS Environmental, Kelso keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. ALS Environmental, Kelso also provides courier service that makes regularly scheduled trips to the Greater Portland, Oregon Metropolitan area.

When ALS Environmental, Kelso ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures (SMO-GEN) for maintaining the samples' chain of custody, packaging and shipment. Dry ice or gel ice is the only temperature preservative used by ALS Kelso, unless otherwise specified by the client or receiving laboratory.

7.2 Sample Receipt and Handling

Standard Operating Procedures (SMO-GEN) are established for the receiving of samples into the laboratory. 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 delivered to the ALS Environmental, Kelso sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRF - See Figure 7-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. 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). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. 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. The LIMS generates a Service Request that 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 appropriate Project Manager for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are stored as per method requirements until they undergo analysis, unless otherwise specified, using various refrigerators or freezers, or designated secure areas. ALS Environmental, Kelso has five walk-in cold storage units which house the majority of sample containers received at the laboratory. In addition, there are four additional refrigerators, including dedicated refrigerated storage of VOC samples. The dedicated storage areas for VOC samples are monitored using storage blanks, as described in VOC-BLAN, *VOA Storage Blanks*. ALS Environmental, Kelso also has nine sub-zero freezers capable of storing samples at -10 to -30° C primarily used for tissue and sediment samples requiring specialized storage conditions. The temperature of each sample storage unit is monitored real time with an electronic temperature monitoring system.

ALS Environmental, Kelso adheres to the method-prescribed or project-specified holding times for all analyses. The sampling date and time are entered into the LIMS system at the time of sample receipt and login. Analysts then 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. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so holding time compliance can be demonstrated. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative). Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples and sample extracts 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. 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.* All waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with applicable local and Federal 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.

7.3 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. This is described in *SMO-GEN, Sample Receiving*. Figure 7-1 is a copy of the chain-of-custody form routinely used at Columbia Analytical.

Facility security and access is important in maintaining the integrity of samples received at Columbia Analytical-Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded entry, except for the reception area and sample receiving doors, which are manned 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

ALS Environmental, Kelso facility is equipped with an alarm system and ALS Environmental, Kelso 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 while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-SCOC).*

7.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. 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. 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. To communicate and specify project-specific requirements, a Tier V form (Figure 7-3) is used and accompanies the service request form.

Table 7-1
Sample 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]
Fecal Streptococci (SM 9230B)	W	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
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 4500NH3)	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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500CN 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 4500CN I)	W,S	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron (CAS SOP)	W, D	G Amber	Cool, 4°C	24 hours
Fluoride (EPA 300.0, SM 4500 F-C)	W,S	P,G	Cool, 4°C	28 days
Fluoride (EPA 9056)	W,S	P,G	Cool, 4°C	Analyze immediately
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
Nitrocellulose	S	G	Cool, 4°C	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
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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Phenolics, Total (EPA 420.1,9056)	W, S	G Amber	Cool, 4°C, H_2SO_4 to pH<4	28 days
Perchlorate (EPA 314.0)	W, DW,S	P,G	Protect from temp. extremes	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total (SM 2540B)	W	P,G	Cool, 4°C	7 days
Residue, Filterable (TDS) (SM2540C)	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, Volatile (EPA 160.4)	W	P,G	Cool, 4°C	7 days
Silica (SM 4500SiO2 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 (SM 4500S2 D)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500S2 F)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (9030/934)	W, S	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sullfides, Acid Voaltile	S	G	Cool, 4°C	14 days
Sulfite (SM 4500SO3 B)	W	P,G	None Required	24 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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
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, Total (EPA 9020)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2, No headspace	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon-Lined Cap	Cool, 4°C, HNO_3 to pH<2	6 months
Metals				
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4°C	24 hours
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
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO_3 to pH<2	28 days
Mercury (7471)	S	P,G	Cool, 4°C	28 days
1631E	W	F	Cool, 4°C, HCl or H_2SO_4 to pH<2	90 days
1631E	S	F	Freeze < -15°C	1 Yr
Methyl Mercury 1630	W,S,T	F	HCL to pH<2	6 months
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4°C	28 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8021, 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, 8021, 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 (8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 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, 8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs 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	7 days
EDB and DBCP (EPA 8260)	W,S	G, Teflon-Lined Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	28 days
Vinyl chloride,styrene, 2-chloroethyl vinyl ether (8260)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, Minimize Headspace	7 days
Vinyl chloride,styrene, 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	H2SO4 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	W	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Resin and Fatty Acids (NCASI 85.02)	W	G, Teflon-Lined Cap	NaOH to pH >10, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4°C	30 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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
PBDE/PBB – ROHS GC/MS	W,S,T	G	Cool, 4°C	40 days after extraction
Pharma Personal Care Products 1694	W	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/Nitoramines 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	H2SO4 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°Cg	7[f] days until extraction;40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Chlorinated Herbicides (EPA 8151)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H2SO4 to pH<2, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Darkg	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 Darkg	7[f] days until extraction;40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7f 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)	DW	G, Teflon-Lined, Septum cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Carbamates, Carbamoyloximes (EPA 531.1)	DW	G, Amber, Teflon-Lined Cap	1.8 mL monochloroacetic acid to pH<3; 80 mg/L $Na_2S_2O_3$ if Res.Cl.; Cool, 4°C	28 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/4omL NaS; Cool , <6°C	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 4°C	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$ if Res.Cl.Cool 4°C	7days 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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Glyphosate (EPA 547)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$,Cool, 4°C	14 days
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
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 ext'n;
			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 ext'n;
			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 ext'n;
			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 ext'n;
Volatile Organics (EPA 1311/8260)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C , Minimize Headspace	14 days until TCLP ext'n;

			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

a For EPA SW-846 methods the method number is 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

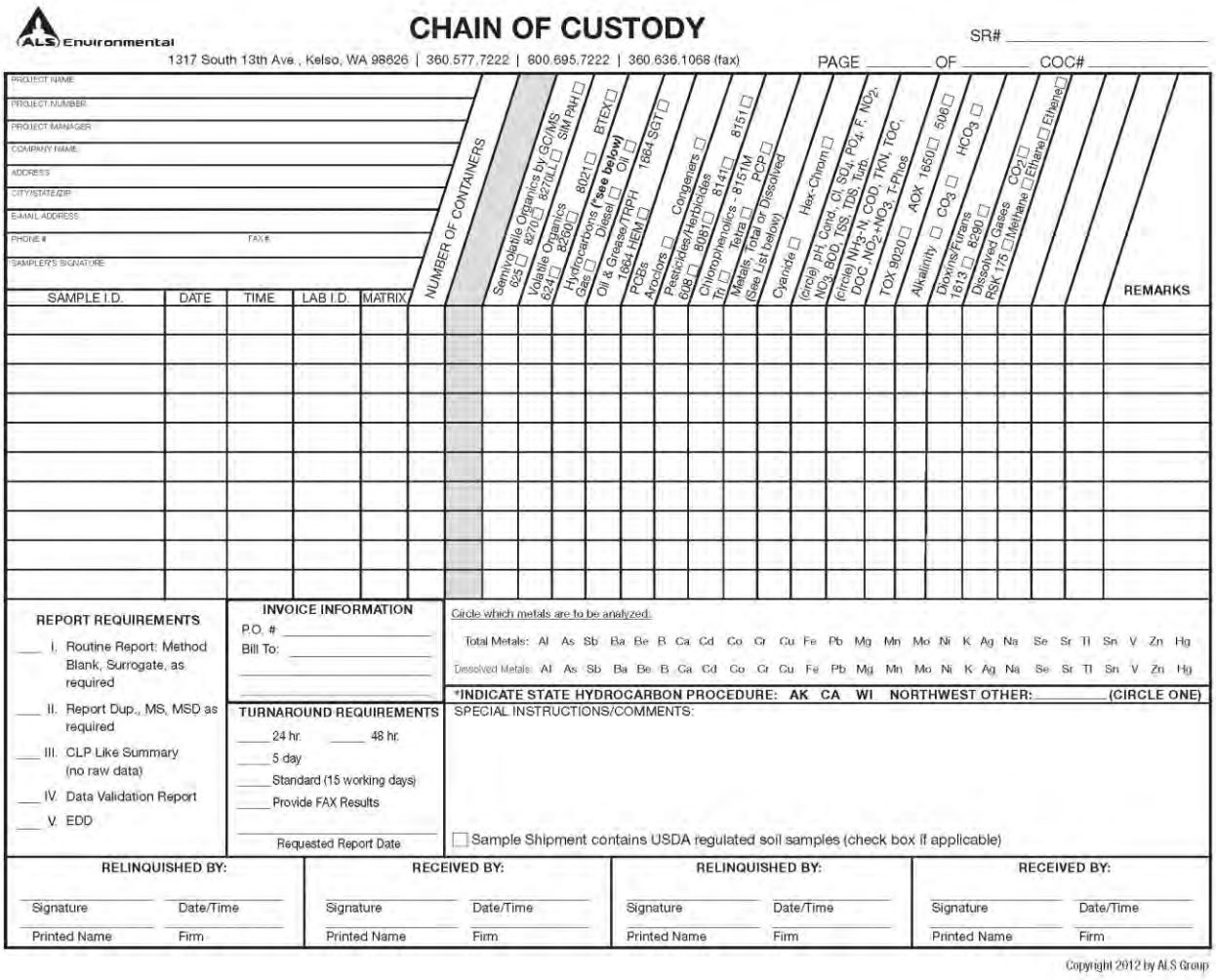
d For chlorinated water samples

e The maximum holding time is dependent upon the geographical proximity of sample source to the laboratory.

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.

Figure 7-1
Chain of Custody Form



ALS Environmental

CHAIN OF CUSTODY

SR# _____

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE _____ OF _____ COC# _____

PROJECT NAME
PROJECT NUMBER
PROJECT MANAGER
COMPANY NAME
ADDRESS
CITY/STATE/ZIP
E-MAIL ADDRESS
PHONE # FAX #
SAMPLER'S SIGNATURE

NUMBER OF CONTAINERS

Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐
Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐
Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐
Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐
PCBs Aroclors☐ Congeners☐
Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐
Chlorophenolics 8151M PCP☐
Tri☐ Tetra☐ Metals Total or Dissolved (See List below)
Cyanide☐ Hex-Chrom☐
(circle) pH Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb. (circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3-N, T-Phos
TOX 9020☐ AOX 1650☐ 508☐
Alkalinity ☐ CO_3 ☐ HCO_3 ☐
Dioxins/Furans 1613☐ 8290☐
Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX		REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 day
____ Standard (15 working days)
____ Provide FAX Results

Requested Report Date _____

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

ALS Environmental

LANDFILL CHAIN OF CUSTODY

1317 South 13th Ave. • Kelso, WA 98626 • (360) 577-7222 • (800) 695-7222 • FAX (360) 636-1068

SR#_____

PAGE_____ OF_____ COC#_____

PROJECT NAME:
PROJECT NUMBER:
PROJECT MANAGER:
COMPANY NAME:
ADDRESS:
CITY/STATE/ZIP:
E-MAIL ADDRESS:
PHONE # FAX #
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Volatile Organics 524.2 ☐ 8260 ☐ TICs ☐	Base / Neutral / Acid Organics 625 ☐ 8270 ☐ TICs ☐	Metals, Total or Dissolved (list below)	pH, Cond., TDS, TSS, BOD, Turb, Color	Orthophosphate, Tan/n/Lignin (circle)	COD, TOC, Total Phos, TKN, NH_3, (circle)	ALK, HCO_3, CO_3; Hardness (circle)	Anion (circle) Cl, SO_4 NO_3 NO_2 F	Anion:Cation Ratio	☐ Enterococcus ☐ E. coli ☐ T-Coliform ☐ F-Coliform	Cyanide ☐	TOX	Dissolved Silica								REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 day
____ Standard (15 working days)

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: As Sb Ba Be Ca Cd Co Cr Cu Fe Pb Mg Mn Na Ni K Ag Se Si Ti V Zn Hg
Dissolved Metals: As Sb Ba Be Ca Cd Co Cr Cu Fe Pb Mg Mn Na Ni K Ag Se Si Ti V Zn Hg

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RELINQUISHED BY:		RELINQUISHED BY:		RELINQUISHED BY:	
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Figure 7-2

PC_____

Cooler Receipt and Preservation Form

Client / Project:_____ Service Request *K13*_____

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_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

lient / Project:_____ Service Request *K13*_____

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:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Page_____of_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

Client / Project:_____ Service Request ***K13***_____

Notes, Discrepancies & Resolutions:

Page_____of_____

Figure 7-3

Tier V Form

Client:
Project Name:
Project Number:
Project Description:

Project Chemist:
Service Request:
LIMS Template ID:

QAPP/SOW Information:

Reporting

TierLevel:
In results field use:
Flagging Requirements:
Other Requirements:

PFD:

Report to:

Sample Considerations:

Sample Limitations:
Sample Prep/Analysis:
Non-Standard Holdtimes:
Historical Data:
Comments:

8.0 ANALYTICAL PROCEDURES

ALS Environmental, 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 Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 17.0. 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 limit, the concentration of the analyte 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 Environmental, Kelso is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix G. Further details are described below.

8.1 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 prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in CE-GEN005, *Document Control*. In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in CE-QA007, *Making Entries onto Analytical Records*. Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

8.2 Deviation from Standard Operating Procedures

When a customer 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 detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

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.

8.3 Modified Procedures

ALS Environmental, 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, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

8.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS Environmental, 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:
   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * 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. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.

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.

8.5 Specialized Procedures

ALS Environmental, 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, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs).

8.6 Sample Cleanup

ALS Environmental, Kelso 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.

9.0 CALIBRATION PROCEDURES

All equipment and instruments used at ALS Environmental, Kelso are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials.

Laboratory support equipment (thermometers, balances, and weights) are routinely verified on an annual basis by a vendor accredited to A2LA or ISO/IEC 17025:2005 International Standards. All analytical measurements generated at ALS Environmental, Kelso are performed using materials where possible and/or processes that are traceable to a reference material. 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 subjected to overloading or mishandling, or has been shown by verification to be 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.

9.1 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 for Support Equipment Monitoring and Calibration (ADM-SEMC).* The SOP also includes the use of acceptance criteria and correction factors.

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 A2LA or ISO/IEC 17025:2005 International Standard on an annual basis.

9.2 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.

9.3 Water Purification Systems

ALS Environmental, 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. Following a written SOP, the status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily in a bound record book. 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.

9.4 Source and Preparation of 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 Environmental, 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 (see section 11.3.5).

9.5 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.).

9.6 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.

9.7 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.

9.8 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 and reference method. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.9 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. *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.10 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 for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).

9.11 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.

9.12 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.

9.13 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.

9.14 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 $\geq$ 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.

9.15 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.

9.16 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.

9.17 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following 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.

9.18 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.

10.0 QUALITY CONTROL

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 Environmental, 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.

10.1 Quality Control Objectives

10.1.1 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.

10.1.2 Accuracy – Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is 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 (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination).

ALS Environmental, 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.

10.1.3 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.

10.1.4 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. 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 QA PM. The new control limits replace the previous limits and data is assessed using the new values. Current 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 CE-QA009, *Control Limits*.

10.1.5 Representativeness – Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, 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 Environmental, 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 appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

10.1.6 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.

10.2 Method Detection Limits, Method Reporting Limits, and Limits of Detection/Quantitation

Method Detection Limits (MDL) for methods performed at Columbia Analytical/(Location) is determined during initial method set up and if any 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 for Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantitation (ADM-MDL), 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 on an annual basis and cannot be lower than the lowest calibration standard. Current MDLs and MRLs are available from the laboratory.

10.3 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.

10.3.1 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.

10.3.2 Calibration Blanks

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.

10.3.3 Continuing Calibration Blanks

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.

10.3.4 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.

10.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed after calibration but prior to sample analysis, in order to verify the validity and accuracy of the standards used in for calibration. Once it is determined that there is no defect or error in the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

10.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) 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.

10.3.7 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.

10.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic 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.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.9 Laboratory Control Samples

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.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.10 Laboratory Fortified Blanks - LFB

A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. A LFB is required with every batch of drinking water samples.

10.3.11 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

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:

$$Recovery\ (\%) = (S - A) \times 100 \div T$$

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

10.3.12 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:

$$Relative\ Percent\ Difference\ (RPD) = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed 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.

10.3.13 Interference Check Samples

An interference check sample (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.

10.3.14 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.

10.3.15 Control Charting

The generation of control charts is routinely performed at Columbia Analytical. 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 CE-QA009, *Control Limits.*

10.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS Environmental, Kelso undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at Columbia Analytical; 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.

11.0 DATA PROCESSING, VALIDATION, AND REPORTING

ALS Environmental, Kelso reports the analytical data produced in its laboratories to the client via the certified analytical report. This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

11.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the 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. 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 from the software used to process the original data set (e.g., chromatographic software). 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 hardcopy is forwarded to the supervisor or second qualified analyst, who reviews the data for errors. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package is then placed into the appropriate service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Data review procedures are described in the *SOP for Laboratory Data Review Process (ADM-DREV).*

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 *CE-QA007, Making Entries onto Analytical Records*.

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 CE-QA002, *Manual Integration Policy and* ADM-MI*, Manual Integration of Chromatographic Peaks.*

11.2 Confirmation Analysis

11.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is

limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.

- The sample meets all of the following requirements:
    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.
    2. All analytes have been previously analyzed in sample(s) from the same source, identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

11.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).
    2. 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 Methods – Two criteria are used to verify identification:
    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.
    2. 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.

11.3 Data Review and Validation of Results

The integrity 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.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and 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.

11.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained analyst or chemist. 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. ALS Environmental, Kelso maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

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 Columbia Analytical-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.

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.

11.5 Documentation

ALS Environmental, 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)*.

11.5.1 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.

11.6 Deliverables

In order to meet individual project needs, ALS Environmental, Kelso provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 11-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) the following specialized deliverables:

- DoD QSM – Army Corp of Engineers, Air Force Center for Environmental Excellence, Navy
- Drinking water – State specific formats

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 CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

When requested, ALS Environmental, Kelso provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS Environmental, 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 11-1
Descriptions of ALS Environmental, Kelso Standard Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Chain of custody documents and sample/cooler receipt documentation
3. Sample analytical results
4. Method blank results
5. Surrogate recovery results and acceptance criteria for applicable organic methods
6. Dates of sample preparation and analysis for all tests
7. Case narrative – **optional**

Tier II. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
4. Case narrative – **optional**

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative – **required**
2. Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits

Note: Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS will be included.

Tier IV. Full Data Validation Package.

1. All raw data associated with the sample analysis, including but not limited to:
   a. Preparation and analysis bench sheets and instrument printouts,
   b. 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 hits, and the results and spectra of TIC compounds when requested.
   c. QC data,
   d. Calibration data (initial, verification, continuing, etc),
   e. Calibration blanks or instrument blanks (as appropriate to method).
2. If a project QAPP or program protocol applies, the report will be presented as required by the QAPP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Quality audits are an essential part of ALS Kelso's 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.

12.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of Columbia Analytical/Kelso are conducted regularly by various regulatory agencies and clients. Appendix G lists the certification and accreditation programs in which Columbia Analytical/Kelso participates. Programs and certifications are added as required. Additionally, internal system audits of Columbia Analytical/Kelso are conducted regularly under the direction of the Quality Assurance Program Manager. The internal audit procedures are described in CE-QA001, *Internal Audits*. The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Technical/method audits – minimum of 3 per quarter
- Hardcopy report audits – minimum of 2 per quarter.
- Chromatographic electronic data audits – each applicable instrument per quarter.

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).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

12.2 Performance Audits

ALS Kelso also 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 CE-QA006, *Proficiency Sample Testing Analysis*. ALS Environmental, 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 PT studies, 2 per year.

- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. 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 reviewed by the QAM, Laboratory Director, the laboratory staff, and the Manager of Quality Assurance, USA. 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.

13.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at ALS Environmental, Kelso (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. 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.

An initial demonstration of analytical control is required on every instrument used at ALS Environmental, Kelso before it may be used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- 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 Columbia Analytical. 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. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. 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. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

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 table in Appendix E for a list of preventive maintenance activities and frequency for each instrument.

14.0 CORRECTIVE AND PREVENTIVE ACTION

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 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.

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 QA PM 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*.

In addition to internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The person who initially receives the feedback (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 QA PM for final resolution. The complaint and resolution are documented. The procedure is described in CE-GEN-010, *Handling Customer Feedback*.

15.0 QUALITY ASSURANCE REPORTS AND MANAGEMENT REVIEW

Quality assurance requires an active, ongoing commitment by ALS Environmental, Kelso personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. 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.

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data, accompanied by signature approval. 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, who in turn reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A case narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc.

The QA PM provides overview support to the Project Managers as required (e.g., contractually specified, etc.). The QAM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAM regularly communicates with the Laboratory Director to review the various QA/QC activities, priorities, and status of program implementation; including such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

An annual management review of the quality and testing systems is performed as described in CE-QA005, *Laboratory Management Review*. This is done to identify any necessary changes or improvements to the quality system or quality assurance policies. This review is documented in a Managerial Review of the Laboratory's Quality Systems and Testing Activities and sent to senior management.

16.0 PERSONNEL TRAINING

Technical position descriptions are available 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 at ALS Environmental, Kelso are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS Environmental, Kelso when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at Columbia Analytical. 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.

Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s). Quality Systems training begins with Quality Assurance orientation for new employees and reading the Quality Assurance Manual. During the employees first year, the employee attends Core Ethics training and learns about ALS Environmental, Kelso quality systems. Each employee participates in annual Ethics Refresher training.

ALS Environmental, 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 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.

16.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (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" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples 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 16-1. 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.

16.2 Continuing Demonstration of Proficiency

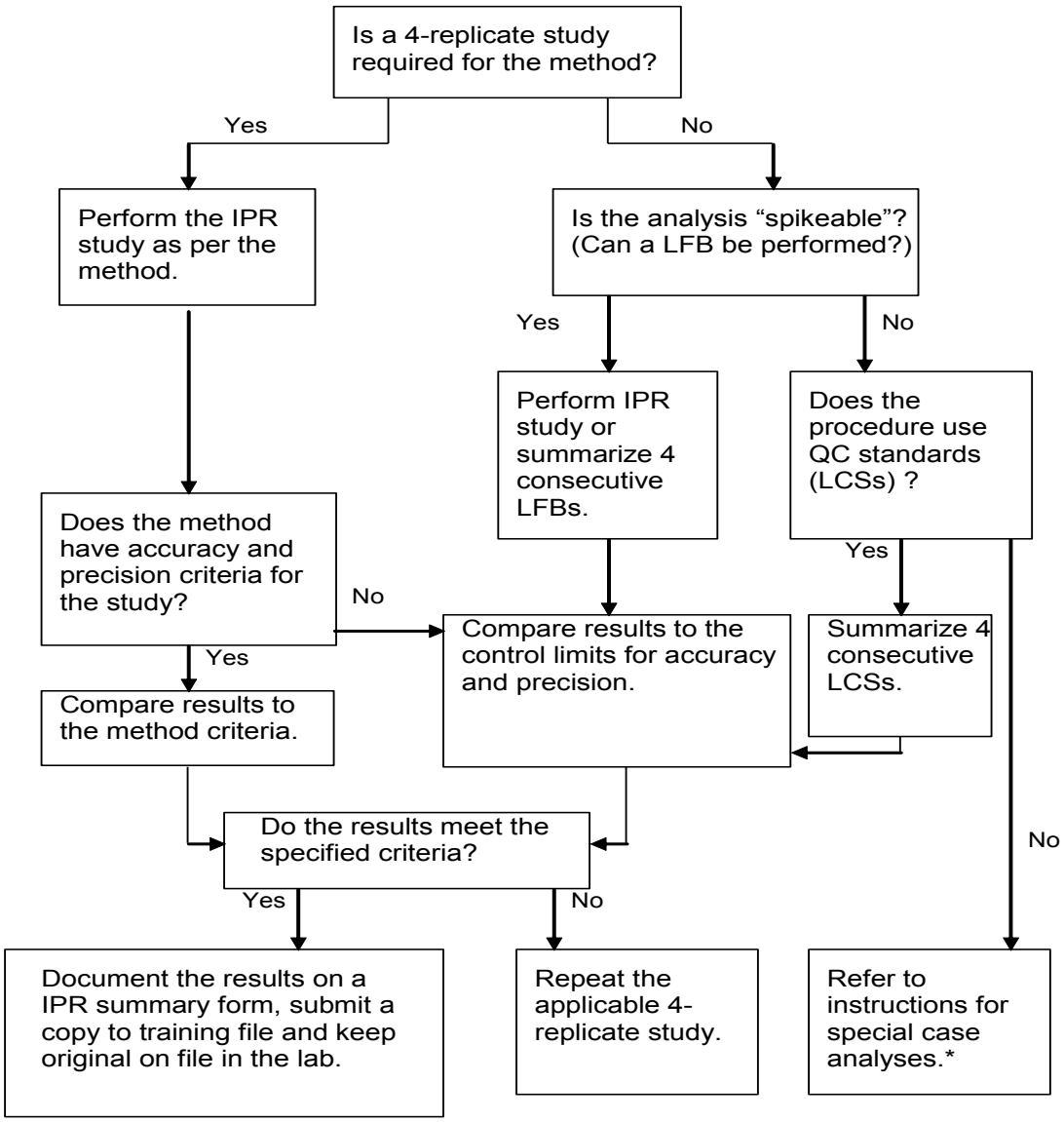
A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- 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.

16.3 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 ALS Environmental, Kelso resumes. QA maintains a database to record the various technical skills and training acquired while employed by Columbia Analytical. 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 ADM-TRAIN, *ALS-Kelso Training Procedure*.

Figure 16-1
Initial Demonstration of Capability Requirements



* Refer to the ADM-TRAIN for details.

17.0 REFERENCES FOR QUALITY SYSTEMS, EXTERNAL DOCUMENTS, MANUALS, STANDARDS, AND ANALYTICAL 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,* Version 4.2, 10/25/2010
- *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.
- 40 CFR Part 141, National Primary Drinking Water Regulations.
- *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).

18.0 ATTACHMENTS

- Appendix A: Approved Signatories, QA Program Documents, Corporate SOP List
- Appendix B: Organizational Chart and Resumes of Key Personnel
- Appendix C: Major Analytical Equipment
- Appendix D: Data Qualifiers and Acronyms
- Appendix E: Preventive Maintenance Procedures
- Appendix F: Standard Operating Procedures
- Appendix G: Laboratory Certifications and Accreditations

APPENDIX A

Approved Signatories

QA Program Documents

Corporate Policies

Administrative Corporate SOP List

APPROVED SIGNATORIES FOR ANALYTICAL REPORTS

ALS Environmental, Kelso, WA

ARNOLD, EILEEN
BAILEY, JOSH
CHAN, JIM
CORONADO, JEFFREY
DEGNER, CARL
DOMENIGHINI, LISA
GRINDSTAFF, JEFF
HADERLY, DOUGLAS
HARRIS, LISA
HOLMES, HOWARD
HUCKESTEIN, LYNDA
JACKY, HARVEY
JAMES, JON
KENNEDY, LES
LEAF, CHRIS
MALLOCH, JANET
MIHAI-LAZAR, CARMEN
MOORE, RACHEL
MURRY, SHANE
PORTWOOD, LOREN
REASONER, KAREN
SALATA, GREGORY
SAMY, SHAR
SHELDON, BRIAN

Update: April 19, 2013 Approved by: Lynda Huckestein/Client Services Manager

QA Program Files

Program	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
Software Quality Assurance Plan	Corp IT
CAS-Kelso Certifications/Accreditations	Cert_kel.xls
Columbia Analytical Services MDL Tracking Spreadsheet	Q:\MDL Tracking\MDL_LIST.r1.XLS
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR dept
Personnel Job Descriptions	HR Department
CAS/KELSO DATA QUALITY OBJECTIVES	CAS Kelso DQO 20XX.rX.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedure Database	Q:\ENVIRONMENTAL\1 SOP & Policy Statements\1_ Kelso SOP.xls

Corporate SOPs

SOP TITLE	SOP Code	Rev	SOP Date
LABORATORY ETHICS AND DATA QUALITY	CE-GEN001	1.00	09/15/12
BP LABORATORY MANAGEMENT PROGRAM SOP	CE-GEN002	1.00	11/1/12
RECORDS MANAGEMENT POLICY	CE-GEN003	00.0	7/15/12
PREVENTIVE ACTION	CE-GEN004	00.0	7/1/12
DOCUMENT CONTROL	CE-GEN005	00.0	9/1/12
DATA RECALL	CE-GEN006	00.0	9/1/12
PROCUREMENT CONTROL OF LABORATORY SERVICES AND SUPPLIES	CE-GEN007	00.0	9/1/12
METHOD DEVELOPMENT	CE-GEN008	0.00	12/01/12
ESTABLISHING STANDARD OPERATING PROCEDURES	CE-GEN009	0.00	01/01/13
HANDLING CUSTOMER FEEDBACK	CE-GEN010	0.00	02/15/13
ASSIGNING A TSR TO A PROJECT	CE-GEN011	0.00	04/01/13
INTERNAL AUDITS	CE-QA001	00.0	1/1/12
MANUAL INTEGRATION POLICY	CE-QA002	00.0	3/15/12
TRAINING POLICY	CE-QA003	00.0	8/1/12
QUALIFICATION OF SUBCONTRACT LABORATORIES	CE-QA004	00.0	8/1/12
LABORATORY MANAGEMENT REVIEW	CE-QA005	00.0	9/1/12
PROFICIENCY TESTING SAMPLE ANALYSIS	CE-QA006	00.0	9/15/12

SOP TITLE	SOP Code	Rev	SOP Date
MAKING ENTRIES ONTO ANALYTICAL RECORDS	CE-QA007	00.0	9/1/12
NONCONFORMITY AND CORRECTIVE ACTION	CE-QA008	00.0	10/1/12
CONTROL LIMITS	CE-QA009	0.00	12/01/12
ESTIMATION OF UNCERTAINTY OF ANALYTICAL MEASUREMENTS	CE-QA010	0.00	01/15/13
PERFORMING METHOD DETECTION LIMIT STUDIES AND ESTABLISHING LIMITS OF DETECTION AND QUANTITATION	CE-QA011	0.00	02/15/13
QUALITY OF REAAGENTS AND STANDARDS	CE-QA012	0.00	02/15/13

Forms

FORM	FILE NAME	DATE
Complaint Report	G:\QA\QA_Forms/Complaint Report_r121509	09/10/12
Critical Job Function Authorization Statement	G:\QA\QA_Forms\IDC-CDC Certification Statements/Critical Job Function Authorization	12/15/09
Data Re-submittal Request Form	G:\QA\QA_Forms/Data Resubmittal Request Form_r112107	11/21/07
Demonstration of Capability Certification Statement (no table version)	G:\QA\QA_Forms\IDC-CDC Certification Statements/DOC Certification Statement_r071206-	06/10/11
Extraction Solvent Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	2012
Laboratory Training Certification	LAB-TRNG_r092109	9/21/09
Metals Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Metals Evaluation xxxx	2012
Method Detection Limit Study Calculation Spreadsheet	R:\LAB MDL LOD LOQ/MDL_FORMR4_r030510	3/5/10
New Vendor Evaluation	G:\QA\QA_Forms\Purchasing/ New Vendor Evaluation 092612	10/15/09
Pipettes Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Pipettes	11/08/11
Procedure Change Form	Q:\ENVIRONMENTAL\1 SOP & Policy Statements/SOP DISTRIBUTION FORMS	12/16/10
Reagent/Consumable Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	5/3/11
Standard Operating Procedure Change Form	G:\QA\QA_Forms//SOP Change Form	9/21/09
LOD Verification	G \QA\QA_Forms\LOD Verification071610.xls	07/16/10

LOQ Verification	G \QA\QA_Forms\LOQ Verification022410.xls	02/24/10
Various Training Plans	G:\QA\QA_Forms\Training Plans\	NA

APPENDIX B

ORGANIZATIONAL CHARTS and RESUMES OF KEY PERSONNEL

USA
March 2013

Sally Roan
Sales & Marketing Director N. America

- Jarrod Evans, Marketing Manager, North America
- Paola Rivera, Technical Sales Coordinator, USA

Les Arnold
Director of Operations Eastern USA

- Peter Frick, Laboratory Director, Middletown, PA
- Jeff Ogle, Laboratory Director, Cincinnati, OH
- Chris Schepcoff, Laboratory Director, Houston, TX
- Jeff Glaser, Laboratory Director, Holland, MI
- Brian Weigel, Laboratory Director, Jacksonville, FL
- Jim Plassard, Laboratory Director – Dioxins, Houston, TX
- Mike Perry, Laboratory Director, Rochester, NY
- Paul Painter, Laboratory Director, South Charleston, West Virginia
- Idelis Williams, QA Manager, USA

Jeff Christian
Director of Operations Western USA

- Ralph Poulsen, Laboratory Director, Tucson, AZ
- Kelly Horiuchi, Laboratory Director, Simi Valley, CA
- Roy French, Laboratory Director, Fort Collins, CO
- Brent Stephens, Laboratory Director, Salt Lake City, UT
- Rick Bagan, Laboratory Director, Everett, WA
- Jeff Grindstaff, Laboratory Director, Kelso, WA

Hoai Van
Technical Director USA

Ann Yeager
Director, HR USA Life Sciences and Tribology

- Alene Albright, HR Business Partner Tribology, USA
- Cindy Richarsdon, Payroll Supervisor
- Tambra Charles, Benefits and Disability Specialist
- Joetta Ozuna, HR Business Partner Western USA
- Sharon Warren, HR Business Partner Eastern USA

Tish Davis
Corporate Controller USA Life Sciences and Tribology

- Phillip Zagotti, Assistant Corporate Controller, USA
- John Hall, Senior Accountant, USA
- Jan Jenkins, Senior Buyer, USA
- Lynn Pope, AP Group Leader, USA
- Dana Gohr, AR Group Leader, USA

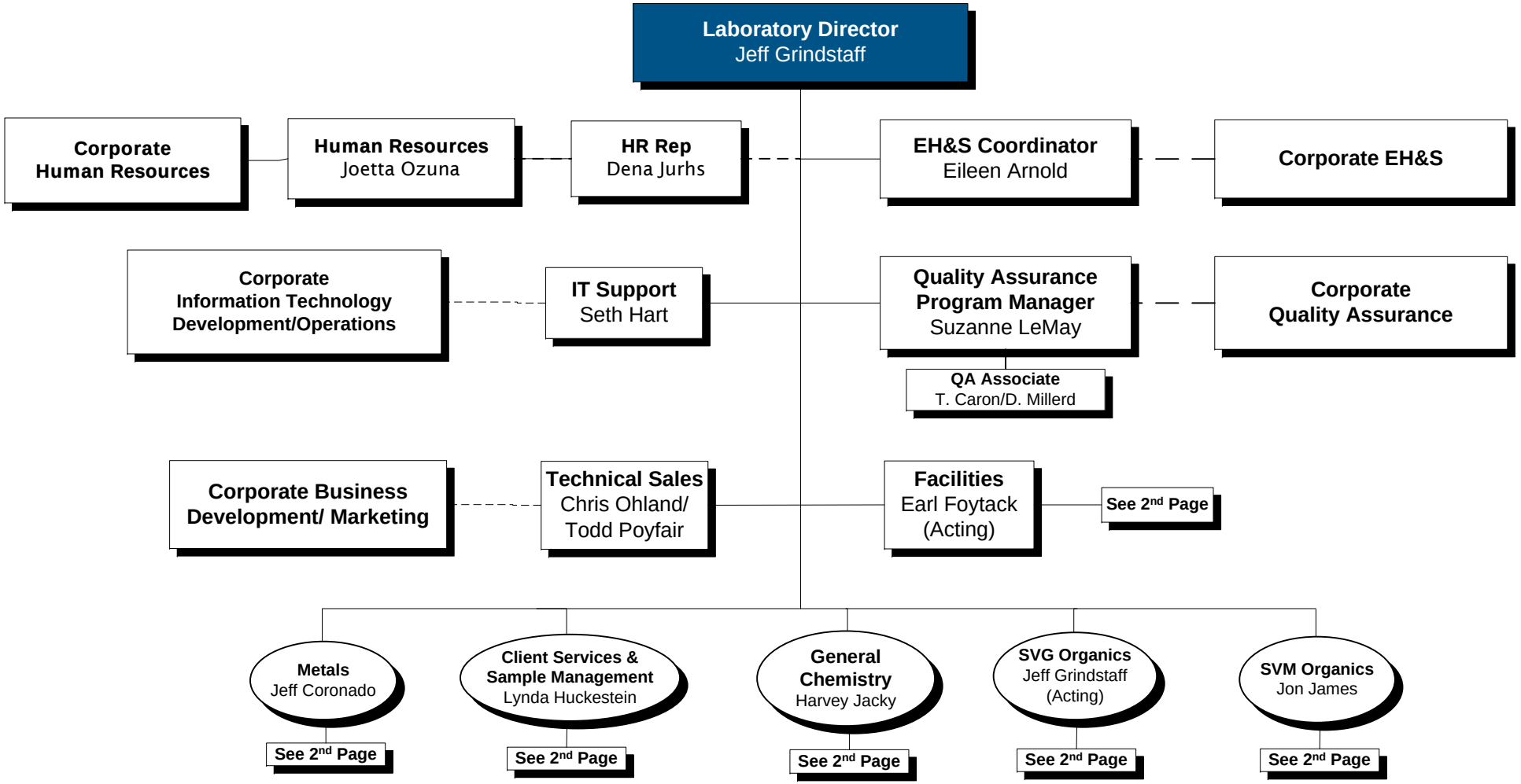
Albert Valle
LIMS Manager USA

Hiren Prajapati
IT Manager USA

Corporate Support Group

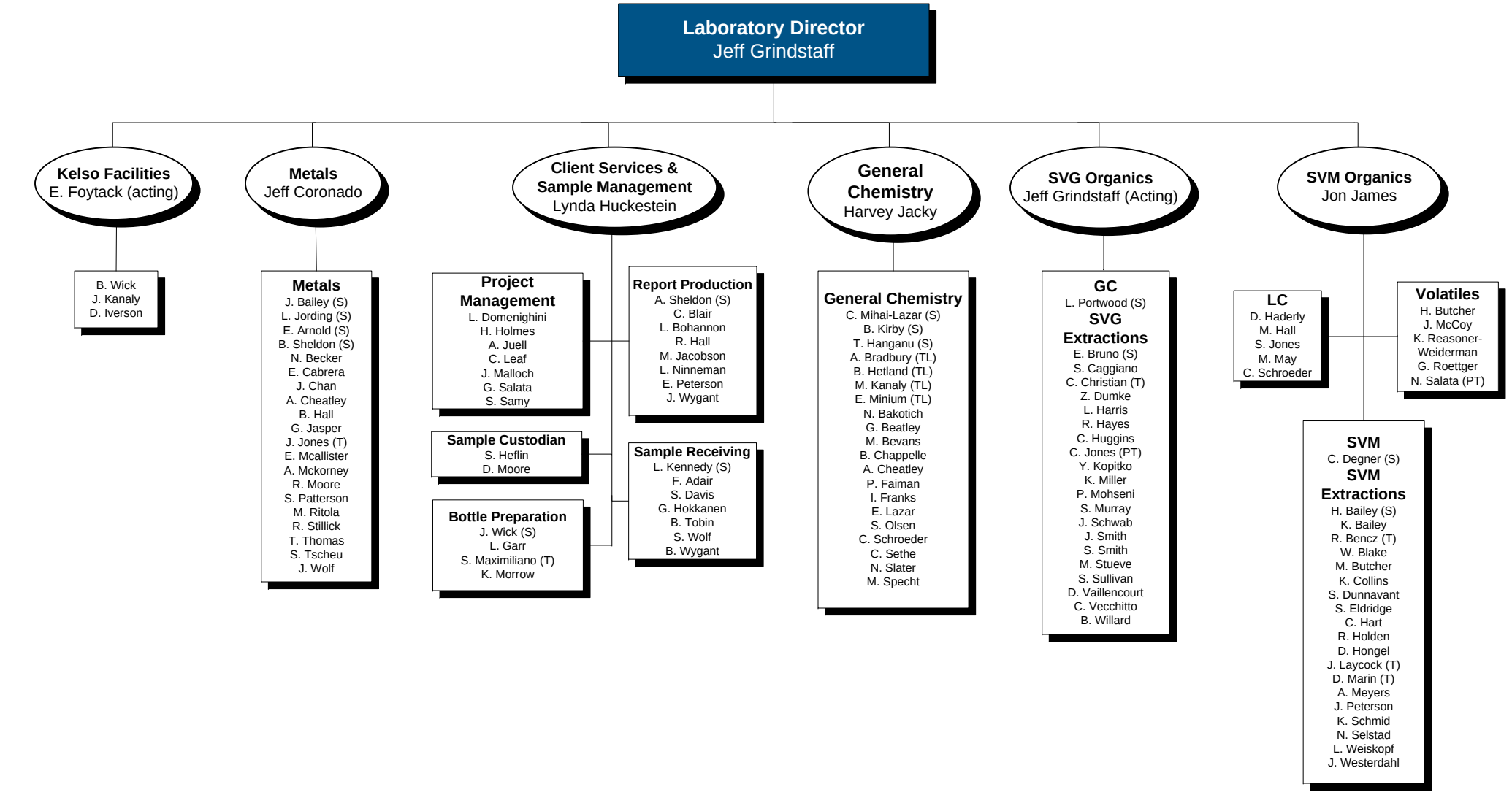
Kelso, Washington Laboratory

February 4, 2013



Kelso, Washington Laboratory

February 4, 2013
Operations



Jeffrey A. Grindstaff

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

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 – Columbia.

Laboratory Director

2010 - 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
Technical Manager III, Pharmaceutical, GC/MS VOA and Semi-VOA Laboratories, '97-'10

Primary responsibilities include leadership of the Pharmaceutical, GC/MS VOA and Semi-VOA 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, 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

Responsibilities 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 customer 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 Service
San Luis Obispo, CA
GC/MS Chemist, VOA Laboratory, '90-'91

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.

Suzanne LeMay

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Education

University of Oregon – Eugene, OR
BS Geology, 1981

Ethics and Integrity Training; ORELAP/OELA Workshop, **2007**
How to Be a QA Manager; Advanced Systems, Inc., **2007**
Assessments for ISO/IEC 17025 and NELAC (ASI Course 300); Advanced Systems, Inc., **2005**
Introduction to Assessments; Advanced Systems, Inc., **2005**
Environmental Training, Quality Assurance/Quality Control (ASI Course 103); Advanced Systems, Inc., **2004**
Manager/Supervisor Training; Portland General Electric, **1998**
Statistics for Methodology Development; AOAC Short Course, **1994**
Quality Assurance for Analytical Laboratories, AOAC, **1991**

Quality Assurance Manager

2012 – Present

Responsible for the overall implementation of the laboratory QA program. Oversees implementation of Quality management systems including: Quality Assurance Manual, Certifications, SOP Control, Proficiency Testing (PT), Non-Conformity, Preventative Actions, Internal Auditing, Control Charting, Documentation of Training, and Metrology. Conducts employee QA training including orientations, sop, and ethics. Maintains state, agency and program certifications/accreditations. Acts as primary point of contact during laboratory audits coordinates audit responses and corrective actions.

Previous Experience

Test America — **Quality Assurance Manager, '00 – '10**
Portland, OR.

Developed and implemented a Quality System compliant with state and national regulatory standards, including: Safe Drinking Water Act, Clean Water Act, and Resource Conservation and Recovery Act. Acquired and maintained multiple laboratory accreditations including Oregon Environmental Laboratory Accreditation Program (ORELAP), Alaska Department of Environmental Conservation, Washington Department of Ecology, and California Environmental Laboratory Accreditation Program. Developed and implemented an internal compliance auditing program. Lead Quality Management projects designed to improve laboratory productivity, quality, and customer service. Organized and directed activities designed to anticipate and address quality issues in the laboratory. Oversight of laboratory support systems and equipment including the DI water system, cold storage, foreign soil storage and disposal, and calibration of balances, thermometers, pipettes, etc. Provided Quality Systems and Ethics training to laboratory staff.

Oregon Analytical Laboratory — **QA/QC Chemist, '92 – '00**
Beaverton, OR.

Developed and implemented a lab quality system encompassing certifications, proficiency testing, corrective actions, internal auditing, training, and maintenance of lab support systems and equipment. Wrote the lab QA Manual and developed and implemented document control procedures. Obtained and maintained multiple laboratory accreditations and transitioned the quality system toward compliance with the emerging NELAP. Directed a lab QA committee and participated in Total Quality Management and process improvement teams.

Oregon Analytical Laboratory — **Asbestos Team Leader, '90 – '92**
Beaverton, OR.

Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP). Analyzed samples for bulk and airborne asbestos and supervised department analysts. Provided method, quality and ethics training. Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP).

Oregon Analytical Laboratory — **Analyst/Technician, '85 – '90**
Beaverton, OR.

Performed sample preparation and analysis in the areas of bulk and airborne asbestos, transformer oil analysis, lube/fuel oil analysis, water chemistry, and particle analysis.

Eileen M. Arnold

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

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.

Lynda A. Huckestein

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

ALS Environmental

Education

Oregon State University, Corvallis, OR
BS in Microbiology, 1983

Client Services Manager IV

1998 - 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 $2 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

Columbia Analytical Services, Inc. — **Project Chemist**, '92-'98
Kelso, WA

Primary responsibilities included technical project management and client service in areas of pulp & paper, marine sediment and tissue services, mining, and DOD. Also responsible for providing technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory.

Columbia Analytical Services, Inc. — **Project Chemist and Dept. Manager**, General Chemistry Laboratory, '89-'92
Kelso, WA

Responsible for management of the General Chemistry laboratory for routine wastewater, bioassay, and microbiological analyses. Also responsible for supervision of staff, data review, and reporting.

Columbia Analytical Services, Inc. — **Analyst III**, 1989
Kelso, WA

Primary responsibilities included coliform testing, total recoverable petroleum hydrocarbon extractions and analysis, BODs, ammonias, and TKN, in addition to miscellaneous wet chemistry analyses.

Coffey Laboratories — **Microbiologist/Chemist**, 1983
Portland, OR

Was responsible for Coliform analysis; water chemistry.

Oregon State University — **Laboratory Assistant**, 1983
Corvallis, OR

Performed wheat spike dissection and tissue culture.

Jeffrey A. Coronado

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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,**
Kelso, WA **'92 – present**

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,**
Kelso, WA **'89 – '92**

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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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.

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

Jonathan (Jon) James

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

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, Semivolatile 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. **Manager VOA and PHC/HPLC**
Kelso, WA **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. **Scientist IV, VOA Laboratory,**
Kelso, WA **'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. **Project Chemist, Supervisor**
Kelso, WA **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. **Analyst, SVOC GC Lab**
Kelso, WA **'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. **Analyst, Organic Extractions**
Kelso, WA **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..

Lester "Les" Kennedy

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

Education

Lower Columbia College, Longview, WA
Coursework, general Studies, 1988 - 1990

Portland Bible College
Portland, OR
Batchelor ofTheology, 2009

Sample Custodian/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. **Project Manager** '99 -'11
Kelso, WA **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. **Supervisor Organic Extractions**
Kelso, WA **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. **Senior Analyst, GC/MS Laboratory**,
Kelso, WA '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. **Senior Analyst, Organic Extractions**
Kelso, WA **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. **Analyst, Organic Extractions**
Kelso, WA **Laboratory,** '91-'93

Duties primarily as listed above

APPENDIX C

MAJOR ANALYTICAL EQUIPMENT

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (16):			
Precisa,Mettler,OHOUS, Adams models	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
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 Meters (2):			
YSI Model 3200	2004	LM	4
VWR	2001	LM	4
Digestion Systems (5):			
COD (4)	1987, 1989	LM	4
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (3)	1987, 1988, 1991	LM	4
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	5
Drying Ovens (12):	1990-2010		
Shel-Lab and VWR models		LM	13
Air Drying Cabinets	2011	LM	NA
Flash Point Testers (2):			
ERDCO Setaflash Tester	1991	LM	3
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
Dionex ICS-2000 with Chromchem Data System	2006	LM	3
Dionex ICS-1600 with Chromchem Data System	2009	LM	
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	1990	LM	4
	1992	LM	4
Microscope - Olympus	1988	LM	1

Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY (continued)			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
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 (2) Coulemetrics Model 5012 Teledyne Tekmar Fusion 1	 1997 2009	 LM LM	 3 3
Total Organic Halogen (TOX) Analyzers (2): Mitsubishi TOX-100	 2001	 LM	 2
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (3): Beckman-Coulter DU520 Perkin Elmer Lambda 25 Abrazix	 1986 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		

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 (5): Varian SpectrAA Zeeman/220 AA (2) CETAC Mercury Analyzer M-6000A Perkin Elmer AAnalyst 200 Flame AA CETAC Mercury Analyzer M-6100	 2000 2000 2005 2010	 LM LM MM MM	 2 2 2 2
Buck AA Spectrophotometer Model 205	2008	LM	2
Atomic Fluorescence Spectrophotometer Brooks-Rand Model III (1) Leeman Mercury Analyzer (1)	 1996, 2005 2006	 LM LM	 3 2
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	3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS): VG Excell Thermo X-Series Nexion Model 300D	 2001 2006 2011	 MM MM MM	 3 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 (4) Mettler PM480, BB300 ,AG204 OHaus EP613	1999 - 2011	MM	12
Centrifuge – Beckman J-6B	1988	LM	12
Drying Ovens (2) Fisher Model 655G VWR Model 1305U	 1991 1999	 LM LM	 12 12
Evaporators/concentrators Organomation N-Evap (8) Organomation S-Evap (8) Zymark Turbovap (2)	 1990-2010 1990-2010 1998-2000	 LM LM LM	 12 12 12
Extractor Heaters: Lab-Line Multi-Unit Models for Continuous Liquid-Liquid and Soxhlet Extractions (102)	1987-2007	LM	8
Solids Extractors: Sonic Bath VWR (2) Sonic Horn (5) Soxhtherm Gerhardt (2) OI Analytical (6)	 1991 -1994 1994 2000 2008	 LM LM LM	 6 6 6
Extractors, TCLP (10): Millipore TCLP Zero Headspace Extractors (5) TCLP Extractor - Tumbler (12 position)	 1987-1992 1989	 LM LM	 2 2
Gel Permeation Chromatography (GPC) (6) ABC single column (3) J2 Scientific AccuPrep (2)	 1998, 1999, 2007 2005, 2010	 LM LM	 4 4
Muffle Furnace - 4	1994-2006	LM	4
Solid Phase Extractors (18) – Horizon SPE-Dex 4790	2003, 2006,2008	LM	4

GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Gas Chromatographs (17):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors	1990 – 1995	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FPD Detectors	1991	LM	3
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, 2012	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		
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
Thermo 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 (12):			
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 5890/5970 with ATAS Optic2 LVI and HP 7673 Autosampler	1994	LM	6
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (3)	1993, 1994, 1998	LM	6
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	2007	LM	6
Agilent7890A/5975C with Agilent 7693 Autosampler (4)	2010	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	4
Drying Oven - Fisher Model 630F	1991	LM	4
Evaporator – Turbo Vap	2009	LM	4
Centrifuge Marathon 21K	1996	LM	4
High-Performance Liquid Chromatographs (3):			
HP 1090M Series II with Diode Array UV Detector	1999	LM	2
HP 1050/1100 Series with Fluorescence & Diode Array UV Detectors	2004	LM	2
Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	2
High-Performance LC/MS (3)			
Spectrometer - Thermo Electron TSQ Quantum LC/MS/MS and Autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC Autosampler	2008	MM	2
AB Sciex 5500 and Schimadzo DGU 20A5	2011	MM	2
Agilent 1100 HPLC -UV/Fluoescence detectors- Pickering PCX-5200 Post-column derivitization unit	2003	LM	2

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 (2):			
Boekel 107801	1989	LM	5
VWR 1305 U	1991	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 5890/5971	1991	LM	5
Tekmar 3000 Purge and Trap Concentrator	2001	LM	5
Dynatech ARCHON 5100 Autosampler	1995	LM	5
Agilent 6890/5973	2001	LM	5
Tekmar 3100 Purge and Trap Concentrator	2001	LM	5
Varian Archon Autosampler	2001	LM	5
Agilent 6890/5973	2005	LM	5
Tekmar Velocity Purge and Trap Concentrator	2005	LM	5
Tekmar Aquatech Autosampler	2005	LM	5
Agilent 6890/5973 (2)	2007	LM	5
Tekmar 3000 Purge and Trap Concentrator	2007	LM	5
Varian Archon 5100 Autosampler	2007	LM	5
Agilent 7980A/5975C (2)	2010, 2011	LM	5
Teledyne Tekmar-Automx	2010,2011	LM	5
Hewlett-Packard 5890 Series II with PID/PID/FID	1991	LM	2
EST-ENCON Purge and Trap Concentrator	1991		
Dynatech Archon 5100 Autosampler	1992		

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1-WAN: LIMS Sample Manager using Oracle 10g & 11g DBMS running on Redhat Advanced Server 4.0 (Linux) platform connected/linked via both fiber and MPLS circuits.	1994-2007	LM	NA
1 - Network Server Pentium 4 class, 1 for Reporting and Data Acquisition running Windows 2003 SP2 Advanced Server, 1 for Applications running Windows 2003 Advanced Server SP2. Data acquisition capacity at 195 GB with redundant tape and disk arrays.	2004-2008	LM	NA
Approximately 80+ HP, Dell, Kyocera Laserjet printers (various types including models III, 4, 5, 8150, 4000, 4041, 4050, 4200 4250, 8150, 1720dn, W5300, 1300D, M4000)	1991 - 2010	LM	NA
Approximately 280 + Gateway/Dell/HP PC/Workstations running Windows 2000/XP on LAN connected via 10BT/100BT and TCP/IP for LIMs Terminal Emulation	1993 - 2010	LM	NA
Microsoft Office 2003 Professional as the base application for all PC/Workstations. Some systems using Office 2000/97, Office 2007.	1996 - 2010	LM	NA
E-Mail with link to SMTP for internal/external messaging. Web mail via Outlook Web Access interface. Microsoft Outlook 2003.	1994 - 2006	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Facsimile Machines - Brother 4750e; Brother 2920; Brother 1860	1991 - 2010	LM	NA
Copiers/Scanners: Konica BizHub 420 (1), BizHub 600 (1), BizHub 920 (2), BizHub Pro 1050 (3), BizHub Pro 1051 (1). All are accessible via LAN for network scanning.	2000 - 2010	LM	NA
Dot Matrix Panasonic KX-P1150	1991 - 2004	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS reporting software systems.	1998 - 2004	LM	NA
Data processing terminals (74) Enviroquant (63) Target (10)			

Saturn (1)			

NA: Not applicable. This equipment administered by IT staff but may be used by all staff.

APPENDIX D

DATA QUALIFIERS AND ACRONYMS

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria are 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 that was detected outside the quantitation range.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 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 matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Metals Data Qualifiers

#	The control limit criteria are not applicable. See case narrative.
J	The result is an estimated value that was detected outside the quantitation range.
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 4.1 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 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 were outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criterion 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 estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value that was detected outside the quantitation range.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria were 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 4.1 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.

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
LUFT	Leaking Underground Fuel Tank
LOD	Limit of Detection
LOQ	Limit of Quantitation
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
TPH	Total Petroleum Hydrocarbons

APPENDIX E

PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Activity	Maint[a]	Frequency
Refrigerators and Coolers	Record temperatures	LM	Daily
	Clean coils	LM	Annually
	Check coolant	LM	Annually or if temperature outside limits
Vacuum Pumps	Clean and change pump oil	LM	Every month or as needed
Fume Hoods	Face velocity measured	LM	Quarterly
	Sash operation	LM	As needed
	Change filters	LM	Annually
	Inspect fan belts	LM	Annually
Ovens	Clean	LM	As needed or if temperature outside lim.
	Record temperatures	LM	Daily, when in use
Incubators	Record temperatures	LM	Daily, morning and evening
Water Baths	Record temperatures	LM	Daily, morning and evening
	Wash with disinfectant solution	LM	When water is murky, dirty, or when growth appears
Autoclave	Check sterility	LM	Every month
	Check temperature	LM	Every month
	Clean	LM	When mold or growth appears
	Calibrate thermometer	VM	Once a year
Analytical Balances	Check alignment	LM	Before every use
	Verify calibration	LM	Daily
	Clean pans and compartment	LM	After every use
	Certified calibration	VM	Once a year
Dissolved Oxygen Meter	Change membrane	LM	When fluctuations occur
pH probes	Condition probe	LM	When fluctuations occur
Fluoride ISE	Store in storage solution	LM	Between uses
Ammonia ISE	Store in storage solution	LM	Between uses
UV-visible Spectrophotometer	Wavelength check	VM	Twice a year

Instrument	Activity	Maint[a]	Frequency
Total Organic Carbon Analyzers	Check IR zero	LM	Weekly
	Check digestion/condensation vessels	LM	Each use
	Clean digestion chamber	LM	Every 2000 hours, or as needed
	Clean permeation tube	LM	Every 2000 hours, or as needed
	Clean six-port valves	LM	Every 200 - 2000 hours, or as needed
	Clean sample pump	LM	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	LM	Every 200 - 2000 hours, or as needed
	Clean IR cell	LM	Every 2000 - 4000 hours, or as needed
Total Organic Carbon Analyzers	Change cell electrolyte	LM	Daily
	Change electrode fluids	LM	Daily
	Change pyrolysis tube	LM	As needed
	Change inlet and outlet tubes	LM	As needed
	Change electrodes	LM	As needed
Flow Injection Analyzer	Check valve flares	LM	Each use
	Check valve ports	LM	Each use
	Check pump tubing	LM	Each use
	Check light counts	LM	Each use
	Check flow cell flares	LM	Quarterly
	Change bulb	LM	As needed
	Check manifold tubing	LM	Each use
	Check T's and connectors	LM	Each use
Discrete Auto Analyzer	Clean probe, wash reservoirs	LM	Every 2 weeks
	Replace peristaltic pump tubing	LM	Every 3 months
	Replace hydraulic circuit tubing	LM	Once/year

Instrument	Activity	Maint[a]	Frequency
Ion Chromatographs	Change column	LM	Every six months or as needed
	Change valve port face & hex nut	LM	Every six months or as needed
	Clean valve slider	LM	Every six months or as needed
	Change tubing	LM	Annually or as needed
	Eluent pump	LM	Annually
Atomic Absorption Spectro-photometers - FAA and CVAA	Check gases	LM	Daily
	Clean burner head	LM	Daily
	Check aspiration tubing	LM	Daily
Atomic Absorption Spectro-photometers - GFAA	Clean optics	LM	Every three months
	Empty waste container	LM	Weekly
	Check gases	LM	Daily
	Check argon dewar	LM	Daily
	Change graphite tube	LM	Daily, as needed
	Clean furnace windows	LM	Monthly
ICP - AES	Check argon dewar	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Empty waste container	LM	Weekly
	Clean nebulizer, spray chamber, and torch	LM	Every two weeks
	Replace water filter	LM	Quarterly
	Replace vacuum air filters	LM	Monthly
ICP - MS	Check argon dewar	LM	Daily
	Check water level in chiller	LM	Daily
	Complete instrument log	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Clean sample and skimmer cones	LM	As needed
	Clean RF contact strip	LM	As needed
	Inspect nebulizer, spray chamber, and torch	LM	Clean as needed
	Clean lens stack/extraction lens	LM	As needed

	Check rotary pump oil	LM	Monthly
	Change rotary pump oil	LM	Every six months

Instrument	Activity	Maint[a]	Frequency
Gel-Permeation Chromatographs	Clean and repack column	LM	As needed
	Backflush valves	LM	As needed
HPCL Chromatographs	Backflush guard column	LM	As needed
	Backflush column	LM	As needed
	Change guard column	LM	As needed when back pressure too high
	Change column	LM	Annually or as needed
	Change in-line filters	LM	As needed
	Leak check	LM	After column maintenance
	Change pump seals	LM	As needed
	Change pump diaphragm	LM	Annually
	Clean flow cell	LM	As needed
	Fluorescence detector check	LM	Daily
	Diode array absorbance check	LM	Daily
HPLC MS/MS	Clean ion transfer tube	LM	Daily or noticeable decrease in signal
	Clean inlet assembly	LM	Monthly or as needed
	Forepump	LM	Blast weekly; change oil every 3 months
Gas Chromatographs, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean FID	LM	Weekly or as needed
	Clean ECD	LM	Quarterly or as needed
	Leak test ECD	LM	Annually

Instrument	Activity	Maint[a]	Frequency
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily, when in use
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Clean source	LM	As needed when tuning problems
	Change pump oil	LM	As specified by service specifications
Purge and Trap Concentrators	Change trap	LM	Every four months or as needed
	Change transfer lines	LM	Every six months or as needed
	Clean purge vessel	LM	Daily
Gas Chromatographs, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean PID lamp	LM	As needed
	Clean FID	LM	As needed
	Change ion exchange resin	LM	Every 60 days
	Replace nickel tubing	LM	Quarterly or as needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily
	Clip first foot of capillary column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails

Instrument	Activity	Maint[a]	Frequency
	Clean source	LM	As needed when tuning problems
	Change pump oil		As specified by service specifications

APPENDIX F

LABORATORY
STANDARD OPERATING PROCEDURES

SOP TITLE	FILE NAME
KELSO ADMINISTRATIVE SOPS	
ALS KELSO TRAINING PROCEDURE	ADM-TRAIN
CHECKING VOLUMETRIC LABWARE	ADM-VOLWARE
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT
DATA ARCHIVING	ADM-ARCH
DATA REPORTING AND REPORT GENERATION	ADM-RG
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD
LABORATORY BALANCE MONITORING AND CALIBRATION	ADM-BAL
LABORATORY DATA REVIEW PROCESS	ADM-DREV
METHOD VALIDATION DOCUMENTATION	ADM-MDLC
PROJECT MANAGEMENT	ADM-PCM
REAGENT LOGIN AND TRACKING	ADM-RLT
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC
SAMPLE BATCHES	ADM-BATCH
SAMPLE MANAGEMENT SOPS	
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT
SAMPLE DISPOSAL	SMO-SDIS
SAMPLE RECEIVING	SMO-GEN
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC
KELSO FACILITY SOPS	
FACILITY AND LABORATORY CLEANING	FAC-CLEAN
OPERATION AND MAINTENANCE OF LABORATORY REAGENT WATER SYSTEMS	FAC-WATER

BIOLOGY SOPS

COLIFORM, FECAL	BIO-9221FC
COLIFORM, TOTAL	BIO-9221TC
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D
COLILERT® , COLILERT-18®, & COLISURE®	BIO-9223
ENTEROLERT	BIO-ENT
HEPTEROTROPHIC PLATE COUNT	BIO-HPC
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN

EXTRACTION SOPS

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520
SOLID PHASE EXTRACTION	EXT-3535
SOXHLET EXTRACTION	EXT-3540
AUTOMATED SOXHLET EXTRACTION	EXT-3541
ULTRASONIC EXTRACTION	EXT-3550
WASTE DILUTION EXTRACTION	EXT-3580
SILICA GEL CLEANUP	EXT-3630
GEL PERMEATION CHROMATOGRAPHY	EXT-3640A
REMOVAL OF SULFUR USING COPPER	EXT-3660
REMOVAL OF SULFUR USING MERCURY	EXT-3660M

SULFURIC ACID CLEANUP	EXT-3665
CARBON CLEANUP	EXT-CARCU
DIAZOMETHANE PREPARATION	EXT-DIAZ
DMD SYNTHESIS	EXT-DMD
FLORISIL CLEAN-UP	EXT-FLOR
ORGANICS EXTRACTIONS GLASSWARE CLEANING	EXT-GC
PERCENT LIPIDS IN TISSUE	EXT-LIPID
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER AND TISSUE	EXT-OSWT
PREPARATION OF REAGENTS AND BLANK MATRICES USED IN SEMIVOLATILE ORGANICS COMPOUNDS	EXT-REAG
ADDITION OF SPIKES AND SURROGATES	EXT-SAS
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL

GENERAL CHEMISTRY SOPS

FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020
COLOR	GEN-110.2
TOTAL SOLIDS	GEN-160.3
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4
SETTEABLE SOLIDS	GEN-160.5
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COLOR, NCASI	GEN-NCAS
NITROCELLULOSE IN SOIL	GEN-NCEL
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CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU
Ph IN SOIL AND SOLIDS	GEN-Phs
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PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM
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SULFIDES, REACTIVE	GEN-RS
TOTAL SULFIDE BY PSEP	GEN-S2PS
SULFITE	GEN-SO3
SPECIFIC GRAVITY	GEN-SPGRAV
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-TDS

THIOCYANATE	GEN-THIOCN
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN
TOTAL NITROGEN AND TOTAL PHOSPHORUS BY ALKALINE PERSULFATE DIGESTION NCASI METHOD TNTP-W10900	GEN-TNTP
TOTAL ORGANIC CARBON IN WATER	GEN-TOC
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-TSS
TURBIDITY MEASUREMENT	GEN-TURB
ULTIMATE BOD	GEN-UBOD
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ORGANIC LIQUID CHROMATOGRAPHY SOPS

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DETERMINATION OF TRIAZINE PESTICIDES AND THEIR DEGRADATES IN WATER BY LIQUID CHROMATOGRAPHY ELECTROSPRAY IONOIZATION TANDEM MASS SPECTROMETRY.	LCP-536
DETERMINATION OF SELECTED PERFLORINATED ALKL ACIDS IN DRINING WATER BY SOLID PHASE EXTRASCTION AND TANDEM LC/MS/MS.	LCP-537
ALDEHYDES BY HPLC	LCP-8315
DETERMINATION OF HORMONES IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY ELECTROSPRAY IONIZATION TANDEM (LC/ESI-MS/MS)	LCP-539
POLYNUCLEAR AROMATIC HYDROCARBONS BY HPLC	LCP-610
QUANTITATIVE DETERMINATION OF CARBAMATE PESTICIDES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDAM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-8321
DETERMINATION OF CARBAMATES IN WATER BY EPA 8321 USING LC TANDEM MASS SPECTROMETRY	LCP-8321W

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ACRYLAMIDE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)..	LCP-ACRYL
QUANTITATIVE DETERMINATION OF AFLATOXINS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-AFLA
QUANTITATIVE DETERMINATION OF 2,2-DIBROMO-3-NITRILOPROPIONAMIDE BY HPLC	LCP-DBNPA
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QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-MS/MS)	LCP-LCMS4
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	LCP-NITG
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ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	LCP-OALC
QUANTITATIVE DETERMINATION OF OPTICAL BRIGHTENER 220 BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)	LCP-OPBR
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TOTAL OLEANOLIC ACID SAPONINS IN WATER BY ACID HYDROLYSIS AND HPLC/MS/MS	SOC-LCMS3
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DIQUAT AND PARAQUAT BY HPLC	SVD-549

METALS SOPS

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METALS DIGESTION	MET-3020A
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DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICP.MS
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PETROLEUM HYDROCARBON SOPS

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ANALYSIS OF WATER AND SOLIDS SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS	PET-TPH

ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO

SEMI-VOLATILE ORGANIC SOPS

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GLYCOLS	SOC-8015M
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PCBS AS AROCLORS	SOC-8082Ar
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CHLORINATED HERBICIDES	SOC-8151
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CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL
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ORGANIC DRINKING WATER SOPS

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SEMI-VOLATILE GC/MS SOPS

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CHLORINATED PESTICIDES BY GC/MS/MS, EPA METHOD 1699 MODIFIED	SVM-PESTMS2

POLYBROMINATED DIPHENYL ETHERS (PBDEs) AND POLYBROMINATED BIPHENYLS (PBBs) BY GC/MS	SOC-ROHS

VOLATILE ORGANIC SOPS

GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO
METHOD FOR DETERMINING GASOLINE RANGE ORGANICS, WISCONSIN DNR	PET-WIGRO
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030
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CARBON, TOTAL ORGANIC IN SOIL

ASTM METHOD D4129-05, MODIFIED FOR SOIL AND SEDIMENT MATRICES (PUGET SOUND ESTUARY PROGRAM AND LLOYD KAHN)

ALS-KELSO

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Standard Operating Procedure

for

CARBON, TOTAL ORGANIC IN SOIL

1. SCOPE AND APPLICATION

1.1. This procedure is applicable to the determination of Total Organic Carbon (TOC) using ASTM method D4129-05, modified for soil and sediment matrices (Puget Sound Estuary Program and Lloyd Kahn). Total organic carbon is a measure of the total amount nonvolatile, partially volatile and particulate organic compounds in a sample. Sample should be treated to remove inorganic carbon (carbonates, bicarbonates, free CO_2 etc.), prior to analysis, as these compounds will interfere with true readings.

1.2. This method is applicable to all soils and sediments and most matrices that can be dried and ground to a fine powder.

1.3. Results are reported as percent (%) carbon, and the applicable range is the MDL - 100%. The Method Reporting Limit (MRL) for TOC on soils is 0.05%, dry weight basis. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The Method Detection Limit (MDL) has been determined at 0.02%.

2. METHOD SUMMARY

2.1. Samples are combusted in an oxygen atmosphere to convert organic and inorganic forms of carbon to CO_2. The combustion temperature is selected to completely oxidize all carbon forms. The combustion product gases are swept through a barium chromate catalyst/scrubber to ensure that all of the carbon is oxidized to CO_2. Other potentially interfering product gases such as SO_2, SO_3, HX, and NO_x are removed from the gas stream in a series of chemical scrubbers. The CO_2 is then swept to the coulometer where it is detected by automatic, coulometric titration, with coulometric end point indication.

2.2. The coulometer cell is filled with a partially aqueous medium containing ethanolamine and a colorimetric indicator. When a gas stream passes through the solution, CO_2 is quantitatively absorbed. CO_2 reacts with the ethanolamine to form a strong titratable acid which caused the indicator to fade. The titration current automatically turns on and electrically generates base to return the solution to its original color.

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.

3.2. 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.

3.3. **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.

3.4.4. Nonaqueous Liquid – Any organic liquid with <15% settleable solids.

3.4.5. Animal tissue – Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.4.6. Solids – Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.4.7. 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.

3.4.8. 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, auto fluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.

3.5. 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 mid point of the calibration range or at levels specified by a project analysis plan.

3.6. 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.

3.7. 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. 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.

3.10. 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.

3.11. 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. Acidic and other gases, including SO_2, SO_3, H_2S, HCl, HBr, HI, Cl_2, and NO_x can be effectively removed using scrubbers such as KI, Ag_2SO_4, $AgNo_3$, and MnO_2.

4.2. Volatile organics may be lost in the decarbonization process.

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. Disconnect teflon tubing from furnace at check valve whenever system is not in use or when O_2 flow is turned off or furnace temperature is reduced. If the carbon cathode solution should be siphoned through a failed check valve into the magnesium perchlorate scrubber potentially explosive DMSO-perchlorate could be formed.

5.5. Do not attempt to combust large samples of organic or other materials that will react with pure oxygen. Such samples can cause the pyrolysis tube to explode.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

Samples can be collected in glass or plastic containers. Samples are preserved by storage at 4±2°C. Samples are analyzed within 28 days of collection.

7. APPARATUS AND EQUIPMENT

7.1. Induction furnace, Coulometrics Incorporated.

7.2. Analytical balance, 0.1mg accuracy.

7.3. Desiccator.

7.4. Quartz combustion boats.

7.5. Sample scoop.

7.6. Porcelain dishes.

7.7. Glass ladles and miscellaneous laboratory glassware,

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. 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 ADM-RTL,

Reagent/Standards Login and Tracking for the complete procedure and documentation requirements.

8.2. Standards

8.2.1. Urea – 20% carbon. Use 10 µg.

8.2.2. Nutrients in Soil, purchased standard with a known TOC value (typically ERA #542). Use 50 mg for LCS.

8.3. Reagents

8.3.1. Hydrochloric acid, 50% and 10%.

8.3.1.1. 10%: Bring 20mL HCl to 200mL final volume
8.3.1.2. 50%: Bring 100mL HCl to 200mL final volume

8.3.2. Carbon Cathode Solution. Dimethyl Sulfoxide; DMSO. Purchased from Coulometrics Inc. as a prepared solution. Used for coulometer solution.

8.3.3. Anode Solution. Dimethyl Sulfoxide and potassium iodide. Purchased from Coulometrics Inc. as prepared solution.

8.3.4. Manganese dioxide. Gas scrubber solution.

8.3.5. Potassium Hydroxide. Gas scrubber solution.

8.3.6. Potassium Iodide. Anode chemical.

8.3.7. Magnesium Perchlorate desiccant

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. Documenting method proficiency, as described in ADM-TRAIN, ALS – Kelso Training Procedure, is also the responsibility of the department supervisor/manager.

10. PREVENTIVE MAINTENANCE

10.1. 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 10. The entry in the log must

include: date of event, the initials of who performed the work, and a reference to analytical control.

Maintenance is performed as follows:

Maintenance Item	Frequency
Cell	Clean daily with methanol and water to clean frit
Mg Perchlorate Scrubber	change daily
KOH Scrubber	change monthly
NOX scrubber	change as needed
Repack Precombustion Column	as needed
Repack Combustion Column	as needed

11. PROCEDURE

11.1. Sample Preparation.

11.1.1. Turn furnace on to ≈1000ºC. Allow furnace to warm-up for about 1/2 hours. Turn on oxygen to ≈5 psi and 75 to 125 ml/min at flowmeter.

11.1.2. Clean quartz boats. Scrape out old sample and rinse boats with DI water. Place boats in crucible and muffle for at least 10-15 minutes. Remove boats and place in desiccator until ready for use.

11.1.3. Samples should be dried at 70ºC and homogenized prior to analysis. Homogenization of dried solid sample should include grinding with a mortar and pestle or shatter box. A shatter box should be used with a larger sample size (i.e. 20+ grams) if the sample exhibits a high degree of heterogeneity. Samples should be ground to a fine, homogenous, powder.

11.1.4. Ground samples must be stored in individual sealed vials. In addition, sample vials analyzed under PSEP methodology must be stored in a desiccator prior to sample analysis.

11.1.5. As a rule, the darker (or closer to black) a sample is, the more carbon it contains. Place a small portion of sample on a watch glass. Add 1 drop of 10% HCl. Watch for effervescence or bubbling. If bubbles are present, the sample contains inorganic carbon (CO_3). If sample bubbles, reduce sample size to prevent sample from bubbling out of boat. If sample is dark, wood product or sludge reduce sample volume to 5 - 10mg. Normal sample volume = 50mg. After boats are loaded with sample add 1 to 2 drops 10% HCl to each sample, LCS, and method blank. Place boats in 70ºC oven to dry. If samples bubbled when acid was added, add 1 to 2 drops more acid and dry at 70ºC. Continue acidifying and drying until samples no longer bubble. Place samples in desiccator until ready for analysis.

11.2. Apparatus Preparation.

11.2.1. Fill cell with carbon cathode solution to 100 – 125 ml, drop in stir bar. Place cell top on snug.

11.2.2. Cover bottom of anode cell with KI. About 2 small scoops.

11.2.3. Add carbon anode solution to cell such that when anode is inserted in the anode cell, the anode solution level is the same as the cathode solution level.

11.2.4. Place cell in coulometer cell holder.

11.2.5. Turn on detector lamp and stir plate. (Power on)

11.2.6. Turn adjust knob to 122 (all the way to the right) then turn back down to 100. Rotate cell until maximum transmittance is obtained.

11.2.7. With oxygen bubbling to cell and maximum transmittance obtained, turn on the current to the anode and cathode. The carbon cathode solution will begin to titrate to a blue color.

11.2.8. Change Magnesium Perchlorate desiccant daily.

11.2.9. The instrument is now ready to run.

11.3. Calibration and Standardization.

11.3.1. Burn both ladles for five minutes each to remove any residual TOC.

11.3.2. Establish baseline.

11.3.2.1. After placing ladles in sample inlet, allow system to purge for 1 minute.

11.3.2.2. Burn three empty boats five minutes each. The average of the three runs is the baseline.

11.4. Analysis.

11.4.1. Place one platinum or quartz boat in a ladle. Place the ladle in the sample inlet and purge for 1 minute. Simultaneously insert the sample into the furnace, press the reset button on the coulometer and start the timer for five minutes.

11.4.2. After five minutes, obtain a reading from the instrument. Remove the ladle from the furnace. (Occasionally, a high sample may require longer than 5 minutes to complete the titration).

11.4.3. Load the other ladle with the next platinum (or quartz) boat. Remove the ladle in use from the inlet port and insert the next ladle.

11.4.4. Repeat steps 11.4.1 through 11.4.3 until all samples are analyzed.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

The precision and accuracy 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's are prepared and analyzed. The RSD should be <20% and average recovery must be within LCS recovery limits (see laboratory DQO Tables).

12.2. Method Detection Limits and Method Reporting 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. Analyze a minimum of seven spiked blank replicates at a level near 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.* The MDL study must be verified annually.

12.2.2. Calculate the average concentration found (x) in the *sample concentration*, 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.

12.2.3. Limits of Quantification (LOQ)

12.2.3.1. The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 75-125% of the true values to verify the data reporting limit. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

12.2.4. The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.3. 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).*

12.4. The QC criteria discussed in the following sections are summarized in Table 1.

12.4.1. LCS – An LCS must be analyzed with each batch of 20 or fewer samples. Analyze 50mg of the purchased standard (see 8.1.2) is used. The acceptance criteria for the LCS are listed in Table 1.

12.4.2. Method Blank – Analyze one method blank per batch of 20 or fewer samples. Add one to two drops of 10% HCl to an empty boat and place the boat in a 70ºC oven to dry. Method Blank must be <0.05% carbon.

12.4.3. CCV (Continuing Calibration Verification) – A CCV must be analyzed every tenth analysis. Analyze ~10mg urea. The CCV must be 18.0% – 22.0% carbon.

12.4.4. CCB (Continuing Calibration Blank) – A CCB must be analyzed following every CCV.

12.4.5. Sample duplicate – ASTM D 4129: One duplicate sample per batch of 20 or fewer samples must be analyzed in duplicate. TOC analysis by PSEP methodology requires one sample to be analyzed in triplicate per batch of 20 or fewer samples. Samples analyzed under Lloyd Kahn methodology must all be analyzed in duplicate. All duplicates and triplicates, regardless of the method cited, should be within 20% RPD, if > five times the MRL.

12.4.6. Matrix Spike – One spike must be analyzed with each batch of 20 or fewer samples. The acidified sample will be spiked with a known amount of urea.

12.4.7. See Table 1 for a summary of acceptance criteria and corrective actions.

13. DATA REDUCTION AND REPORTING

13.1. Calculate % carbon as follows:

$$\%Carbon = \frac{(Gross\ reading\ -baseline\ \mu g)(0.1)}{mg\ sample\ analyzed}$$

13.1.1. Total organic carbon is reported as % carbon, normally on a dry weight basis. Results may be reported on an as received basis.

13.2. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

where S1 = Sample with higher value
S2 = Sample with lower value
Avg = Average of the two sample values

13.3. Calculate percent recovery as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

where X = Concentration of the analyte recovered
X1 = Concentration of unspiked analyte
TV = True value of amount spiked

13.4. Data Review and Assessment

13.4.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative. All data will be initialed, dated and attached to required data quality worksheet.

13.5. Reporting

13.5.1. Refer to ADM-RG, *Data Reporting and Report Generation* for reporting guidelines.

13.5.2. The analyst enters data directly into LIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.5.3. As an alternative, reports are generated using Excel© templates located in R:\WET. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates.

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. METHOD PERFORMANCE

15.1. This method is validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available. The method detection limit (MDL) is established using the procedure described in CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

15.2. Method Reporting Limits are established for this method *based on MDL studies and as specified in* CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

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.

16.4. This method uses a base. Waste base is hazardous to the sewer system and to the environment. All 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. METHOD MODIFICATIONS

17.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

18. REFERENCES

18.1. Coulometrics Inc. Instruction Manual, Model 5020.

18.2. Total Organic Carbon (TOC), Conventional Sediment Variables, Puget Sound Estuary Program, March 1986.

18.3. Determination of Total Organic Carbon in Sediment, Lloyd and Kahn, U.S.E.P.A Region II, July 1988.

18.4. ASTM Method D4129-05.

19. CHANGES SINCE THE LAST REVISION

19.1. Reformatted method per ALS branding
19.2. Changed "CAS" references to "ALS"
19.3. Updated SOP references
19.4. Sec. 1.2: replaced "shatter boxed" with "ground"
19.5. Sec 8.3.1: Added preparation of 10% and 50% HCl
19.6. Sec 11.1.1: Deleted "#5"
19.7. Sec 11.1.5: Added LCS and MB to sample preparation (addition of acid)
19.8. Sec 11.3.2.2: Corrected word order
19.9. Sec 12.1: Referred to DQO tables for LCS recovery limits
19.10. Sec 12.4.2: Added method blank preparation
19.11. Table 1: Referred to DQO Tables for LCS and MS recovery limits.

TABLE 1
Summary of Corrective Actions

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
ASTM D4129 PSEP Lloyd Kahn	CCV	Verify calibration by analyzing prior to samples, after every 10 analysis and after the last sample	±10%	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn	LCS	Include with each analysis batch (up to 20 samples)	See DQO Tables	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn	Method Blank	Include with each analysis batch (up to 20 samples)	< 0.05%	If target exceeds 0.05%, clean boats and re-analyze.
ASTM D4129 PSEP Lloyd Kahn	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if the there is a matrix effect or analytical error
ASTM D4129 PSEP Lloyd Kahn	Sample Duplicates	Include with each analysis batch (up to 20 samples)	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
ASTM D4129 PSEP Lloyd Kahn	Sample Triplicate	Include with each analysis batch (up to 20 samples)	≤ 20 % RSD	Re-homogenize and re-analyze if result is > 5 X the MRL
ASTM D4129 PSEP Lloyd Kahn	Sample Duplicates	All samples in each analysis batch	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL

APPENDIX I

BENCHSHEETS

Columbia Analytical Services, Inc.

Service Request #: _____ Method: ASTM D4129-82M/EPA Lkahn/ PSEP (Combustion/Coulometric)

Analysis For: Total Organic Carbon (TOC) Matrix: Soil / Dry Weight Basis

Sample Number	mg Sample Injected	Sample Reading, µg C	Baseline Reading, µg C	Net µg C	% Carbon	% Carbon Reported
CCV-1					#VALUE!	#VALUE!
CCB-1	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
LCS-1					#VALUE!	#VALUE!
MB-1	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
CCV-2					#VALUE!	#VALUE!
CCB-2	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
CCV-3					#VALUE!	#VALUE!
CCB-3	50.0		0.0	#VALUE!	#VALUE!	#VALUE!

R:\WET\ANALYSES\TOC\TEMPLATE\TOCsoil_LIMS 011612

Revision 2

Acid Purge Time: 1 minute **Reading Time:** 5 minutes **TOC % =** $\frac{\text{(Net Reading)(µg 0.1)}}{\text{mg Sample Injected}}$

LCS: ERA Cat#: 542 Lot#: D068-542 ID#: TOCS/2-89-A TV = 0.28%C %REC=

CCV : Urea EMD (lot #3229B230) ID#: TOCS/1-11-M TV = 20.0%C

CCV1 = #VALUE! CCV2 = #VALUE! CCV3= #VALUE!

HCl: 10% ID#Toc/2-80-____ Balance: K-Balance-

Oven ID# Thermometer ID#

Kms =mg x 20 /= % REC= RSD= x=

Kmsd =mg x 20 / = % REC=

date time

Analyzed By:	Date:
Reveiwed By:	Date:

Sample #	mg Sample	Reading	Date Baked	Baseline
CCV-1			#VALUE!	
CCB-1	50.0			
LCS-1			#VALUE!	
MB-1	50.0			AVG
				0.0
CCV-2			#VALUE!	
CCB-2	50.0			
CCV-3			#VALUE!	
CCB-3	50.0			
CCV-4			#VALUE!	
CCB-4	50.0			
CCV-5			#VALUE!	
CCB-5	50.0			
CCV-6			#VALUE!	
CCB-6	50.0			
CCV-7			#VALUE!	
CCB-7	50.0			
CCV-8			#VALUE!	
CCB-8	50.0			
CCV-9			#VALUE!	
CCB-9	50.0			

Analyst	Date	Time
0	1/0/00	0:00

PH IN SOIL AND SOLIDS

EPA METHOD 9045D

ALS-KELSO

SOPID: GEN-PHS	Rev. Number: 13	Effective Date: 04/30/201313

Approved By: _____ Date: 4/18/13
Department Supervisor - Harvey Jacky

Approved By: _____ Date: 4/18/13
QA Manager - Suzanne LeMay

Approved By: _____ Date: 4/19/13
Laboratory Director - Jeff Grindstaff

Issue Date: _____	Doc Control ID#: _____	Issued To: _____

STANDARD OPERATING PROCEDURE

for

pH IN SOIL AND SOLIDS

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine pH in soil, solid, and certain waste samples using EPA Method 9045D.

1.2. When used to determine pH in multiphase wastes, the procedure is applicable if the aqueous phase constitutes less than 20% of the total volume of the waste.

2. METHOD SUMMARY

2.1. The pH is determined by potentiometric measurement of a soil slurry or aqueous solution using a standard combination glass pH electrode and pH meter.

2.2. The procedure uses methodology described in EPA Method 9045D, WDOE Test Method, and Oregon State Soil Methods.

3. DEFINITIONS

3.1. Analysis Batch - A sequence of samples, which are analyzed within a 24-hour period and include no more than 20 field samples.

3.2. Sample Duplicate - two aliquots of the same sample that are treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures.

3.3. Sample Triplicate – three aliquots of the same sample that are treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures.

4. INTERFERENCES

4.1. Samples with extreme pH results may give incorrect readings on the meter. Samples with a high sodium concentration and pH > 10 can cause error. Using a “low sodium error” electrode (such as Orion 8165, 8172 or equivalent) eliminates this issue to a pH of 12. If the pH is greater than 12, the sodium content of the sample may need to be determined and the pH result may need correction. Strong acid solutions with pH < 1 may give incorrect high pH readings.

4.2. Samples containing oil may coat the electrode and cause a sluggish response or inaccurate reading. If an electrode becomes coated with a material which cannot be rinsed off, the electrode can be cleaned with an ultrasonic bath, be washed with detergent and rinsed then

placed in 1:1 HCl so that the lower third of the electrode is submerged, then rinsed thoroughly with water.

4.3. Temperature fluctuations will cause instrument errors.

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 CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Sample bottles can either be glass or plastic and must be thoroughly cleaned and rinsed prior to use.

6.2. Samples must be stored refrigerated at 4 C (± 2ºC). Although there is no holding time established for soils, samples should be analyzed as soon as possible.

7. APPARATUS AND EQUIPMENT

7.1. Fisher Accumet pH meter, Model 25 or equivalent.

7.2. Combination electrode for pH with temperature probe (such as Orion 8165 or equivalent).

7.3. Conductivity jars, 50 ml.

7.4. Analytical balance capable of weighing 0.1 g.

7.5. Paint filters.

7.6. Erlenmeyer flasks, 250 ml.

7.7. Water bath capable of maintaining a constant temperature of 25°C. One large for all samples and buffers and one smaller bath for analyzing samples at 25°C ± 1°C.

7.8. Standard stir plate and submersible stir plate and stir bars.

7.9. Eight ounce or 16 ounce juice bottles and caps.

7.10. Wrist action shaker?

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. pH buffers: 1.00, 4.00, 7.00, 10.00, 12.45, (true value of buffers at 25° C).

8.2. Commercially available solutions should be validated and traceable to NIST standards and are recommended for routine use.

9. PREVENTIVE MAINTENANCE

9.1. The probe should contain filling solution past the coils to ensure accurate readings. Filling solution should be a non-AgCl containing solution.

9.2 Cleaning the probe

9.2.1 The probe should be emptied and refilled with filling solution once a week.

9.2.2 The glass bulb should be cleaned every other week, or more, by placing it in a beaker with approximately 40 ml of 0.1N HCl and allowed to sit while stirring for approximately 5 minutes. Then rinse the probe with DI water 3 times and blot with a kimwipe.

9.3 If the coils are no longer orange it means the electrode's ion reservoir is empty and it needs to be replaced.

10. RESPONSIBILITIES

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.

11. PROCEDURE

11.1. **Calibration**

11.1.1. All buffers are placed in conductivity jars, capped and stored in the large 25° C water bath. All readings need to be within 1°C of the buffer temperatures.

11.1.1.1. Buffer in conductivity jars needs to be replaced with buffer from the primary container daily.

11.1.1.2. Once a manufacture's bottle of buffer is open it's good for 3 months, because it becomes contaminated with carbon dioxide.

11.1.2. Perform calibration daily. Record calibration; buffer checks and buffer temperatures in instrument logbook or benchsheet with date and analyst's initials.

11.1.3. The slope of the calibration points should be between 95 and 105% or within the range set by the probe manufacturer. The meter displays the slope of calibration.

11.1.4. If the slope exceeds the above end points either the buffer(s) is contaminated or the probe is no longer functioning properly.

11.1.4.1. Replace buffers, rewarm and then re calibrate

11.1.4.2. Empty the probe rinse the inside 3 times with DI water, then refill with electrode filling solution and rise the outside of the probe and blot with kimwipe

11.1.5. Calibration (Fisher Accumet pH Meter 25)

11.1.5.1. Push "standardize"

11.1.5.2. Select 2

11.1.5.3. Push "standardize".

11.1.5.4. Select 1

11.1.5.5. Enter the first buffer value, 4.00. Push “enter”.

11.1.5.6. Place enough buffer solution in a conductivity jar so that the electrode is sufficiently submersed without coming into contact with the stir bar.

11.1.5.7. Rinse electrode

11.1.5.8. Immerse the electrode in the solution. Allow time to stabilize.

11.1.5.9. Push “enter”.

11.1.5.10. Record the buffer value to 0.01 pH units and the buffer temperature to the nearest °C. (4.00 and 25°C).

11.1.5.11. Repeat steps 11.2.2.1 through 11.2.2.9 for buffers 7.00 and 10.00. Also use the 12.45 and 1.00 buffers if needed.

11.1.6. Calibration (Fisher Accumet pH Meter AR25)

11.1.6.1. Calibrate according to the manufacturer’s specifications.

Note: Initial calibration is performed using the 4.00, 7.00, and 10.00 buffers. If any subsequent sample pH is outside the calibration range (greater than 10.00 or less than 4.00), the 1.00 and/or 12.45 buffers are added to the calibration and the applicable samples are reanalyzed.

11.2. **Soil samples preparation for EPA Method 9045D**.

11.2.1. Weigh out 10g of soil into a beaker. Add 10mL of reagent water, cover, and stir the suspension continuously for 5 minutes. Alternative sample volumes may be used as long as soil:water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.

11.2.2. Let the soil suspension stand for 1 hour to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.

11.2.3. Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.

11.3. **Waste material preparation for EPA Method 9045D.**

11.3.1. Wastes may be solids, sludges, or non-aqueous liquids. For multi-phase wastes by method 9045D, a determination of the percentage of the sample that is non-

aqueous must be made. This can be calculated from a % solids determination. If the non-aqueous phase is > 20%, continue with this section. If the non-aqueous phase is < 20%, analyze the sample by EPA Method 9040C see also SOP GEN-pHW.

11.3.2. Weigh out 20g of waste sample into a beaker. Add 20mL of reagent water, cover, and stir the suspension continuously for 5 minutes. Alternative sample volumes may be used as long as solid:water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.

11.3.3. Let the waste suspension stand for 15 minutes to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.

11.3.4. If the waste absorbs all the reagent water, begin the test again with 20g waste and 40mL of water.

11.3.5. If the supernatant is multi-phasic, decant the oily phase and perform the pH determination on the aqueous phase.

11.3.6. Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.

11.4. **Sample preparation for Washington DOE Test Method**.

11.4.1. Weigh three, 50.0g aliquots of each sample into either 3, 8-ounce or 3, 16-ounce juices bottles and add 50mL of D.I. water to each and cap tightly. Each sample is analyzed in triplicate.

11.4.2. Place all bottles on the wrist action shaker. The speed of the shaker should be adjusted so that the sample and water have maximum contact time however the shaking action should not be so vigorous as to cause absorption of CO_2 into the sample.

11.4.3. Filter the liquid through a paint filter into a clean conductivity jar for analysis.

11.5. **Oregon State Soil Methods sample preparation**

11.5.1. Weigh 20.0g of soil into a beaker and add 40mL of D.I. water.

11.5.2. Stir the suspension 2-3 times over a 30-minute period.

11.5.3. Analyze the supernatant.

11.6. **Sample Analysis**

11.6.1. Rinse and blot electrode, then immerse into the sample. Press pH and record the pH when stabilized, record the temperature to the nearest °C. Remove electrodes from sample after each measurement and rinse 3 times with D.I. water.

11.6.2. Regardless of the method employed, all pH readings must be within 2°C of the temperature of the buffer solutions.

11.6.3. If the pH of the sample is ≥11.00 control the temperature of the samples to 25°C±1°C.

12. QA/QC REQUIREMENTS

12.1. A buffer check is analyzed after every 10 readings. For buffer checks, use either pH 4.00 or 10.00, choosing whichever standard brackets the majority of the previous samples with pH 7.00. The buffer check should be within 0.05 pH units of the true value.

12.2. A laboratory control sample (LCS) is analyzed at a frequency of one per 20 samples, with acceptance criteria of 85-115% of the true value. Analyze the LCS prior to the sample set. The LCS is prepared identically to associated samples and documented on the benchsheet. If the LCS is outside of these limits, recalibrate.

12.3. A duplicate sample is analyzed at a frequency of 10% of the samples, with acceptance criteria of 10% RPD between the two readings. If the duplicate is outside of these limits, the sample is reanalyzed. Duplicates are documented on the benchsheet. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

Where S1 = Sample with higher value
S2 = Sample with lower value
Avg. = Average of the two sample values

12.4. For DOE/pH, all samples are analyzed in triplicate and the logarithmic average is reported.

12.5. Sum the antilog of the three pH readings obtained in section 11.5, divide by 3 then take the log.

Example:
Three pH readings obtained: 1.5 1.6 2.5

antilog(1.5) + antilog(1.6) + antilog(2.5) =
31.62 + 39.81 + 316.23 = 387.66
387.66 ÷ 3 = 129.22
log(129.22) = 2.11
pH(average) = 2.11

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Refer to ADM-DREV, *Laboratory Data Review Process* for general guidelines for data review.

13.2. All data and corrective actions must be recorded, dated, and signed or initialed by the analyst. 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 above. Average, RPD, and buffer level are entered on the benchsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

13.3. The data packet for the sequence is submitted for review by supervisor or designee.

13.4. Reporting

13.4.1. Refer to ADM-RG, *Data Reporting and Report Generation* for reporting guidelines.

13.4.2. Reports are generated in the CAS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be CAS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4.3. The pH is reported as pH units. Values are reported to 0.01 pH units.

13.4.4. The benchsheets, located in Appendix A, should be in use at all times during pH analysis.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Non Conformity 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

This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

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.

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 for a period of one week. 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.

17.1.4. 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. CHANGES SINCE THE LAST REVISION

18.1. Reformatted to ALS style.
18.2. CAS references changed to ALS
18.3. Attachment 1: Added a copy of the benchsheet.

19. REFERENCES

19.1. EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IIIIB, November 2004, Method 9045D, Revision 4.

19.2. Method 83-13, State of Washington, Department of Ecology.

19.3. Oregon State University, Methods of Soil Analysis Used in the Soil Testing Laboratory at Oregon State University.

ATTACHMENT 1
Benchsheet

COLUMBIA ANALYTICAL SERVICES, INC.

Service Request #: _____ Method: 9045D

Analysis: _____ pH Corrosivity _____ Matrix: Soil/Solid

Calibration						
Buffer	1.00	4.00	7.00	10.00	12.45	Value of Buffers at 25 °C
Reading						pH Slope:_____
Temp °C						

Sample Number	Sample Wt. (g)	Vol of Ext Sol (mLs)	pH	Time Analyzed	Temp °C	% Solids
Buffer Check	**Buffer Value:**					
LCS	--	--				
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					

LCS: ERA **Lot #:** **ID #:** **T. V. =** **% REC. =**

pH 4.00 buffer: 12-GEN. pH-001-21_____ pH 7.00 buffer: 12-GEN. pH-001-35_____ pH 10.00 buffer: 12-GEN. pH-001-49_____

ph 1.00 buffer Cond/1-73-_____pH 12.45 buffer Cond/1-82-_____ Extraction Solution: _____

Probe ID# rcl/1-79-1 Water Bath ID# K-wb-01 Thermometer ID# L82605

Meter ID# K-pH-01

Analyst:	Date:
Reviewed By:	Date:

R: WET/Analysis/PH/Templates/SOILPH Revison: 2

SOILPH2.xls

COLUMBIA ANALYTICAL SERVICES, INC.

Service Request #: _____ Method: 9045D

Analysis: pH Corrosivity Matrix: Soil /Solid

Sample Number	Sample Wt. (g)	Vol of Ext Sol (mLs)	pH	Time Analyzed	Temp °C	% Solids
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					

Comments: _____

Analyst:	Date:
Reviewed By:	Date:

SOILPH2.xls

STANDARD OPERATING PROCEDURE

PARTICLE SIZE DETERMINATION

GEN-PSP
Revision 7

Effective Date: November 25, 2011

Approved By:

Supervisor	10/26/11 Date
QA Manager	10/27/11 Date
Laboratory Manager	10/27/11 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

DOCUMENT CONTROL	
NUMBER:	
Initials:	Date:

PARTICLE SIZE DETERMINATION

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine the fraction of pre-determined sizes of particles in sediments. The procedures are based on Puget Sound Protocols, Plumb (1981) and a modified ASTM D422 methodology. Particle size can be characterized in a wide range of detail. The grossest divisions that generally are considered useful for characterizing particle size distributions are percentages of gravel, sand, silt, and clay. However, each of these size fractions can be subdivided further so that additional characteristics of the size distribution (e.g., mean diameter, skewness, and kurtosis) can be determined. Additionally, this procedure describes wet sieving protocols used when trace metals analysis are to be performed on the sieved fractions.

1.2. Detection limits are determined from accuracy of analytical balances. Samples are weighed to the nearest 0.01g and results are reported to the nearest 0.01 percent.

2. METHOD SUMMARY

2.1. Particle size is used to characterize the physical characteristics of sediments. Because particle size influences both chemical and biological variables, it can be used to normalize chemical concentrations according to sediment characteristics and to account for some of the variability found in biological assemblages. Particle size is also an important variable for marine engineering purposes. In addition to Plumb (1981), other references discuss the uses and measurement of particle size (e.g., Krumbein and Pettijohn 1938; Folk 1968; Buchanan 1984).

2.2. Particle size determinations can either include or exclude organic material. If organic material is removed prior to analysis, the "true" (i.e., primarily inorganic) particle size distribution is determined. If organic material is included in the analysis, the "apparent" (i.e., organic plus inorganic) particle size distribution is determined. Because true and apparent distributions may differ, detailed comparisons between samples analyzed by these different methods are questionable. It is therefore desirable that all samples within each study (at a minimum) and among different studies (if possible) be analyzed using only one of these two methods.

3. DEFINITIONS

3.1. Particle size – The size of various solid components making up sediment, as named in the applicable method reference (gravel, sand, silt, clay, etc.).

3.2. True particle size – The particle size determined when organic material is removed prior to analysis.

3.3. Apparent particle size – The particle size determined when organic material is not removed prior to analysis.

3.4. 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.

3.5. Laboratory Triplicates – Triplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative standard deviation (RSD) between the sample and its duplicates are calculated and used to assess analytical precision.

4. INTERFERENCES

Depending on the required particle size distribution, organic material can be an interference.

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 CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Samples can be collected in glass or plastic containers. A minimum sample size of 100-150g is recommended. If unrepresentative material is to be removed from the sample, it should be removed in the field under the supervision of the chief scientist and noted on the field log sheet.

6.2. Samples should be stored at 4 ± 2 °C, and can be held for up to 6 months before analysis. Samples must not be frozen or dried prior to analysis, as either process may change the particle size distribution.

7. APPARATUS AND EQUIPMENT

7.1. Sieve shaker - Ro-Tap or equivalent

7.2. Drying oven

7.3. Constant temperature bath

7.4. Analytical balance - 0.1mg accuracy

7.5. Desiccator

7.6. Clock - with second hand

7.7. Standard sieves - Appropriate mesh sizes, sieve pan and top, sieve brush.

7.8. Funnel

7.9. Graduated cylinders

7.10. 250-mL beakers

7.11. 20-mL pipettes

7.12. Water pique or squirt bottle

7.13. Glossy paper

7.14. 1000 mL Polycarbonate Centrifuge Bottles

7.15. Centrifuge - With buckets appropriate for 1000 mL bottles

7.16. 1000 mL Glass Beakers

7.17. Thermometer capable of reading to ± 0.5ºC, Verification performed internally per the SOP *Support Equipment Monitoring and Calibration (*ADM-SEMC).

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. 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.

8.2. Dispersant - 1 percent sodium hexamethaphosphate = 1 percent commercially available Calgon. To prepare, weigh 10.0g sodium hexamethaphosphate and dilute to 1.0L in DI Water.

8.3. Distilled water

8.4. Reagent grade Hydrogen Peroxide, 30 percent.

8.5. Ten percent hydrogen peroxide; One part H_2O_2 to two parts DI Water.

9. PREVENTIVE MAINTENANCE

9.1. No specific maintenance steps are needed for sieves other than normal cleaning and inspection.

9.2. Balance calibration checks are performed daily.

9.3. Color-indicating desiccant is recommended so that spent desiccant can be detected easily. The desiccant needs to be changed every 3 weeks to ensure its effectiveness. Also, the seal on the desiccator should be checked periodically, and, if necessary, the ground glass rims should be greased or the "0" rings should be replaced.

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 for Documentation of Training (ADM-TRANDOC).

11. PROCEDURE (Particle Size Fractionation)

11.1. Sample Preparation

11.1.1. Unless specifically asked for, organic oxidation is not performed and the apparent particle size distribution is determined.

11.1.2. It is critical that each sample be homogenized thoroughly in the laboratory before a subsample is taken for analysis. Laboratory homogenization should be conducted even if samples were homogenized in the field.

11.1.3. The total amount of sample used for analysis should be 25-100g. Refer to section 12.1 for a discussion of use of alternate sample sizes.

11.1.4. If True Particle size analysis is requested, place sample aliquot into a large beaker (1 to 2 Liter) and add 20 milliliters of ten percent hydrogen peroxide. Let the sample stand until frothing ceases and then add an additional 10 ml of hydrogen peroxide. Continue the incremental addition of hydrogen peroxide until no frothing occurs on addition.

11.1.5. Boil the sample to remove any excess hydrogen peroxide. This should be done in a large beaker to prevent sample loss due to boiling over or frothing.

11.2. Analysis

11.2.1. Particle size determination is determined by four similar methods using this SOP. They include Puget Sound Estuary Protocols; condensed version and expanded version, and ASTM D422 Modified; condensed version and expanded version. The differences between these methods are explained below:

11.2.1.1. Puget Sound Estuary Protocol (Condensed Version): Course particle size fractions are determined by using the following standard sieves: 10, 18, 35, 60, 120, and 230. The silt/clay portion of the sample is determined by pipette extraction using the withdrawal times given in Table 1.

11.2.1.2. Puget Sound Estuary Protocol (Expanded Version): Course particle size fractions are determined by using the following standard sieves: 10, 18, 35, 60, 120, and 230. The silt/clay portions of the sample are broken down into subdivisions and are determined by pipette extraction using the withdrawal times given in Table 2.

11.2.1.3. ASTM D422 Modified (Condensed Version): Course particle size fractions are determined by using the following standard sieves: 4, 10, 20, 40, 60, 140, and 200. The silt/clay portion of the sample is determined by pipette extraction using the withdrawal times given in Table 1.

11.2.1.4. ASTM D422 Modified (Expanded Version): Course particle size fractions are determined by using the following standard sieves: 4, 10, 20, 40, 60, 140, and 200. The silt/clay portions of the sample are broken down into subdivisions and are determined by pipette extraction using the withdrawal times given in Table 2.

11.2.2. Weigh sample as received. Record the balance ID on the benchsheet.

11.2.3. Total solids using the procedure described in the SOP GEN-160.3 (Total Solids) are determined at the same time the sample is weighed out.

11.2.4. Wet sieve through the appropriate (200 or 230) sieve, washing what goes through into a 1000mL graduated cylinder.

11.2.5. Add 10mL of a 1% sodium hexametaphosphate solution to cylinder.

11.2.6. Retain what was left on the 200 (or 230) sieve (gravel/sand fraction). Wash into a preweighed 250-ml beaker, and dry in 105ºC oven to dryness. Dry sieve through the applicable sieves (see 11.2.1). After dry-sieving a sample, all material must be removed from the sieve. This can be accomplished by tapping the rim of the sieve evenly on a hard surface and by brushing the screen.

11.2.7. Silt-clay fraction:

Note: Before pipette extractions can be made, the sample must be homogenized thoroughly within the settling cylinder. Once the pipette analysis begins, the settling cylinders must not be disturbed, as this will alter particle settling velocities. Care must be taken to disturb the sample as little as possible when pipette extractions are made.

11.2.7.1. After sample is brought to 1L and mixed, it is left on the counter and the temperature is tracked with a thermometer in a graduated cylinder with DI water. The temperature does not usually vary by more than ± 2°C from the start to the completion of the pipette analysis.

11.2.7.2. Withdrawal times for pipette analysis as a function of particle size and water temperature are given in Tables 1 and 2. Shake for 1 minute and take a 20mL aliquot at 20cm deep at 20 seconds.

11.2.7.3. Take 20mL aliquots at 10cm at differing times according to temperature of the suspension (see the attached sheets for specific times).

11.2.7.4. If the condensed analysis is wanted (silt & clay) only use 4 and 8 phi/times (Table 1). If the expanded analysis is wanted, refer to Table 2 for phi sizes and times.

11.2.7.5. After a pipette extract has been transferred to a drying beaker, any sample adhering to the inside of the pipette must be removed. This can be accomplished by drawing 20mL of distilled water into the pipette and adding this rinse water to the drying beaker.

11.2.8. Dried samples should be cooled in a desiccator and held there until they are weighed. If a desiccator is not used, the sediment will accumulate ambient moisture and the sample weight will be overestimated. A color-indicating desiccant is recommended so that spent desiccant can be detected easily.

12. PROCEDURE (Preparation for trace metals analysis)

12.1. Special Considerations

12.1.1. Metal sieves must not be used when preparing samples for trace metals analysis. Polymer mesh and pans are to be utilized.

12.1.2. Site water related to the samples being prepared is recommended for the wet sieving procedure. However, if site water is not available laboratory dionized water can be used.

12.1.3. Decontamination of all equipment that comes in contact with the sample must be performed prior to initiating the sieving. Rinse with 25% hydrochloric acid, followed by a minimum of 3 DI water rinses.

12.2. Analysis (Dry Sieve for Fractions >63 um)

12.2.1. Follow protocol described in Section 11, but include considerations listed in Section 12.1.

12.3. Analysis (Wet Sieve for ≤ 63 um Fraction)

12.3.1. Place an aliquot of sample onto the appropriate size sieve (sieve sized to be determined on a project specific basis).

12.3.2. Using a squirt bottle filled with the specified rinse solution (i.e. site or DI water) wash the sample through the sieve. Use a plastic funnel to capture the target sample fraction in a 1000 mL polycarbonate centrifuge bottle.

12.3.3. When sufficient sample has been captured, centrifuge the polycarbonate bottle then pour off and discard the supernatant. Transfer the remaining sample to an appropriate sized glass jar (i.e. 8 oz., 16 oz., etc.) clearly labeled with the sample I.D. and particle size fraction information. Store at 4±2°C.

12.3.4. The remaining sample is now ready for trace metals determination. (Note: The variety and combinations of trace metals analyses that can be performed vary widely, so subsequent analytical procedures will be defined on a project specific basis.) If further particle size reduction in needed an aliquot is retained for analysis. The remaining sample is then processed once more as described above using the next smaller sieve size as designated in the project plan.

12.3.5. So the final results can be reported on a dry weight basis perform a total solids determination on each fraction being analyzed for trace metals.

13. QUALITY CONTROL

13.1. The total amount of fine-grained material used for pipette analysis should be 5-25g. If more material is used, particles may interfere with each other during settling and the possibility of flocculation may be enhanced. If less material is used, the experimental error in weighing becomes large relative to the sample size.

13.2. It is recommended for Puget Sound Protocols that triplicate analyses be conducted on one of every 20 samples, or one sample per batch if less than 20 samples are analyzed. For ASTM Modified, it is recommended that duplicate analyses be conducted on one of every 20 samples, or one sample per batch is less than 20 samples are analyzed.

13.2.1. Calculate Relative Percent Difference (RPD) as:

$$\%\,RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1= Higher Result
R2= Lower Result

13.2.2. Calculate Relative Standard Deviation (RSD) as:

$$\%RSD = \frac{stddev}{mean} \times 100$$

13.2.3. The acceptance range for %RPD or %RSD is ≤ 20%. If the RPD is within the acceptance range, the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.

14. DATA REDUCTION, REVIEW, AND REPORTING

14.1. Calculations

14.1.1. The total weight of a phi-size interval in the 1-L graduated cylinder is determined as follows:

Phi weight (g dry weight) = 50[(A-C)-(B-C)]

Where: A = weight (g) of residue in a 20-mL aliquot for a given phi-size boundary
B = weight (g) residue in a 20-mL aliquot for the next larger phi-size boundary
C = mean weight (g) of dispersant in a 20-mL aliquot.

14.2. The data is entered into a spreadsheet and results determined using the appropriate equations.

14.3. Reporting and review

14.3.1. The weight of each sediment fraction should be reported to the nearest 0.0001g dry weight. The laboratory should report the results of all samples analyzed (including QA replicates) and should note any problems that may have influenced data quality.

14.3.2. 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 for samples (above). These results are then used to calculate QC determinations

14.3.3. The results are entered directly onto the appropriate Reporting/EDD forms located in the CAS network directory R:\WET\ANALYSES\GRAINSIZE\TEMPLATE. Once the results are transferred, the data and report are reviewed.

14.4. Data Review and Assessment

14.4.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

15. CORRECTIVE ACTION

15.1. Refer to the SOP for Corrective Action (ADM-CA) 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.

15.2. Handling out-of-control or unacceptable data

15.3. 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.

15.4. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

16. TRAINING

16.1. Training outline

16.1.1. 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.

16.1.2. 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.

16.1.3. Independently perform the analyses. For Initial Demonstration of Capability the data must be reviewed by a supervisor and the supervisor must document that the analyst is trained.

16.2. Training is documented following the *SOP for Documentation of Training.*

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. There are no known modifications in this laboratory standard operating procedure from the reference method described in the PSEP based upon Plumb 1981.

17.2. ASTM D422 does not use pipettes to determine the fractions but rather uses hydrometers. This SOP allows the use of the same sieve sizes as used in ASTM D422 but uses the pipette procedure from Plumb to determine the fractions.

18. REFERENCES

18.1. Conventional Sediment Variables - Particle Size, March 1986, *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, January, 1996.

18.2. *Procedures for Handling and Chemical Analysis of Sediment and Water Samples*, R.H. Plumb, prepared for USEPA and Army Corps of Engineers, May, 1981.

18.3. ASTM Procedure D422.

18.4. Related Documents – These documents are used in the laboratory to support this procedure and are reviewed at the same time this SOP is reviewed each year.

FILE NAME

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM CB special form.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM CB.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM EB.XLS

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\HYDEDD-PSEP.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB apparent.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB Teck.xlt

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB True.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB.xlt

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB Clark County.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB10-230.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB4-230.xlt

19. CHANGES SINCE THE LAST REVISION

19.1. Sec 1.1 – added modified to ASTM D422

19.2. Sec 3.4 and 3.5 are new
19.3. Sec 7.16 and 7.17 added to list
19.4. Sec 8.1, 8.4 and 8.5 are new
19.5. Sec 9.3 – second sentence is new
19.6. Sec 11.1.4 and 11.1.5 are new
19.7. Sec 11.2.2 – added the requirement to record balance ID
19.8. Sec 11.2.7.1 –edited last sentence for clarity
19.9. Sec 11.2.3 is new
19.10. Sec 12.1.3 –added 3 DI rinses
19.11. Sec 13.2.1 – 13.2.3 are new
19.12. Sec 14.4 is new
19.13. Sec 13 renamed
19.14. Sec 15 on Corrective Action added
19.15. Sec 17 is new

Table 1

Withdrawal Times for Pipette Analysis as a Function of Particle Size and Water Temperature
Silt & Clay Fraction – Condensed Analysis

Micron μm	Diameter finer than (phi)	Diameter finer than (μm)	Withdrawal depth (cm)	Elapsed time for withdrawal of sample in hours (h), minutes (m), and seconds(s).						
				18°C	19°C	20°C	21°C	22°C	23°C	24°C
62.5	4.0	62.5 - 3.9	20	20s	20s	20s	20s	20s	20s	20s
3.9	8.0[a]	3.9	10	2h8m	2h5m	2h2m	1h59m	1h56m	1h53m	1h51m

Table 2

Withdrawal Times for Pipette Analysis as a Function of Particle Size and Water Temperature
Silt & Clay Fraction – Expanded Analysis

Micron μm	Diameter finer than (phi)	Diameter finer than (μm)	Withdrawal depth (cm)	Elapsed time for withdrawal of sample in hours (h), minutes (m), and seconds(s).						
				18°C	19°C	20°C	21°C	22°C	23°C	24°C
62.5	4.0	62.5	20	20s	20s	20s	20s	20s	20s	20s
31.2	5.0	31.2	10	2m0s	1m57s	1m54s	1m51s	1m49s	1m46s	1m44s
15.6	6.0	15.6	10	8m0s	7m48s	7m36s	7m25s	7m15s	7m5s	6m55s
7.8	7.0	7.8	10	31m59s	31m11s	30m26s	29m41s	28m59s	28m18s	27m39s
3.9	8.0[a]	3.9	10	2h8m	2h5m	2h2m	1h59m	1h56m	1h53m	1h51m
1.95	9.0	1.95	10	8h32m	8h18m	8h6m	7h56m	7h44m	7h32m	7h22m
0.98	10.0	0.98	10	34h6m	33h16m	32h28m	31h40m	30h56m	30h12m	29h30m

a) Breakpoint between silt and clay.

METALS DIGESTION METHOD 3050B

MET-3050B

ALS-KELSO

SOP ID: MET-3020a Rev. Number: 13 Effective Date: 12/1/2012

Approved By: _____ Date: 11/28/12
Department Supervisor - Jeff Coronado

Approved By: _____ Date: 11/28/12
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Approved By: _____ Date: 11/29/12
Laboratory Director - Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

Standard Operating Procedure

For

METALS DIGESTION – 3050B

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 (HNO_3) and hydrogen peroxide (H_2O_2). 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

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, 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. APPARATUS AND EQUIPMENT

7.1. 125 mL plastic cup beaker cup, calibrated at 50mL and 100mL

7.2. Borosilicate watch glasses

7.3. Block Digester, calibrated to maintain 95°C ± 2°C

7.4. Hot Plates: "Thermolyne Cimerac 3", calibrated to maintain 95°C ± 2°C

7.5. Laboratory balance, top-loader capable of reading 0.01g

7.6. Evergreen disposable tubes 50 ml: 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.

7.7. USS # 10 sieve.

8. STANDARDS AND REAGENTS

8.1. 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.

8.2. Reagent water: ASTM Type I water (resistivity ≥18 MΩ-cm, conductivity ≤0.056 uS/cm).

8.3. Concentrated Nitric Acid: J.T. Baker "Instra-analyzed", Trace Metals Grade

8.4. Concentrated Hydrochloric Acid: EMD GR ACS

8.5. Hydrogen Peroxide (30%): EMD GR ACS

8.6. Standards

8.6.1. 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.

8.6.2. Metals spiking solutions: Five spiking solutions are needed to prepare the matrix spike sample; SS1, SS2, SS3, SS4, and SS5.

8.6.3. Follow the formulations laid out on the "Metals Spike Form" (see Attachments for example). 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.

8.6.4. 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.

8.6.5. 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.

8.6.6. SS3 (As, Se, and Tl): 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. 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.

8.6.7. 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.

8.6.8. 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.

8.7. Metals reference material (ERA Priority PollutnT/CLP Inorganic Soil) for use as the laboratory control sample. The expiration date is assigned by the manufacturer.

8.8. Teflon beads, Teflon boiling chips, or other suitable blank material.

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.

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.

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 ≥18 M□-cm, conductivity ≤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 sludge's 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 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.

For ICP and ICP-MS digestions 1.0 mL of SS1 and 0.50 mL of SS3 and SS4 are added to the sample aliquot designated as the matrix spike sample. The matrix spike sample is then digested as per the procedure.
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. 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).

14. CORRECTIVE ACTION

14.1. Refer to the SOP for *Corrective Action* 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. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when: a) corrective action is not taken or not possible b) corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis c) reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15. METHOD PERFORMANCE

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.

16. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. 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 solvent and reagents used in this method can be minimized when recycled or disposed of properly.

17. WASTE MANAGEMENT

17.1. 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.

17.2. 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.

18. TRAINING

18.1. Training outline

18.1.1. 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.

18.1.2. 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.

18.1.3. 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.

18.2. 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.

19. METHOD MODIFICATIONS

19.1. The method uses 2 mL of water and 3 mL of H_2O_2 in step 11.6. The lab does not add the 2 mL of water. 3.0 mL aliquots of 30% H_2O_2 in lieu of 1.0 mL aliquots are added subsequently.

20. REFERENCES

20.1. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA SW-846, 3rd Edition, Final Update III, Method 3050B, December 1996.

20.2. Table A - METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

21. CHANGES SINCE THE LAST REVISION

21.1. Reformatted to ALS style.
21.2. Sec. 11.5: Changed wording to reflect hotplate temperature monitoring per batch

Table A

METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

Solution Name	Element	mLs of 1000ppm Solution	Final Volume	Solution Conc. mg/L	Concentration in the digest mg/L
SS1	HNO3	50.0	1000ml	-	
	Al	100*	1000ml	200	2
	Ag	100*	1000ml	5	0.05
	Ba	100*	1000ml	200	2
	Be	100*	1000ml	5	0.05
	Cd	100*	1000ml	5	0.05
	Co	100*	1000ml	50	0.5
	Cr	100*	1000ml	20	0.2
	Cu	100*	1000ml	25	0.25
	Fe	100*	1000ml	100	1
	Pb	100*	1000ml	50	0.5
	Mn	100*	1000ml	50	0.5
	Ni	100*	1000ml	50	0.5
	Sb	50	1000ml	50	0.5
	V	100*	1000ml	50	0.5
	Zn	100*	1000ml	50	0.5
SS2	HNO3	25.0	500ml	-	
GFAA SPIKE	As	2.0	500ml	4	0.04
	Cd	2.0	500ml	4	0.04
	Pb	2.0	500ml	4	0.04
	Se	2.0	500ml	4	0.04
	Tl	2.0	500ml	4	0.04
	Cu	2.0	500ml	4	0.04
SS3	HNO3	25.0	500ml	-	
	As	50.0	500ml	100	1
	Se	50.0	500ml	100	1
	Tl	50.0	500ml	100	1
SS4	HNO3	25	500ml	-	
	B	50	500ml	100	1
	Mo	50	500ml	100	1

* Denotes volume of mixed stock standard.
** Denotes 10,000 ppm individual stock standards.

DETERMIMATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUOPLED PLASMA-MASS SPECTROMETRY (ICP-MS)

MET-6020

ALS-KELSO

SOP ID:	MET-6020	Rev. Number:	15	Effective Date:	07/31/2013

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Approved By: _____ Date: 7/16/13
Laboratory Director - Jeff Grindstaff

Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

For

DETERMIMATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP-MS) 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. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL) and Practical Quantitation Limit (PQL). Therefore, MRL=EQL=PQL. 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 SUMMARY OF METHOD

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.

3.2 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.

3.3 **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.

3.4.4 Nonaqueous Liquid – Any organic liquid with <15% settleable solids.

3.4.5 Animal tissue – Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.4.6 Solids – Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.4.7 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.

3.4.8 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.

3.5 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 mid point of the calibration range or at levels specified by a project analysis plan.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

3.10 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

3.11 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.

3.12 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.

3.13 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 isoptope.

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 APPARATUS & EQUIPMENT

7.1 Instruments: Thermo Elemental ExCell (K-ICP-MS-02) Serial # EX191, Thermo Elemental X-Series (K-ICP-MS-03) Serial # X0193, and NexION 300D (K-ICP-MS-04).

7.2 Thermo Meinhard type (Part # 1201318)

7.3 Thermo Impact Bead Quartz Spray Chamber (Part # 3600170)

7.4 Thermo X7 Nickel Sample Cone (1.0 mm orifice) (Part # 3004661), or Xi sample cone (part # 3600812)

7.5 Thermo X7 Nickel Skimmer Cone (0.75 mm orifice) (Part # 3200860) or Xi skimmer cone(part # 3600811)

8 STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1 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.

8.1.1 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.

8.1.2 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.

8.1.3 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.

8.2 Standards Preparation

8.2.1 Expiration of all standard solutions defaults to the earliest expiration date of an individual component unless otherwise specified.

8.2.2 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).

8.2.3 Initial Calibration Verification (ICV)

8.2.3.1 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.

8.2.3.2 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.

8.2.4 Interference Check Solutions (ICSA and ICSAB)

8.2.4.1 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.

8.2.4.2 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.

8.2.5 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.

8.2.6 Refer to the appropriate digestion SOP for details of LCSW and matrix spike solution composition and preparation.

8.2.7 Tuning / Mass Calibration Solution

8.2.7.1 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.

8.2.7.2 The working solution is prepared in three ways:

- For the ExCell (K-ICP-MS-02) 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.

8.3 Internal Standards Stock Solution – Prepare a 10 µg/mL solution containing ^{71}Ga, ^{115}In, ^{6}Li, ^{175}Lu, ^{103}Rh ^{45}Sc, and ^{89}Y by adding 10.0 mL 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 ration 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.

8.4 Additional Reagents

8.4.1 Reagent water, ASTM Type II

8.4.2 "OmniTrace Ultra" Concentrated Nitric Acid (EM Science # NX0408-2)

8.4.3 Argon (Airgas Industrial Grade – 99.999% pure, bulk delivered)

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

11.4.1.1Allow 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 8.2.7.2 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 10% 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 1. 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% to 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. See the Attachments for a listing of control 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. The matrix spike recovery and relative percent difference will be calculated while analysis is in progress. See the Attachments for a listing of control limits. 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 and are listed in Table 2. 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, REPORTING, AND REVIEW

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:

$$\mu g / L\ (Sample) = C^{*} \text{ x Digestion Dilution Factor x Post Digestion Dilution Factor}$$

C*= Concentration of analyte as measured at the instrument in ug/L (in digestate).

Solid samples are reported in mg/Kg:

$$mg/Kg\ (Sample) = C^{*} \text{ x Post Digestion Dilution Factor } x \frac{Digestion\ Vol.(ml)}{Sample\ wt.(g)} x \frac{1mg}{1000ug} x \frac{1L}{1000ml} x \frac{1000g}{1Kg}$$

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 *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 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.

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 TRAINING

16.1 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.

16.2 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.

16.3 Training outline

16.3.1 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.

16.3.2 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.

16.3.3 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.

16.4 Training and proficiency is documented in accordance with the SOP ADM-TRANDOC.

17 POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1 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.

17.2 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.

18 METHOD MODIFICATIONS

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

19 CHANGES SINCE THE LAST REVISION

19.1 Reformatted to ALS branding.
19.2 Replaced "CAS" references with "ALS".
19.3 Updated SOP references.
19.4 Sec. 1.1: Removed reference to annual studies, replaced with "new".
19.5 Sec. 7.1: Added NexION 300D.
19.6 Sec 8.2.7.1: Removed Ba and Tl from the intermediate solution; added Ce.
19.7 Sec 8.2.7.2: Added NexION working solution prep.
19.8 Sec. 8.3.2.1: Revised ICV int. stock sol. prep instructions.
19.9 Sec. 8.2.7.1/2: Updated solution prep instructions.
19.10 Sec. 12.8: Added description of NexION IS correction.
19.11 Sec. 18: New.

20 REFERENCES

20.1 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III Method 6020, Revision 0, September 1994.

20.2 USEPA, Test Methods for Evaluating Solid Waste, SW-846, Update IV, Method 6020A, Revision 1, February 2007.

20.3 VG and Thermo Elemental Instrument Manuals

TABLE 1
Method Reporting Limits and Method Detection Limits – Water Matrix

	Water (ug/L)			Water (ug/L)			Seawater (ug/L)		
	CLP Digestion			3020 Digestion			Reductive Precipitation		
Analyte	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**
Aluminum	2	**2**	**0.3**	2.4	**2**	**0.8**	–	**–**	**–**
Antimony	0.09	**0.05**	**0.03**	0.09	**0.05**	**0.03**	–	**–**	**–**
Arsenic	0.5	**0.5**	**0.08**	0.5	**0.5**	**0.07**	0.5	**0.5**	**0.02**
Barium	0.06	**0.05**	**0.02**	0.12	**0.05**	**0.04**			
Beryllium	0.02	**0.02**	**0.008**	0.02	**0.02**	**0.006**	0.02	**0.02**	**0.0007**
Bismuth	0.1	**0.1**	**0.02**	–	**–**	**–**	–	**–**	**–**
Boron	0.9	**0.5**	**0.3**	–	**–**	**–**	–	**–**	**–**
Cadmium	0.02	**0.02**	**0.008**	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.006**
Chromium	0.2	**0.2**	**0.07**	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Cobalt	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.001**
Copper	0.1	**0.1**	**0.02**	0.21	**0.1**	**0.07**	0.1	**0.1**	**0.03**
Lead	0.03	**0.02**	**0.009**	0.06	**0.05**	**0.02**	0.02	**0.02**	**0.003**
Manganese	0.06	**0.05**	**0.02**	0.05	**0.05**	**0.01**	–	**–**	**–**
Molybdenum	0.09	**0.05**	**0.03**	0.09	**0.05**	**0.03**	–	**–**	**–**
Nickel	0.2	**0.2**	**0.07**	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Selenium	1.2	**1**	**0.4**	1	**1**	**0.2**	–	**–**	**–**
Silver	0.03	**0.02**	**0.009**	0.03	**0.02**	**0.009**	0.02	**0.02**	**0.004**
Thallium	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.004**	0.02	**0.02**	**0.0009**
Tin	0.1	**0.1**	**0.04**	–	**–**	**–**	–	**–**	**–**
Uranium	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.004**	–	**–**	**–**
Vanadium	0.2	**0.2**	**0.08**	0.2	**0.2**	**0.05**	–	**–**	**–**
Zinc	0.5	**0.5**	**0.1**	0.6	**0.5**	**0.2**	0.5	**0.5**	**0.04**

TABLE 1 (continued)
Method Reporting Limits and Method Detection Limits – Solid Matrix

	Soil/Sediment (mg/kg)			Tissue (mg/kg, dry basis)		
	3050 Digestion			PSEP		
Analyte	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**
Aluminum	2	**2**	**0.5**	2	**2**	**0.4**
Antimony	0.09	**0.05**	**0.03**	0.06	**0.05**	**0.02**
Arsenic	0.5	**0.5**	**0.1**	0.5	**0.5**	**0.05**
Barium	0.09	**0.05**	**0.03**	0.15	**0.05**	**0.05**
Beryllium	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.005**
Bismuth	0.1	**0.1**	**0.02**	–	–	–
Cadmium	0.02	**0.02**	**0.008**	0.03	**0.02**	**0.01**
Chromium	0.2	**0.2**	**0.04**	–	–	–
Cobalt	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.006**
Copper	0.3	**0.1**	**0.1**	0.1	**0.1**	**0.03**
Lead	0.06	**0.05**	**0.02**	0.02	**0.02**	**0.006**
Manganese	0.12	**0.05**	**0.04**	0.06	**0.05**	**0.02**
Molybdenum	0.15	**0.05**	**0.05**	0.06	**0.05**	**0.02**
Nickel	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Selenium	2	**1**	**0.4**	–	–	–
Silver	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.006**
Thallium	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.005**
Tin	0.2	**0.1**	**0.06**	–	–	–
Uranium	0.02	**0.02**	**0.004**	0.02	**0.02**	**0.007**
Vanadium	0.2	**0.2**	**0.04**	0.2	**0.2**	**0.04**
Zinc	0.6	**0.5**	**0.2**	1.2	**0.5**	**0.4**

ATTACHMENTS

List of Target Element Masses

Example Standard Sheet

QC Acceptance Criteria

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

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
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MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

METALS ANALYSES						
Method	Prep Method	Matrix	Analyte	LCS Accuracy (% Rec.)	Matrix Spike (% Rec.)	Precision (RPD)
6020	3050B	Soil	Aluminum	41-158	75-125*	20
6020	3050B	Soil	Antimony	50-150	10-103	20
6020	3050B	Soil	Arsenic	78-122	57-133	20
6020	3050B	Soil	Barium	81-119	54-173	20
6020	3050B	Soil	Beryllium	83-117	64-133	20
6020	3050B	Soil	Boron	67-133	75-125*	20
6020	3050B	Soil	Cadmium	81-119	68-137	20
6020	3050B	Soil	Chromium	80-119	34-175	20
6020	3050B	Soil	Cobalt	82-118	74-118	20
6020	3050B	Soil	Copper	83-116	22-181	20
6020	3050B	Soil	Lead	79-121	27-178	20
6020	3050B	Soil	Manganese	81-119	75-125*	20
6020	3050B	Soil	Molybdenum	75-125	53-143	20
6020	3050B	Soil	Nickel	81-118	59-132	20
6020	3050B	Soil	Selenium	80-120	65-125	20
6020	3050B	Soil	Silver	66-134	62-131	20
6020	3050B	Soil	Thallium	79-120	70-128	20
6020	3050B	Soil	Uranium	80-120*	75-125*	20
6020	3050B	Soil	Vanadium	79-121	59-142	20
6020	3050B	Soil	Zinc	73-121	37-162	20
6020	CLP/3020A	Water	Aluminum	85-120	56-143	20
6020	CLP/3020A	Water	Antimony	91-112	66-133	20
6020	CLP/3020A	Water	Arsenic	89-112	72-129	20
6020	CLP/3020A	Water	Barium	92-111	86-117	20
6020	CLP/3020A	Water	Beryllium	81-122	73-125	20
6020	CLP/3020A	Water	Cadmium	92-111	87-113	20
6020	CLP/3020A	Water	Chromium	88-113	60-136	20
6020	CLP/3020A	Water	Cobalt	87-114	84-115	20
6020	CLP/3020A	Water	Copper	89-113	62-130	20
6020	CLP/3020A	Water	Lead	90-112	76-117	20
6020	CLP/3020A	Water	Manganese	89-115	25-180	20
6020	CLP/3020A	Water	Molybdenum	66-135	67-138	20
6020	CLP/3020A	Water	Nickel	89-113	78-117	20
6020	CLP/3020A	Water	Selenium	87-115	47-150	20
6020	CLP/3020A	Water	Silver	64-134	55-136	20
6020	CLP/3020A	Water	Thallium	78-123	75-121	20
6020	CLP/3020A	Water	Vanadium	87-113	82-119	20
6020	CLP/3020A	Water	Zinc	86-119	65-126	20

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)
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SRM = NIST 2711, Montana Soil Spike Solution = _____

Analyst:_____ Date:_____

Reviewer:_____ Date:_____

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

MET-ICP

ALS-KELSO

SOP ID:	MET-ICP	Rev. Number:	24	Effective Date:	12/1/2012

Approved By: _____ Date: 11/26/12
Department Manager – Jeff Coronado

Approved By: _____ Date: 11/26/12
QA Manager – Suzanne LeMay

Approved By: _____ Date: 11/27/12
Laboratory Director – Jeff Grindstaff

Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

For

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 QAPPs 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 **Analysis Sequence** - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration followed by sample digestates interspersed with calibration standards.

3.2 **Independent Calibration Verification** (ICV) - ICV solutions are made from stock solutions different from the stock used to prepare calibration standards and are used to verify the validity of the standardization.

3.3 **Laboratory Control Sample** (LCS): A laboratory blank that has been fortified with target analyte and used to determine that the analysis is in control. For solids, a reference material may be used unless prohibited by project protocols.

3.4 **Matrix Spike** (MS) - In the matrix spike analysis, predetermined quantities of standard solutions of certain analytes are added to a sample matrix prior to sample digestion and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. Percent recoveries are calculated for each of the analytes detected.

3.5 **Matrix Spike Duplicate** (MSD) - In the matrix spike duplicate analysis, predetermined quantities of standard solutions of certain analytes are added to a sample matrix prior to sample digestion and analysis. The purpose of the matrix spike duplicate is to evaluate the effects of the sample matrix on the methods used for the analyses. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the matrix spikes is calculated and used to assess analytical precision.

3.6 **Duplicate Sample** (DUP) - A laboratory duplicate 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.

3.7 **Method Blank** - The method blank is an artificial sample designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

3.8 **Continuing Calibration Verification Standard (CCV)** - A standard analyzed at specified intervals and used to verify the ongoing validity of the instrument calibration.

3.9 **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.

3.10 **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.

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. A face shield is required when working with Hydrofluoric Acids.

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 APPARATUS & EQUIPMENT

7.1 Inductively Coupled Plasma Atomic Emission Spectrometer

7.1.1 Thermo Scientific ICAP 6500 (AES-03).
7.1.2 Thermo Scientific ICAP 6500 (AES-04).

7.2 Concentric nebulizers.

7.3 Microflow nebulizer for ICAP 6500.

7.4 Torches and injector tips for each ICP.

7.5 Cyclonic spray chambers for each instrument.

7.6 Water coolers for each ICP.

7.7 Argon Humidifiers for the ICAP 6500.

7.8 ESI SC4 DX Autosampler with Fast System for ICAP 6500.

7.9 Peristaltic Pumps for each Spectrometer.

7.10 RF Generators for each ICP (internal on the ICAP 6500).

8 STANDARDS, REAGENTS, & CONSUMABLE MATERIALS

8.1 Standards Preparation

8.1.1 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.

8.1.2 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 autopipettors. 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.

8.1.3 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.

8.1.4 Initial Calibration Verification (ICV) Standards

The ICV working standards are produced by direct dilution of three certified mixed stock solutions (QCP-CICV1, QCP-CICV2, 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.

8.1.5 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.

8.1.6 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.

8.1.7 The solutions and materials used for the LCS and matrix spikes are described in the applicable digestion SOP.

8.1.8 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.

8.2 High Purity Argon.

8.3 Capillary, rinse and peristaltic pump tubing.

8.4 17 x 100mm polypropylene test tubes.

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 with fused silica.

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 or CRI, CCV, CCB, ICSA, ICSAB, routine samples.

11.3.2 Evaluate the initial QC using the following criteria:

11.3.2.1For 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: $StdDev_{ccv}$ = Standard deviation of the replicate integrations
$Average_{ccv}$ = 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 and results must verify within 20% 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. The LLICV is used for Method 6010C.

- 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 ALS SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL.)*

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 1-4X 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 should be verified quarterly 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 method 200.7, the LCS recovery criterion is 85-115% for water samples. For method 6010B/C, the control limits are 80-120% or in-house calculated limits. 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. In all cases, project-specific QC limits may be required. 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. The default criteria may be used if statistically generated criteria are broader or insufficient points are available for accurate statistical limits. Currently, statistically generated criteria are broader and the default is used for all elements but Manganese, for which the limit is 17% RPD. The RPD criteria are <30% for soil samples and <20% for water samples for methods 200.7 and 6010B. The RPD criteria is <20% for both soils and waters for method 6010C. Criteria are subject to change as statistical data are generated. 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. Matrix spike recovery criteria for method 200.7 is 70-130% for both water and soil samples. For 6010B, the control limits are derived from lab data and are listed in Table 2. For 6010C, the control limits are 75-125% or in-house calculated limits. For CLP, use the prescribed limits for the SOW in use. In all cases, project-specific QC limits may be required. If the recovery is outside acceptance limits, either re-digest 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 A post spike shall be performed for 6010C - Tier III and Tier IV.

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%.

12.9 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 ICAP6500.

Aqueous samples are reported in µg/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:

$$mg/Kg(Sample) = C^{*} \; x \; PostDigestionDilutionFactor \; x \; \frac{DigestionVol(ml)}{Samplewt(g)} \; x \; \frac{1L}{1000ml} \; x \; \frac{1000g}{1Kg}$$

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.

$$Hardness, mg\ equivalent CaCO_3/L = 2.497[Ca, mg/L] + 4.118[Mg, mg/L]$$

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 CORRECTIVE ACTION

14.1 Refer to the SOP for *Non Conformity and Corrective Action* 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 Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15 METHOD PERFORMANCE

This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.

15.1 The method detection limit (MDL) is established using the procedure described in the SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL).* 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 Refer to ADM-TRAIN for standard procedures.

17.2 Training outline

17.2.1 Review literature (see references section). Review 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.

17.2.2 The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of 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.

17.2.3 Perform initial precision and recovery (IPR) study as described in Section 12.1 for water samples. Summaries of the IPR are reviewed and signed by the supervisor.

17.3 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 CHANGES SINCE THE LAST REVISION

19.1 Sec 6.2: Changed hold time after preservation to minimum 24 hours.
19.2 Sec 7.1.1: Removed reference to IRIS.
19.3 Sec 7.1.2: Added Thermo Scientific ICAP 6500 (AES-04).
19.4 Sec 7.6: Removed reference to IRIS.
19.5 Sec 7.7: Removed reference to IRIS.
19.6 Sec 7.10: Removed section.
19.7 Sec 7.11: Removed section.
19.8 Sec. 8.1.2: Removed reference to IRIS.
19.9 Sec 9.3: Removed section.
19.10 Sec 11.1.1: Removed section.
19.11 Sec 11.1.2: Changed reference to include new ICAP 6500.
19.12 Sec 11.2.1: Removed section.
19.13 Sec 11.2.2.5: Removed section.
19.14 Sec 11.2.4: Removed LLICV text.
19.15 Sec 11.3.1.2: Revised QC list.
19.16 Sec 11.3.2.1: Added LLICV test.
19.17 Sec 11.3.4: Removed “or ICS”.
19.18 Sec 12: Added “Internal Standard” section.
19.19 Sec 12.6: Added manual/auto correction using iTEVA software.
19.20 Sec 12.8.2: Added 6010C default limits.
19.21 Sec 12.8.5: Added 6010C default limits.
19.22 Sec 12.8.6: Revised section; changed order in which post spikes and serial dilutions are performed.
19.23 Table 3: Removed.
19.24 Table 5: Revised boron prep instruction.
19.25 Table 7: Removed.

20 REFERENCES/ATTACHMENTS

20.1 USEPA, Contract Laboratory Program, SOW #ILM04.0
20.2 Thermo Jarrell Ash ICAP61 Manual
20.3 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010B, Revision 2, December 1996.
20.4 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010C, Revision 3, February 2007.
20.5 USEPA, Methods for Determination of Metals in Environmental Samples, Supplement I, EPA/600/R-94/111, Method 200.7, Revision 4.4, May 1994.
20.6 *Hardness by Calculation, Method 2340B,* Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.
20.7 Table 1.1, ALS Kelso Data Quality Objectives, 200.7, soil.
20.8 Table 1.2, ALS Kelso Data Quality Objectives, 200.7, water.
20.9 Table 1.3, ALS Kelso Data Quality Objectives, 6010C, water.
20.10 Table 1.4, ALS Kelso Data Quality Objectives, 6010C, soil.
20.11 Table 1.5, ALS Kelso Data Quality Objectives, 6010C LL, soil.

20.12 Table 1.6, ALS Kelso Data Quality Objectives, 6010C LL, water.
20.13 Table 1.7, ALS Kelso Data Quality Objectives, 6010C/PSEP, tissue
20.14 Table 2, Standard A for ICAP 6500 ICP-OES.
20.15 Table 3, ICP ICV Standards.
20.16 Table 4, ICP Interference Check Solutions.
20.17 Table 5, ICAP 6500 Analytical Wavelengths.

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.1

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
200.7	Aluminum	7429-90-5	Soil	6	10	mg/kg	41-158	70-130	30
200.7	Antimony	7440-36-0	Soil	3	10	mg/kg	50-150	70-130	30
200.7	Arsenic	7440-38-2	Soil	4	20	mg/kg	75-125	70-130	30
200.7	Barium	7440-39-3	Soil	0.3	2	mg/kg	81-119	70-130	30
200.7	Beryllium	7440-41-7	Soil	0.03	1	mg/kg	83-117	70-130	30
200.7	Boron	7440-42-8	Soil	0.4	10	mg/kg	67-133	70-130	30
200.7	Cadmium	7440-43-9	Soil	0.2	1	mg/kg	81-119	70-130	30
200.7	Calcium	7440-70-2	Soil	2	10	mg/kg	79-121	70-130	30
200.7	Chromium	7440-47-3	Soil	0.4	2	mg/kg	80-119	70-130	30
200.7	Cobalt	7440-48-4	Soil	0.3	2	mg/kg	82-118	70-130	30
200.7	Copper	7440-50-8	Soil	0.6	2	mg/kg	83-116	70-130	30
200.7	Iron	7439-89-6	Soil	0.7	4	mg/kg	50-149	70-130	30
200.7	Lead	7439-92-1	Soil	3	20	mg/kg	79-121	70-130	30
200.7	Lithium	7439-93-2	Soil	0.5	2	mg/kg	75-125	70-130	30
200.7	Magnesium	7439-95-4	Soil	0.3	4	mg/kg	73-127	70-130	30
200.7	Manganese	7439-96-5	Soil	0.04	2	mg/kg	81-119	70-130	30
200.7	Molybdenum	7439-98-7	Soil	0.5	2	mg/kg	75-125	70-130	30
200.7	Nickel	7440-02-0	Soil	0.5	4	mg/kg	81-118	70-130	30
200.7	Phosphorus	7723-14-0	Soil	3	40	mg/kg	75-125	70-130	30
200.7	Potassium	7440-09-7	Soil	20	80	mg/kg	73-126	70-130	30
200.7	Selenium	7782-49-2	Soil	4	20	mg/kg	75-125	70-130	30
200.7	Silver	7440-22-4	Soil	0.4	2	mg/kg	66-134	70-130	30
200.7	Sodium	7440-23-5	Soil	4	40	mg/kg	74-126	70-130	30
200.7	Strontium	7440-24-6	Soil	0.02	2	mg/kg	79-121	70-130	30
200.7	Thallium	7440-28-0	Soil	3	20	mg/kg	75-125	70-130	30
200.7	Tin	7440-31-5	Soil	2	10	mg/kg	75-124	70-130	30

200.7	Titanium	7440-32-6	Soil	0.5	2			mg/kg	75-125	70-130	30
200.7	Vanadium	7440-62-2	Soil	0.4	2			mg/kg	79-121	70-130	30
200.7	Zinc	7440-66-6	Soil	0.3	2			mg/kg	73-121	70-130	30

a Method Detection Limits are subject to change as new MDL studies are completed.

ALS/KELSO DATA QUALITY OBJECTIVES — Table 1.2

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
200.7	Aluminum	7429-90-5	Water	30	50	28	50	ug/L	85-115	70-130	20
200.7	Antimony	7440-36-0	Water	20	50	30	50	ug/L	85-115	70-130	20
200.7	Arsenic	7440-38-2	Water	20	100	30	100	ug/L	85-115	70-130	20
200.7	Barium	7440-39-3	Water	1	5	1.5	5	ug/L	85-115	70-130	20
200.7	Beryllium	7440-41-7	Water	0.2	5	0.3	5	ug/L	85-115	70-130	20
200.7	Boron	7440-42-8	Water	3	50		50	ug/L	85-115	70-130	20
200.7	Cadmium	7440-43-9	Water	0.8	5	2	5	ug/L	85-115	70-130	20
200.7	Calcium	7440-70-2	Water	10	50	25	50	ug/L	85-115	70-130	20
200.7	Chromium	7440-47-3	Water	3	5	2.5	5	ug/L	85-115	70-130	20
200.7	Cobalt	7440-48-4	Water	2	10	2.5	10	ug/L	85-115	70-130	20
200.7	Copper	7440-50-8	Water	5	10	4.5	10	ug/L	85-115	70-130	20
200.7	Iron	7439-89-6	Water	2	20	4	20	ug/L	85-115	70-130	20
200.7	Lead	7439-92-1	Water	8	50	30	50	ug/L	85-115	70-130	20
200.7	Lithium	7439-93-2	Water	2	10	3.5	10	ug/L	85-115	70-130	20
200.7	Magnesium	7439-95-4	Water	0.7	20	0.5	20	ug/L	85-115	70-130	20
200.7	Manganese	7439-96-5	Water	0.4	5	0.5	5	ug/L	85-115	70-130	20
200.7	Molybdenum	7439-98-7	Water	3	10	5	10	ug/L	85-115	70-130	20
200.7	Nickel	7440-02-0	Water	2	20	4	20	ug/L	85-115	70-130	20
200.7	Phosphorus	7723-14-0	Water	30	200	40	200	ug/L	85-115	70-130	20
200.7	Potassium	7440-09-7	Water	50	400	80	400	ug/L	85-115	70-130	20
200.7	Selenium	7782-49-2	Water	30	100	40	100	ug/L	85-115	70-130	20
200.7	Silicon	7440-21-3	Water	10	400		400	ug/L	85-115	70-130	20

200.7	Silver	7440-22-4	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Sodium	7440-23-5	Water	30	200	20	200	ug/L	85-115	70-130	20
200.7	Strontium	7440-24-6	Water	0.06	10			ug/L	85-115	70-130	20
200.7	Thallium	7440-28-0	Water	30	100	60	100	ug/L	85-115	70-130	20
200.7	Tin	7440-31-5	Water	20	50	30	50	ug/L	85-115	70-130	20
200.7	Titanium	7440-32-6	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Vanadium	7440-62-2	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Zinc	7440-66-6	Water	2	10	2.5	10	ug/L	85-115	70-130	20

Table 1.3

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C	Aluminum	7429-90-5	Water	40	50	40	50	ug/L	92-112	75-125	20
6010C	Antimony	7440-36-0	Water	10	50	30	50	ug/L	90-113	75-125	20
6010C	Arsenic	7440-38-2	Water	20	100	30	100	ug/L	90-112	75-125	20
6010C	Barium	7440-39-3	Water	0.5	5	1.5	5	ug/L	91-113	75-125	20
6010C	Beryllium	7440-41-7	Water	0.2	5	0.3	5	ug/L	91-113	75-125	20
6010C	Boron	7440-42-8	Water	2	50	4	50	ug/L	91-112	75-125	20
6010C	Cadmium	7440-43-9	Water	0.9	5	2	5	ug/L	93-113	75-125	20
6010C	Calcium	7440-70-2	Water	9	50	25	50	ug/L	85-116	75-125	20
6010C	Chromium	7440-47-3	Water	2	5	5	5	ug/L	93-114	75-125	20
6010C	Cobalt	7440-48-4	Water	2	10	2.5	10	ug/L	93-114	75-125	20
6010C	Copper	7440-50-8	Water	5	10	9	10	ug/L	91-111	75-125	20
6010C	Iron	7439-89-6	Water	3	20	4	20	ug/L	92-111	75-125	20
6010C	Lead	7439-92-1	Water	8	50	30	50	ug/L	92-113	75-125	20
6010C	Lithium	7439-93-2	Water	2	10	3.5	10	ug/L	80-120	75-125	20
6010C	Magnesium	7439-95-4	Water	0.4	20	0.5	20	ug/L	86-115	75-125	20
6010C	Manganese	7439-96-5	Water	0.7	5	0.5	5	ug/L	92-112	75-125	20
6010C	Molybdenum	7439-98-7	Water	2	10	5	10	ug/L	92-113	75-125	20
6010C	Nickel	7440-02-0	Water	3	20	4	20	ug/L	91-118	75-125	20
6010C	Phosphorus	7723-14-0	Water	60	200	40	200	ug/L	80-120	75-125	20
6010C	Potassium	7440-09-7	Water	40	400	80	400	ug/L	89-114	75-125	20
6010C	Selenium	7782-49-2	Water	20	100	40	100	ug/L	88-113	75-125	20
6010C	Silicon	7440-21-3	Water	6	400	8	400	ug/L	80-120	75-125	20
6010C	Silver	7440-22-4	Water	5	10	10	10	ug/L	93-110	75-125	20
6010C	Sodium	7440-23-5	Water	20	200	20	200	ug/L	80-120	75-125	20
6010C	Strontium	7440-24-6	Water	0.9	10	0.25	10	ug/L	80-120	75-125	20
6010C	Thallium	7440-28-0	Water	30	100	60	100	ug/L	80-120	75-125	20
6010C	Tin	7440-31-5	Water	9	50	30	50	ug/L	80-120	75-125	20
6010C	Titanium	7440-32-6	Water	4	10	10	10	ug/L	80-120	75-125	20

6010C	Vanadium	7440-62-2	Water	6	10	6.25	10	ug/L	92-111	75-125	20
6010C	Zinc	7440-66-6	Water	2	10	2.5	10	ug/L	92-112	75-125	20

Table 1.4

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C	Aluminum	7429-90-5	Soil	6	10	10	10	mg/kg	41-158	75-125	20
6010C	Antimony	7440-36-0	Soil	3	10	6	10	mg/kg	50-150	75-125	20
6010C	Arsenic	7440-38-2	Soil	4	20	8	20	mg/kg	78-122	75-125	20
6010C	Barium	7440-39-3	Soil	0.08	2	0.16	2	mg/kg	81-119	75-125	20
6010C	Beryllium	7440-41-7	Soil	0.02	1	0.04	1	mg/kg	83-117	75-125	20
6010C	Boron	7440-42-8	Soil	0.4	10	0.8	10	mg/kg	67-133	75-125	20
6010C	Cadmium	7440-43-9	Soil	0.3	1	0.6	1	mg/kg	81-119	75-125	20
6010C	Calcium	7440-70-2	Soil	2	10	4	10	mg/kg	79-121	75-125	20
6010C	Chromium	7440-47-3	Soil	0.5	2	1	2	mg/kg	80-119	75-125	20
6010C	Cobalt	7440-48-4	Soil	0.4	2	0.8	2	mg/kg	82-118	75-125	20
6010C	Copper	7440-50-8	Soil	0.7	2	1.4	2	mg/kg	83-116	75-125	20
6010C	Iron	7439-89-6	Soil	0.7	4	1.4	4	mg/kg	50-149	75-125	20
6010C	Lead	7439-92-1	Soil	3	20	6	20	mg/kg	79-121	75-125	20
6010C	Lithium	7439-93-2	Soil	0.5	2	0.8	2	mg/kg	75-125	75-125	20
6010C	Magnesium	7439-95-4	Soil	0.08	4	0.16	4	mg/kg	73-127	75-125	20
6010C	Manganese	7439-96-5	Soil	0.04	2	0.08	2	mg/kg	81-119	75-125	20
6010C	Molybdenum	7439-98-7	Soil	0.7	2	1.4	4.5	mg/kg	75-125	75-125	20
6010C	Nickel	7440-02-0	Soil	0.6	4	1.2	4	mg/kg	81-118	75-125	20
6010C	Phosphorus	7723-14-0	Soil	4	40	8	40	mg/kg	75-125	75-125	20
6010C	Potassium	7440-09-7	Soil	20	80	40	80	mg/kg	73-126	75-125	20
6010C	Selenium	7782-49-2	Soil	5	20	10	20	mg/kg	80-120	75-125	20
6010C	Silver	7440-22-4	Soil	2	2	4	4	mg/kg	66-134	75-125	20
6010C	Sodium	7440-23-5	Soil	4	40	8	40	mg/kg	74-126	75-125	20
6010C	Strontium	7440-24-6	Soil	0.02	2	0.04	2	mg/kg	79-121	75-125	20
6010C	Thallium	7440-28-0	Soil	7	20	14	20	mg/kg	79-120	75-125	20
6010C	Tin	7440-31-5	Soil	4	10	8	10	mg/kg	75-124	75-125	20
6010C	Titanium	7440-32-6	Soil	0.8	2	1.6	2	mg/kg	75-125	75-125	20

6010C	Vanadium	7440-62-2	Soil	2	2	2	2	mg/kg	79-121	75-125	20
6010C	Zinc	7440-66-6	Soil	0.3	2	0.6	2	mg/kg	73-121	75-125	20

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.5

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C LL	Aluminum	7429-90-5	Soil	0.4	1	0.8	2	mg/kg	41-158	75-125	20
6010C LL	Antimony	7440-36-0	Soil	0.5	2	1	3	mg/kg	50-150	75-125	20
6010C LL	Arsenic	7440-38-2	Soil	0.9	2	1.8	5	mg/kg	78-122	75-125	20
6010C LL	Barium	7440-39-3	Soil	0.06	0.5	0.12	0.5	mg/kg	81-119	75-125	20
6010C LL	Beryllium	7440-41-7	Soil	0.03	0.1	0.06	0.2	mg/kg	83-117	75-125	20
6010C LL	Boron	7440-42-8	Soil	0.4	2	1.6	10	mg/kg	67-133	75-125	20
6010C LL	Cadmium	7440-43-9	Soil	0.03	0.1	0.06	0.18	mg/kg	81-119	75-125	20
6010C LL	Calcium	7440-70-2	Soil	0.6	2	1.2	3.6	mg/kg	79-121	75-125	20
6010C LL	Chromium	7440-47-3	Soil	0.2	0.5	0.4	1.2	mg/kg	80-119	75-125	20
6010C LL	Cobalt	7440-48-4	Soil	0.2	0.5	0.4	1.2	mg/kg	82-118	75-125	20
6010C LL	Copper	7440-50-8	Soil	0.3	0.6	0.6	1.8	mg/kg	83-116	75-125	20
6010C LL	Iron	7439-89-6	Soil	0.7	2	1.4	4.2	mg/kg	50-149	75-125	20
6010C LL	Lead	7439-92-1	Soil	0.4	2	0.8	2	mg/kg	79-121	75-125	20
6010C LL	Lithium	7439-93-2	Soil	0.5	2	1	3	mg/kg	80-120	75-125	20
6010C LL	Magnesium	7439-95-4	Soil	0.06	0.5	0.12	0.5	mg/kg	73-127	75-125	20
6010C LL	Manganese	7439-96-5	Soil	0.02	0.2	0.04	0.2	mg/kg	81-119	75-125	20
6010C LL	Molybdenum	7439-98-7	Soil	0.08	0.4	0.06	0.4	mg/kg	75-125	75-125	20
6010C LL	Nickel	7440-02-0	Soil	0.07	0.4	0.14	0.4	mg/kg	81-118	75-125	20
6010C LL	Phosphorus	7723-14-0	Soil	3	6	6	40	mg/kg	80-120	75-125	20
6010C LL	Potassium	7440-09-7	Soil	20	60	40	120	mg/kg	73-126	75-125	20
6010C LL	Selenium	7782-49-2	Soil	0.7	4	1.4	4.2	mg/kg	80-120	75-125	20
6010C LL	Silver	7440-22-4	Soil	0.2	0.5	0.4	1.2	mg/kg	66-134	75-125	20
6010C LL	Sodium	7440-23-5	Soil	4	40	8	40	mg/kg	74-126	75-125	20
6010C LL	Strontium	7440-24-6	Soil	0.02	2	0.06	2	mg/kg	80-120	75-125	20
6010C LL	Thallium	7440-28-0	Soil	0.4	2	0.4	20	mg/kg	79-120	75-125	20
6010C LL	Tin	7440-31-5	Soil	0.7	10	1.6	10	mg/kg	75-124	75-125	20
6010C LL	Titanium	7440-32-6	Soil	0.05	0.2	0.16	2	mg/kg	80-120	75-125	20

6010C LL	Vanadium	7440-62-2	Soil	0.3	1	0.6	2	mg/kg	79-121	75-125	20
6010C LL	Zinc	7440-66-6	Soil	0.3	1	0.6	2	mg/kg	73-121	75-125	20

Table 1.6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C LL	Aluminum	7429-90-5	Water	0.5	2	6	18	ug/L	92-112	75-125	20
6010C LL	Antimony	7440-36-0	Water	3	10	6	18	ug/L	90-113	75-125	20
6010C LL	Arsenic	7440-38-2	Water	4	10	8	24	ug/L	90-112	75-125	20
6010C LL	Barium	7440-39-3	Water	0.4	2	0.8	2.4	ug/L	91-113	75-125	20
6010C LL	Beryllium	7440-41-7	Water	0.09	0.2	0.18	0.6	ug/L	91-113	75-125	20
6010C LL	Boron	7440-42-8	Water	2	10	8	50	ug/L	91-112	75-125	20
6010C LL	Cadmium	7440-43-9	Water	0.3	0.5	0.6	1.8	ug/L	93-113	75-125	20
6010C LL	Calcium	7440-70-2	Water	2	4	20	50	ug/L	85-116	75-125	20
6010C LL	Chromium	7440-47-3	Water	0.4	2	0.8	2.4	ug/L	93-114	75-125	20
6010C LL	Cobalt	7440-48-4	Water	0.4	1	0.8	2.4	ug/L	93-114	75-125	20
6010C LL	Copper	7440-50-8	Water	2	2	4	12	ug/L	91-111	75-125	20
6010C LL	Iron	7439-89-6	Water	3	10	6	18	ug/L	92-111	75-125	20
6010C LL	Lead	7439-92-1	Water	4	10	8	24	ug/L	92-113	75-125	20
6010C LL	Lithium	7439-93-2	Water	2	10	4	12	ug/L	80-120	75-125	20
6010C LL	Magnesium	7439-95-4	Water	0.4	2	6	20	ug/L	86-115	75-125	20
6010C LL	Manganese	7439-96-5	Water	0.2	0.6	0.4	2.4	ug/L	92-112	75-125	20
6010C LL	Molybdenum	7439-98-7	Water	0.6	2	1.2	3.6	ug/L	92-113	75-125	20
6010C LL	Nickel	7440-02-0	Water	0.7	2	1.4	4.2	ug/L	91-118	75-125	20
6010C LL	Phosphorus	7723-14-0	Water	7	20	7	400	ug/L	80-120	75-125	20
6010C LL	Potassium	7440-09-7	Water	50	100	100	300	ug/L	89-114	75-125	20
6010C LL	Selenium	7782-49-2	Water	5	20	10	30	ug/L	88-113	75-125	20
6010C LL	Silicon	7440-21-3	Water	10	50	10	400	ug/L	80-120	75-125	20
6010C LL	Silver	7440-22-4	Water	0.7	2	1.4	4.2	ug/L	93-110	75-125	20
6010C LL	Sodium	7440-23-5	Water	70	200	140	420	ug/L	80-120	75-125	20

6010C LL	Strontium	7440-24-6	Water	0.07	0.2	0.07	10	ug/L	80-120	75-125	20
6010C LL	Thallium	7440-28-0	Water	2	10	6	18	ug/L	80-120	75-125	20
6010C LL	Tin	7440-31-5	Water	2	10	2	10	ug/L	80-120	75-125	20
6010C LL	Titanium	7440-32-6	Water	0.2	1	0.8	10	ug/L	80-120	75-125	20
6010C LL	Vanadium	7440-62-2	Water	1	2	2	6	ug/L	92-111	75-125	20
6010C LL	Zinc	7440-66-6	Water	0.7	2	1.4	4.2	ug/L	92-112	75-125	20

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.7

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C/PSEP	Aluminum	7429-90-5	Tissue	0.07	1	mg/kg	75-125	70-130	30
6010C/PSEP	Antimony	7440-36-0	Tissue	0.4	5	mg/kg	75-125	70-130	30
6010C/PSEP	Arsenic		Tissue	0.6	10	mg/kg	75-125	70-130	30
6010C/PSEP	Barium	7440-39-3	Tissue	0.04	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Beryllium		Tissue	0.02	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Boron	7440-42-8	Tissue	0.2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Cadmium	7440-43-9	Tissue	3	5	mg/kg	75-125	70-130	30
6010C/PSEP	Calcium	7440-70-2	Tissue	2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Chromium	7440-47-3	Tissue	0.08	0.2	mg/kg	75-125	70-130	30
6010C/PSEP	Cobalt		Tissue	0.05	1	mg/kg	75-125	70-130	30
6010C/PSEP	Copper	7440-50-8	Tissue	0.2	1	mg/kg	75-125	70-130	30
6010C/PSEP	Iron	7439-89-6	Tissue	0.4	2	mg/kg	75-125	70-130	30
6010C/PSEP	Lead		Tissue	0.2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Lithium	7439-93-2	Tissue	0.3	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Magnesium	7439-95-4	Tissue	0.4	2	mg/kg	75-125	70-130	30
6010C/PSEP	Manganese	7439-96-5	Tissue	0.03	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Molybdenum	7439-98-7	Tissue	0.05	1	mg/kg	75-125	70-130	30
6010C/PSEP	Nickel	7440-02-0	Tissue	0.06	2	mg/kg	75-125	70-130	30
6010C/PSEP	Phosphorus	7723-14-0	Tissue	2	20	mg/kg	75-125	70-130	30
6010C/PSEP	Potassium	7440-09-7	Tissue	6	40	mg/kg	75-125	70-130	30
6010C/PSEP	Selenium	7782-49-2	Tissue	0.7	10	mg/kg	75-125	70-130	30
6010C/PSEP	Silver	7440-22-4	Tissue	0.1	1	mg/kg	75-125	70-130	30
6010C/PSEP	Sodium	7440-23-5	Tissue	4	20	mg/kg	75-125	70-130	30
6010C/PSEP	Strontium	7440-24-6	Tissue	0.02	1	mg/kg	75-125	70-130	30
6010C/PSEP	Thallium	7440-28-0	Tissue	0.3	10	mg/kg	75-125	70-130	30

6010C/PSEP	Tin	7440-31-5	Tissue	0.3	5		mg/kg	75-125	70-130	30
6010C/PSEP	Titanium	7440-32-6	Tissue	0.09	1		mg/kg	75-125	70-130	30
6010C/PSEP	Vanadium	7440-62-2	Tissue	0.07	1		mg/kg	75-125	70-130	30
6010C/PSEP	Zinc	7440-66-6	Tissue	0.06	1		mg/kg	75-125	70-130	30

TABLE 2
Standard A for ICAP 6500 ICP-OES

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (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	(1)	100	5	1000	0.5
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

Standard B for ICAP 6500 ICP-OES

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (ppm)
Aluminum	Elemental Stock	10000	2	1000	20
Arsenic	Elemental Stock	1000	2	1000	2
Barium	Elemental Stock	10000	2	1000	20
Calcium	Elemental Stock	10000	2	1000	20
Iron	Elemental Stock	10000	2	1000	20
Lithium	Elemental Stock	1000	2	1000	2
Manganese	Elemental Stock	1000	2	1000	2
Magnesium	Elemental Stock	10000	2	1000	20
Phosphorus	Elemental Stock	10000	2	1000	20
Potassium	Elemental Stock	10000	2	1000	20
Silicon	Elemental Stock	10000	2	1000	20
Sodium	Elemental Stock	10000	2	1000	20
Strontium	Elemental Stock	1000	2	1000	2
HCl	-	-	50	1000	5%
HNO3	-	-	10	1000	1%

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-2	500	2.5	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%

ICVB Solution

Analyte	Source	Source Concentration	Aliquot	Final Volume	Final Concentration

		(ppm)	(mL)	(mL)	(ppm)
Aluminum	Elemental Stock	1000	0.5	500	1
Boron	Elemental Stock	1000	1	500	2
Calcium	Elemental Stock	1000	2.5	500	5
Iron	Elemental Stock	1000	5	500	10
Lithium	Elemental Stock	1000	1	500	2
Magnesium	Elemental Stock	1000	2.5	500	5
Manganese	Elemental Stock	1000	5	500	10
Phosphorus	Elemental Stock	1000	2.5	500	5
Silicon	Elemental Stock	1000	2.5	500	5
Strontium	Elemental Stock	1000	1	500	2
Tin	Elemental Stock	1000	2.5	500	5
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

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 5
ICAP 6500 Analytical Wavelengths, continued

Strontium	407.7	
Thallium	190.8	
Tin	189.9	
Titanium	336.1	
Vanadium	292.4	
Zinc	206.2	
Zinc	213.8	Alternate

APPENDIX G

List of Laboratory Certifications and Accreditations

Federal and National Programs

- The TNI (The NELAC Institute) National Environmental Laboratory Accreditation Program (NELAP) Accredited Drinking Water, Non-Potable Water, Solid & Hazardous Waste, and Biological Tissue Laboratory
- ANSI-ASQ National Accreditation Board/ACLASS ISO 17025:2005
- DoD- ELAP Environmental Laboratory Accreditation Program
- U.S. EPA Region 8
  Approved Drinking Water Laboratory

State and Local Programs

- State of Alaska, Department of Environmental Conservation
  UST Laboratory, Lab I.D. UST040
- State of Arizona, Department of Health Services
  License No. AZ0339
- State of Arkansas, Department of Environmental Quality
  Certified Environmental Laboratory, Lab I.D. 88-0637
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program, Certification No. 2286
- State of Florida, Department of Health
  Accredited Environmental Laboratory No. E87412
- State of Georgia, Department of Natural Resources
  Certified Drinking Water Laboratory
- State of Hawaii, Department of Health
  Certified Drinking Water Laboratory
- State of Idaho, Department of Health and Welfare
  Certified Drinking Water Laboratory
- State of Indiana, Department of Health
  Certified Drinking Water Laboratory, Lab I.D. C-WA-01
- State of Louisiana, Department of Environmental Quality
  Accredited Environmental Laboratory, Lab I.D. 3016
- State of Maine, Department of Human Services
  Certified Environmental Laboratory, Lab I.D. WA0035
- State of Michigan, Department of Environmental Quality
  Certified Drinking Water Laboratory, Lab I.D. 9949

State and Local Programs (continued)

- State of Minnesota, Department of Health
  Certified Environmental Laboratory, Lab I.D. 053-999-368
- State of Montana, Department of Health and Environmental Sciences
  Certified Drinking Water Laboratory, Lab I.D. 0047
- State of Nebraska, Division of Public Health
  Certified Drinking Water Laboratory, Lab I.D. NE-OS-23-13
- State of Nevada, Division of Environmental Protection
  Certified Drinking Water Laboratory, Lab I.D. WA35
- State of New Jersey, Department of Environmental Protection
  Accredited Environmental Laboratory, Lab I.D. WA005
- State of North Carolina, Department of Environment and Natural Resources
  Certified Environmental Laboratory, Lab I.D. 605
- State of Oklahoma, Department of Environmental Quality
  General Water Quality/Sludge Testing, Lab I.D. 9801
- State of Oregon, ORELAP Laboratory Accreditation Program
  Accredited Environmental Laboratory, Lab I.D. WA200001
- State of South Carolina, Department of Health and Environmental Control
  Certified Environmental Laboratory, Lab I.D. 61002
- State of Texas, Commission on Environmental Quality
  Certified Environmental Laboratory, Lab I.D. T104704427-12-4
- State of Utah, Department of Health
  Accredited Environmental Laboratory, Lab I.D. WA000352013-2
- State of Washington, Department of Ecology
  Accreditation Program Lab I.D. C1203
- State of Wisconsin, Department of Natural Resources
  Accredited Environmental Laboratory, Lab I.D. 998386840

A complete listing of and certifications and accreditations can be found at:

http://alsnetnew/divisions/env_northamerica/Lists/USA%20Certifications1/AllItems.aspx

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Columbia Analytical Services, Inc. Kelso

WA100010

1317 South 13th Ave.

Kelso,WA 98626

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

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

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

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

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

Gary K. Ward

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 02/11/2013

EXPIRATION DATE: 02/10/2014

Certificate No: WA100010 - 005

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: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

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Kelso WA 98626

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MATRIX : Biological Tissue

Reference	Code	Description
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	Arsenic (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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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

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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
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Analyte Code	*Analyte*
1150	Silver
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

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
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
4835	Hexachlorobutadiene
7725	Isodrin

ORELAP Fields of Accreditation

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EPA CODE: WA00035
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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
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',5,6-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)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
8915	2-Chlorobiphenyl (BZ-1)
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)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	*Analyte*
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
9105	Decachlorobiphenyl (BZ-209)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
6380	1-Methylnaphthalene
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
5670	Butyl benzyl phthalate
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
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
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)
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: WA00035
Certificate: WA100010 - 005

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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 200.9 2.2	**10015404**	**Metals by Graphite Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
1010	Arsenic
1055	Copper
1075	Lead
1140	Selenium
1165	Thallium

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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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
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 **10082007** **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
7250	Chlordane (tech.)
7470	Dieldrin
7540	Endrin
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor

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Analyte Code	*Analyte*
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
8505	Acifluorfen
8555	Dalapon
8570	DCPA di-acid degradate
8595	Dicamba
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
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
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4835	Hexachlorobutadiene
4900	Isopropylbenzene
4950	Methyl bromide (Bromomethane)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	*Analyte*
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
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 (s-ethyl-n,n-dipropyl thio carbamate)
6275	Hexachlorobenzene
6285	Hexachlorocyclopentadiene
6320	Isophorone
7835	Metolachlor
7845	Metribuzin
7875	Molinate
8045	Propachlor (Ramrod)
8125	Simazine
8180	Terbacil

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

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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*
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

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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

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MATRIX : Non-Potable Water

Reference	Code	Description
ASTM D1426-98B	**30023406**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

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)
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
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

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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	Soil 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*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 1650 **10124808** **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

ORELAP Fields of Accreditation

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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
220	5,5-Diphenylhydantoin (Dilantin)
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
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

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
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*
1005	Antimony
1010	Arsenic
1055	Copper
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

ORELAP Fields of Accreditation

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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*
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

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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 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

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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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium
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

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Analyte Code	*Analyte*
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
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
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4680	cis-1,3-Dichloropropene
4765	Ethylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
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
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

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Analyte Code	*Analyte*
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
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 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
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

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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
9408	Gasoline range organics (GRO)

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

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

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
4835	Hexachlorobutadiene
7725	Isodrin

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
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',5,6-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)
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)

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Analyte Code	*Analyte*
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
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
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

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
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
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
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
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
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)

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Analyte Code	*Analyte*
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
4440	sec-Butylbenzene
5100	Styrene
4370	t-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
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

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Analyte Code	*Analyte*
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
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
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
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
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

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Analyte Code	*Analyte*
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6535	n-Nitrosodiphenylamine
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*
6380	1-Methylnaphthalene
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
5670	Butylbenzylphthalate
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
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
6665	Pyrene

EPA 8315A **10188008** **Determination of Carbonyl Compounds by HPLC/UV-VIS**

Analyte Code	*Analyte*
4815	Formaldehyde

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
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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

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)

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

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

ORELAP Fields of Accreditation

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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 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 F 20th ED **20051300** **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

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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

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⁻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

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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

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-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9230 B (PSE) 20th ED **20217203** **Multiple Tube Fermentation Quantitative: Fecal Streptococci**

Analyte Code	*Analyte*
2540	Fecal streptococci

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MATRIX : Solids

Reference	Code	Description
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
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
7910	trans-Nonachlor

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

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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*
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

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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

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

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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
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156406** **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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium

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Analyte Code	*Analyte*
1185	Vanadium
1190	Zinc

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 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 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 8021B **10174803** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

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

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Analyte Code	*Analyte*
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
4835	Hexachlorobutadiene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
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)
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)

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Analyte Code	*Analyte*
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)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

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Kelso WA 98626

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

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

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

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
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
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
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethylenoxide)
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
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	*Analyte*
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
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
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

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Customers. Please verify the current accreditation standing with ORELAP.

Analyte Code	*Analyte*
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
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
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
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	*Analyte*
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
6535	n-Nitrosodiphenylamine
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*
6380	1-Methylnaphthalene
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
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	*Analyte*
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
6615	Phenanthrene
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)
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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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)

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

The State of Washington Department of Ecology

ALS Environmental - Kelso
Kelso, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective July 9, 2013 and shall expire July 8, 2014.

Witnessed under my hand on July 26, 2013

Alan D. Rue
Lab Accreditation Unit Supervisor

Laboratory ID
C544

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

ALS Environmental - Kelso

Kelso, WA

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

Matrix/Analyte	Method	Notes
Drinking Water		
Turbidity	EPA 180.1_2_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate	EPA 300.0_2.1_1993	
Nitrite	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Bromate	EPA 300.1_1_1997	
Bromide	EPA 300.1_1_1997	
Chlorate	EPA 300.1_1_1997	
Chlorite	EPA 300.1_1_1997	
Perchlorate	EPA 314.0	
Total cyanide	EPA 335.4_1_1993	
Nitrate	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Color	SM 2120 B-01	
Alkalinity	SM 2320 B-97	
Conductivity	SM 2510 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Cyanide, Total	SM 4500-CN^- E-99	
Fluoride	SM 4500-F C-97	
Orthophosphate as P	SM 4500-P E-99	
Total organic carbon	SM 5310 C-00	

Matrix/Analyte	Method	Notes
Aluminum	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Silica as SiO2	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Total hardness as CaCO3	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	
Chromium	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Arsenic	EPA 200.9 Rev 2.2 (1994)	
Copper	EPA 200.9 Rev 2.2 (1994)	4

Matrix/Analyte	Method	Notes
Lead	EPA 200.9 Rev 2.2 (1994)	
Selenium	EPA 200.9 Rev 2.2 (1994)	
Thallium	EPA 200.9 Rev 2.2 (1994)	
Mercury	EPA 245.1_3_1994	
1,2,3-Trichloropropane	EPA 504.1_1.1_1995	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1_1.1_1995	
Dibromochloropropane	EPA 504.1_1.1_1995	
4,4'-DDD	EPA 508.1_2_1995	
4,4'-DDE	EPA 508.1_2_1995	
4,4'-DDT	EPA 508.1_2_1995	
Aldrin	EPA 508.1_2_1995	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Aroclor-1016 (PCB-1016)	EPA 508.1_2_1995	
Aroclor-1221 (PCB-1221)	EPA 508.1_2_1995	
Aroclor-1232 (PCB-1232)	EPA 508.1_2_1995	
Aroclor-1242 (PCB-1242)	EPA 508.1_2_1995	
Aroclor-1248 (PCB-1248)	EPA 508.1_2_1995	
Aroclor-1254 (PCB-1254)	EPA 508.1_2_1995	
Aroclor-1260 (PCB-1260)	EPA 508.1_2_1995	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Chlordane (tech.)	EPA 508.1_2_1995	
delta-BHC	EPA 508.1_2_1995	
Dieldrin	EPA 508.1_2_1995	
Endosulfan I	EPA 508.1_2_1995	
Endosulfan II	EPA 508.1_2_1995	
Endosulfan sulfate	EPA 508.1_2_1995	
Endrin	EPA 508.1_2_1995	
Endrin aldehyde	EPA 508.1_2_1995	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Heptachlor	EPA 508.1_2_1995	
Heptachlor epoxide	EPA 508.1_2_1995	
Methoxychlor	EPA 508.1_2_1995	
PCBs	EPA 508.1_2_1995	

Matrix/Analyte	Method	Notes
Toxaphene (Chlorinated camphene)	EPA 508.1_2_1995	
2,4,5-T	EPA 515.4_1_2000	
2,4-D	EPA 515.4_1_2000	
2,4-DB	EPA 515.4_1_2000	
3,5-Dichlorobenzoic acid	EPA 515.4_1_2000	
Acifluorfen	EPA 515.4_1_2000	
Bentazon	EPA 515.4_1_2000	
Chloramben	EPA 515.4_1_2000	
Dalapon	EPA 515.4_1_2000	
DCPA di acid degradate	EPA 515.4_1_2000	
DCPA mono acid degradate	EPA 515.4_1_2000	
Dicamba	EPA 515.4_1_2000	
Dichlorprop	EPA 515.4_1_2000	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 515.4_1_2000	
Pentachlorophenol	EPA 515.4_1_2000	
Picloram	EPA 515.4_1_2000	
Silvex (2,4,5-TP)	EPA 515.4_1_2000	
Diquat	EPA 549.2_1_1997	
Paraquat	EPA 549.2_1_1997	
Bromoacetic acid	EPA 552.2_1_1995	
Bromochloroacetic acid	EPA 552.2_1_1995	
Chloroacetic acid	EPA 552.2_1_1995	
Dibromoacetic acid	EPA 552.2_1_1995	
Dichloroacetic acid	EPA 552.2_1_1995	
Total haloacetic acids	EPA 552.2_1_1995	
Trichloroacetic acid	EPA 552.2_1_1995	
1,1,1,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,1-Trichloroethane	EPA 524.2_4.1_1995	
1,1,2,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,2-Trichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethylene	EPA 524.2_4.1_1995	
1,1-Dichloropropene	EPA 524.2_4.1_1995	
1,2,3-Trichlorobenzene	EPA 524.2_4.1_1995	
1,2,3-Trichloropropane	EPA 524.2_4.1_1995	
1,2,4-Trichlorobenzene	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
1,2,4-Trimethylbenzene	EPA 524.2_4.1_1995	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 524.2_4.1_1995	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 524.2_4.1_1995	
1,2-Dichlorobenzene	EPA 524.2_4.1_1995	
1,2-Dichloroethane	EPA 524.2_4.1_1995	
1,2-Dichloropropane	EPA 524.2_4.1_1995	
1,3,5-Trimethylbenzene	EPA 524.2_4.1_1995	
1,3-Dichlorobenzene	EPA 524.2_4.1_1995	
1,3-Dichloropropane	EPA 524.2_4.1_1995	
1,4-Dichlorobenzene	EPA 524.2_4.1_1995	
2,2-Dichloropropane	EPA 524.2_4.1_1995	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 524.2_4.1_1995	
2-Chlorotoluene	EPA 524.2_4.1_1995	
2-Hexanone	EPA 524.2_4.1_1995	
4-Chlorotoluene	EPA 524.2_4.1_1995	
4-Methyl-2-pentanone (MIBK)	EPA 524.2_4.1_1995	
Acetone	EPA 524.2_4.1_1995	
Benzene	EPA 524.2_4.1_1995	
Bromobenzene	EPA 524.2_4.1_1995	
Bromochloromethane	EPA 524.2_4.1_1995	
Bromodichloromethane	EPA 524.2_4.1_1995	
Bromoform	EPA 524.2_4.1_1995	
Carbon disulfide	EPA 524.2_4.1_1995	
Carbon tetrachloride	EPA 524.2_4.1_1995	
Chlorobenzene	EPA 524.2_4.1_1995	
Chloroethane	EPA 524.2_4.1_1995	
Chloroform	EPA 524.2_4.1_1995	
cis-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
cis-1,3-Dichloropropene	EPA 524.2_4.1_1995	
Dibromochloromethane	EPA 524.2_4.1_1995	
Dibromomethane	EPA 524.2_4.1_1995	
Dichlorodifluoromethane	EPA 524.2_4.1_1995	
Dichloromethane (DCM, Methylene chloride)	EPA 524.2_4.1_1995	
Ethylbenzene	EPA 524.2_4.1_1995	
Hexachlorobutadiene	EPA 524.2_4.1_1995	
Isopropylbenzene	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
Methyl bromide (Bromomethane)	EPA 524.2_4.1_1995	
Methyl chloride (Chloromethane)	EPA 524.2_4.1_1995	
Methyl tert-butyl ether (MTBE)	EPA 524.2_4.1_1995	
m-Xylene	EPA 524.2_4.1_1995	
Naphthalene	EPA 524.2_4.1_1995	
n-Butylbenzene	EPA 524.2_4.1_1995	
n-Propylbenzene	EPA 524.2_4.1_1995	
o-Xylene	EPA 524.2_4.1_1995	
p-Isopropyltoluene	EPA 524.2_4.1_1995	
p-Xylene	EPA 524.2_4.1_1995	
sec-Butylbenzene	EPA 524.2_4.1_1995	
Styrene	EPA 524.2_4.1_1995	
tert-Butylbenzene	EPA 524.2_4.1_1995	
Tetrachloroethylene (Perchloroethylene)	EPA 524.2_4.1_1995	
Toluene	EPA 524.2_4.1_1995	
Total trihalomethanes	EPA 524.2_4.1_1995	
trans-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
trans-1,3-Dichloropropylene	EPA 524.2_4.1_1995	
Trichloroethene (Trichloroethylene)	EPA 524.2_4.1_1995	
Trichlorofluoromethane	EPA 524.2_4.1_1995	
Trihalomethanes	EPA 524.2_4.1_1995	
Vinyl chloride	EPA 524.2_4.1_1995	
Xylenes (total)	EPA 524.2_4.1_1995	
2,4-Dinitrotoluene (2,4-DNT)	EPA 525.2_2_1995	
2,6-Dinitrotoluene (2,6-DNT)	EPA 525.2_2_1995	
2-Chlorobiphenyl	EPA 525.2_2_1995	
Acenaphthylene	EPA 525.2_2_1995	
Alachlor	EPA 525.2_2_1995	
Ametryn	EPA 525.2_2_1995	
Anthracene	EPA 525.2_2_1995	
Atraton	EPA 525.2_2_1995	
Atrazine	EPA 525.2_2_1995	
Benzo(a)anthracene	EPA 525.2_2_1995	
Benzo(a)pyrene	EPA 525.2_2_1995	
Benzo(g,h,i)perylene	EPA 525.2_2_1995	
Benzo(k)fluoranthene	EPA 525.2_2_1995	

Matrix/Analyte	Method	Notes
Benzo[b]fluoranthene	EPA 525.2_2_1995	
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 525.2_2_1995	
Bromacil	EPA 525.2_2_1995	
Butachlor	EPA 525.2_2_1995	
Butyl benzyl phthalate	EPA 525.2_2_1995	
Butylate	EPA 525.2_2_1995	
Carboxin	EPA 525.2_2_1995	
Chlorobenzilate	EPA 525.2_2_1995	
Chloroneb	EPA 525.2_2_1995	
Chloropropham	EPA 525.2_2_1995	
Chlorothalonil	EPA 525.2_2_1995	
Chrysene	EPA 525.2_2_1995	
cis-Permethrin	EPA 525.2_2_1995	
Cyanazine	EPA 525.2_2_1995	
Cycloate	EPA 525.2_2_1995	
Dacthal (DCPA)	EPA 525.2_2_1995	
Di(2-ethylhexyl)adipate	EPA 525.2_2_1995	
Di(2-ethylhexyl)phthalate	EPA 525.2_2_1995	
Diazinon	EPA 525.2_2_1995	
Dibenz(a,h) anthracene	EPA 525.2_2_1995	
Diethyl phthalate	EPA 525.2_2_1995	
Dimethyl phthalate	EPA 525.2_2_1995	
Di-n-butyl phthalate	EPA 525.2_2_1995	
Diphenamid	EPA 525.2_2_1995	
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 525.2_2_1995	
Ethoprop	EPA 525.2_2_1995	
Etridiazole	EPA 525.2_2_1995	
Fenamiphos	EPA 525.2_2_1995	
Fenarimol	EPA 525.2_2_1995	
Fluorene	EPA 525.2_2_1995	
Hexachlorobenzene	EPA 525.2_2_1995	
Hexachlorocyclohexane	EPA 525.2_2_1995	
Hexazinone	EPA 525.2_2_1995	
Indeno(1,2,3-cd) pyrene	EPA 525.2_2_1995	
Isophorone	EPA 525.2_2_1995	
Merphos	EPA 525.2_2_1995	

Matrix/Analyte	Method	Notes
Metolachlor	EPA 525.2_2_1995	
Metribuzin	EPA 525.2_2_1995	
Mevinphos	EPA 525.2_2_1995	
MGK-264	EPA 525.2_2_1995	
Molinate	EPA 525.2_2_1995	
Napropamide	EPA 525.2_2_1995	
Norflurazon	EPA 525.2_2_1995	
Pebulate	EPA 525.2_2_1995	
Phenanthrene	EPA 525.2_2_1995	
Prometon	EPA 525.2_2_1995	
Prometryn	EPA 525.2_2_1995	
Pronamide (Kerb)	EPA 525.2_2_1995	
Propachlor (Ramrod)	EPA 525.2_2_1995	
Propazine	EPA 525.2_2_1995	
Pyrene	EPA 525.2_2_1995	
Simazine	EPA 525.2_2_1995	
Simetryn	EPA 525.2_2_1995	
Tebuthiuron	EPA 525.2_2_1995	
Terbacil	EPA 525.2_2_1995	
Terbufos	EPA 525.2_2_1995	
Terbutryn	EPA 525.2_2_1995	
trans Permethrin	EPA 525.2_2_1995	
Triademefon	EPA 525.2_2_1995	
Tricyclazole	EPA 525.2_2_1995	
Trifluralin (Treflan)	EPA 525.2_2_1995	
Vernolate	EPA 525.2_2_1995	
Endothall	EPA 548.1_1_1992	
Heterotrophic plate count	SM 9215 B (PCA)	
Total & Fecal Coli - count	SM 9221 B (LTB) + E1 (EC) + C MPN	
Total Coli/Ecoli - count	SM 9221 B (LTB) + F (EC Mug) + C	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Total Coli/Ecoli - detect	SM 9223 B Colilert	6
Non-Potable Water		
Formaldehyde	ASTM D 19	

Matrix/Analyte	Method	Notes
Kjeldahl nitrogen - total	ASTM D1426-93B	
Conductivity	EPA 120.1_1982	
Solids, Total Volatile	EPA 160.4_1971	
Adsorbable Organic Halides (AOX)	EPA 1650_C_1997	
n-Hexane Extractable Material (O&G)	EPA 1664A (SGT-HEM)	
Turbidity	EPA 180.1_2_1993	
Bromide	EPA 300.0_2.1_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate	EPA 300.0_2.1_1993	
Nitrite	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Perchlorate	EPA 314.0	
Total cyanide	EPA 335.4_1_1993	
Nitrate	EPA 353.2_2_1993	
Nitrate-nitrite	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Orthophosphate as P	EPA 365.3_1978	
Phosphorus, total	EPA 365.3_1978	
Phenolics, Total	EPA 420.1_1978	
Chromium, Hexavalent	EPA 7196A_1_1992	
Color	SM 2120 B-01	
Acidity, as CaCO3	SM 2310 B-97	
Alkalinity as CaCO3	SM 2320 B-97	
Total hardness as CaCO3	SM 2340 C-97	
Solids, Total	SM 2540 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Solids, Total Suspended	SM 2540 D-97	
Solids, Settleable	SM 2540 F-97	
Chromium, Hexavalent	SM 3500-Cr B-09	
Chloride	SM 4500-Cl C-93	
Amenable cyanide	SM 4500-CN G-97	
Cyanides, Amenable to Chlorination	SM 4500-CN G-97	
Cyanide, Total	SM 4500-CN^- E-99	
Fluoride	SM 4500-F C-97	
pH	SM 4500-H+ B-00	1

Matrix/Analyte	Method	Notes
Ammonia as N	SM 4500-NH3 E-97	
Sulfide	SM 4500-$S2^{-}$ F-00	
Biochemical oxygen demand	SM 5210 B-01	
Chemical oxygen demand	SM 5220 C-97	
Total organic carbon	SM 5310 C-00	
Surfactants - MBAS	SM 5540 C-00	
Tannin & Lignin	SM 5550	
Methyl Mercury	EPA 1630	
Mercury	EPA 1631 E-02	
Antimony	EPA 1638_1996	2
Cadmium	EPA 1638_1996	2
Copper	EPA 1638_1996	2
Lead	EPA 1638_1996	2
Nickel	EPA 1638_1996	2
Selenium	EPA 1638_1996	2
Silver	EPA 1638_1996	2
Thallium	EPA 1638_1996	2
Zinc	EPA 1638_1996	2
Aluminum	EPA 200.7_4.4_1994	
Antimony	EPA 200.7_4.4_1994	
Arsenic	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Cobalt	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Lead	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Molybdenum	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Potassium	EPA 200.7_4.4_1994	

Matrix/Analyte	Method	Notes
Selenium	EPA 200.7_4.4_1994	
Silica as SiO2	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Strontium	EPA 200.7_4.4_1994	
Thallium	EPA 200.7_4.4_1994	
Tin	EPA 200.7_4.4_1994	
Titanium	EPA 200.7_4.4_1994	
Total hardness as CaCO3	EPA 200.7_4.4_1994	
Vanadium	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	
Chromium	EPA 200.8_5.4_1994	
Cobalt	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Molybdenum	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Vanadium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Arsenic	EPA 200.9 Rev 2.2 (1994)	
Lead	EPA 200.9 Rev 2.2 (1994)	
Selenium	EPA 200.9 Rev 2.2 (1994)	
Thallium	EPA 200.9 Rev 2.2 (1994)	

Matrix/Analyte	Method	Notes
Mercury	EPA 245.1_3_1994	
Acenaphthene	EPA 610	
Acenaphthylene	EPA 610	
Anthracene	EPA 610	
Benzo(a)anthracene	EPA 610	
Benzo(a)pyrene	EPA 610	
Benzo(g,h,i)perylene	EPA 610	
Benzo(k)fluoranthene	EPA 610	
Benzo[b]fluoranthene	EPA 610	
Chrysene	EPA 610	
Dibenz(a,h) anthracene	EPA 610	
Fluoranthene	EPA 610	
Fluorene	EPA 610	
Indeno(1,2,3-cd) pyrene	EPA 610	
Naphthalene	EPA 610	
Phenanthrene	EPA 610	
Pyrene	EPA 610	
Organo-tins	Krone 1988	
Methanol	NCASI 94.03	
2-Butanone (Methyl ethyl ketone, MEK)	NCASI DI/HAPS-99.01	
Acetaldehyde	NCASI DI/HAPS-99.01	
Methanol	NCASI DI/HAPS-99.01	
Propionaldehyde	NCASI DI/HAPS-99.01	
2,3,4,6-Tetrachlorophenol	EPA 1653_A_1997	
2,4,5-Trichlorophenol	EPA 1653_A_1997	
2,4,6-Trichlorophenol	EPA 1653_A_1997	
3,4,5-Trichlorocatechol	EPA 1653_A_1997	
3,4,5-Trichloroguaiacol	EPA 1653_A_1997	
3,4,6-Trichlorocatechol	EPA 1653_A_1997	
3,4,6-Trichloroguaiacol	EPA 1653_A_1997	
4,5,6-Trichloroguaiacol	EPA 1653_A_1997	
Pentachlorophenol	EPA 1653_A_1997	
Tetrachlorocatechol	EPA 1653_A_1997	
Tetrachloroguaiacol	EPA 1653_A_1997	
Trichlorosyringol	EPA 1653_A_1997	
Acetaminophen	EPA 1694	

Matrix/Analyte	Method	Notes
Caffeine	EPA 1694	
Fluoxetine	EPA 1694	
Gemfibrozil	EPA 1694	
Ibuprofen	EPA 1694	
Naproxen	EPA 1694	
Triclosan	EPA 1694	
Trimethoprim	EPA 1694	
1,1,1,2-Tetrachloroethane	EPA 624	
1,1,1-Trichloroethane	EPA 624	
1,1,2,2-Tetrachloroethane	EPA 624	
1,1,2-Trichloroethane	EPA 624	
1,1-Dichloroethane	EPA 624	
1,1-Dichloroethylene	EPA 624	
1,2-Dichlorobenzene	EPA 624	
1,2-Dichloroethane	EPA 624	
1,2-Dichloropropane	EPA 624	
1,3-Dichlorobenzene	EPA 624	
1,4-Dichlorobenzene	EPA 624	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 624	
2-Chloroethyl vinyl ether	EPA 624	
Acetone	EPA 624	
Acetonitrile	EPA 624	
Acrolein (Propenal)	EPA 624	
Acrylonitrile	EPA 624	
Benzene	EPA 624	
Bromodichloromethane	EPA 624	
Bromoform	EPA 624	
Carbon tetrachloride	EPA 624	
Chlorobenzene	EPA 624	
Chloroethane	EPA 624	
Chloroform	EPA 624	
cis-1,3-Dichloropropene	EPA 624	
Dibromochloromethane	EPA 624	
Dichlorodifluoromethane	EPA 624	
Dichloromethane (DCM, Methylene chloride)	EPA 624	
Ethylbenzene	EPA 624	

Matrix/Analyte	Method	Notes
Methyl bromide (Bromomethane)	EPA 624	
Methyl chloride (Chloromethane)	EPA 624	
Methyl tert-butyl ether (MTBE)	EPA 624	
Methylene chloride	EPA 624	
Styrene	EPA 624	
Tetrachloroethylene (Perchloroethylene)	EPA 624	
Toluene	EPA 624	
trans-1,2-Dichloroethylene	EPA 624	
trans-1,3-Dichloropropylene	EPA 624	
Trichloroethene (Trichloroethylene)	EPA 624	
Trichlorofluoromethane	EPA 624	
Vinyl chloride	EPA 624	
1,2,4-Trichlorobenzene	EPA 625	
1,2-Diphenylhydrazine	EPA 625	
2,4,5-Trichlorophenol	EPA 625	
2,4,6-Trichlorophenol	EPA 625	
2,4-Dichlorophenol	EPA 625	
2,4-Dimethylphenol	EPA 625	
2,4-Dinitrophenol	EPA 625	
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	
2-Chloronaphthalene	EPA 625	
2-Chlorophenol	EPA 625	
2-Nitrophenol	EPA 625	
3,3'-Dichlorobenzidine	EPA 625	
4,6-Dinitro-2-methylphenol	EPA 625	
4-Bromophenyl phenyl ether	EPA 625	
4-Chloro-3-methylphenol	EPA 625	
4-Chlorophenyl phenylether	EPA 625	
4-Nitrophenol	EPA 625	
Acenaphthene	EPA 625	
Acenaphthylene	EPA 625	
Anthracene	EPA 625	
Atrazine	EPA 625	
Benzidine	EPA 625	
Benzo(a)anthracene	EPA 625	

Matrix/Analyte	Method	Notes
Benzo(a)pyrene	EPA 625	
Benzo(g,h,i)perylene	EPA 625	
Benzo(k)fluoranthene	EPA 625	
Benzo[b]fluoranthene	EPA 625	
Benzoic acid	EPA 625	
Biphenyl	EPA 625	
bis(2-Chloroethoxy)methane	EPA 625	
bis(2-Chloroethyl) ether	EPA 625	
bis(2-Chloroisopropyl) ether	EPA 625	
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	
Butyl benzyl phthalate	EPA 625	
Carbazole	EPA 625	
Chrysene	EPA 625	
Dibenz(a,h) anthracene	EPA 625	
Dibenzofuran	EPA 625	
Diethyl phthalate	EPA 625	
Dimethyl phthalate	EPA 625	
Di-n-butyl phthalate	EPA 625	
Di-n-octyl phthalate	EPA 625	
Fluoranthene	EPA 625	
Fluorene	EPA 625	
Hexachlorobenzene	EPA 625	
Hexachlorobutadiene	EPA 625	
Hexachlorocyclopentadiene	EPA 625	
Hexachloroethane	EPA 625	
Indeno(1,2,3-cd) pyrene	EPA 625	
Isophorone	EPA 625	
Naphthalene	EPA 625	
Nitrobenzene	EPA 625	
N-Nitrosodimethylamine	EPA 625	
N-Nitroso-di-n-propylamine	EPA 625	
N-Nitrosodiphenylamine	EPA 625	
Pentachlorophenol	EPA 625	
Phenanthrene	EPA 625	
Phenol	EPA 625	
Pyrene	EPA 625	

Matrix/Analyte	Method	Notes
Pyridine	EPA 625	
Enterococci	Enterolert	
Heterotrophic plate count	SM 9215 B (PCA)	
Total & Fecal Coli - count	SM 9221 B (LTB) + E1 (EC) + C MPN	
Total Coli/Ecoli - count	SM 9221 B (LTB) + F (EC Mug) + C	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Total Coli/Ecoli - count	SM 9223 B (Colilert® QTray)	6
Fecal streptococci	SM 9230 B (PSE)	
Solid and Chemical Materials		
Nitrogen, Total Kjeldahl	ASTM D1426-93B	
Total Organic Carbon	ASTM D4129-05	
Solids, Total Volatile	EPA 160.4_1971	
Ammonia as N	EPA 350.1_2_1993	
Nitrate	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Orthophosphate	EPA 365.3_1978	
Phosphorus, total	EPA 365.3_1978	
Chromium VI	EPA 7196A_1_1992	
Total cyanide	EPA 9012A_1_1996	
Total organic halides (TOX)	EPA 9020B_2_1994	
Sulfide	EPA 9030B_2_1996	
Sulfide	EPA 9034_1996	3
pH	EPA 9040C_2002	
pH (non-aqueous)	EPA 9045C_3_1995	
Chloride	EPA 9056A_(11/00)	
Fluoride	EPA 9056A_(11/00)	
Nitrate	EPA 9056A_(11/00)	
Nitrite	EPA 9056A_(11/00)	
Sulfate	EPA 9056A_(11/00)	
Total organic carbon	EPA 9060	
Oil & Grease	EPA 9071 B_2_1999	
Sulfide	PSEP 1986 Color	
Solids, Total	SM 2540 B-97	

Matrix/Analyte	Method	Notes
Chemical Oxygen Demand (COD)	SM 5220 C-97	
Methyl Mercury	EPA 1630	
Aluminum	EPA 200.7_4.4_1994	
Antimony	EPA 200.7_4.4_1994	
Arsenic	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Cobalt	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Lead	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Molybdenum	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Potassium	EPA 200.7_4.4_1994	
Selenium	EPA 200.7_4.4_1994	
Silica	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Strontium	EPA 200.7_4.4_1994	
Thallium	EPA 200.7_4.4_1994	
Tin	EPA 200.7_4.4_1994	
Titanium	EPA 200.7_4.4_1994	
Vanadium	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	

Matrix/Analyte	Method	Notes
Chromium	EPA 200.8_5.4_1994	
Cobalt	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Molybdenum	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Uranium	EPA 200.8_5.4_1994	4
Vanadium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Aluminum	EPA 6010C_(2/07)	
Antimony	EPA 6010C_(2/07)	
Arsenic	EPA 6010C_(2/07)	
Barium	EPA 6010C_(2/07)	
Beryllium	EPA 6010C_(2/07)	
Boron	EPA 6010C_(2/07)	
Cadmium	EPA 6010C_(2/07)	
Calcium	EPA 6010C_(2/07)	
Chromium	EPA 6010C_(2/07)	
Cobalt	EPA 6010C_(2/07)	
Copper	EPA 6010C_(2/07)	
Iron	EPA 6010C_(2/07)	
Lead	EPA 6010C_(2/07)	
Magnesium	EPA 6010C_(2/07)	
Manganese	EPA 6010C_(2/07)	
Molybdenum	EPA 6010C_(2/07)	
Nickel	EPA 6010C_(2/07)	
Potassium	EPA 6010C_(2/07)	
Selenium	EPA 6010C_(2/07)	
Silver	EPA 6010C_(2/07)	
Sodium	EPA 6010C_(2/07)	
Thallium	EPA 6010C_(2/07)	
Vanadium	EPA 6010C_(2/07)	

Matrix/Analyte	Method	Notes
Zinc	EPA 6010C_(2/07)	
Aluminum	EPA 6020A_(2/07)	
Antimony	EPA 6020A_(2/07)	
Arsenic	EPA 6020A_(2/07)	
Barium	EPA 6020A_(2/07)	
Beryllium	EPA 6020A_(2/07)	
Cadmium	EPA 6020A_(2/07)	
Chromium	EPA 6020A_(2/07)	
Cobalt	EPA 6020A_(2/07)	
Copper	EPA 6020A_(2/07)	
Lead	EPA 6020A_(2/07)	
Manganese	EPA 6020A_(2/07)	
Molybdenum	EPA 6020A_(2/07)	
Nickel	EPA 6020A_(2/07)	
Selenium	EPA 6020A_(2/07)	
Silver	EPA 6020A_(2/07)	
Thallium	EPA 6020A_(2/07)	
Vanadium	EPA 6020A_(2/07)	
Zinc	EPA 6020A_(2/07)	
Antimony	EPA 7010 (2007)	
Arsenic	EPA 7010 (2007)	
Chromium	EPA 7010 (2007)	
Lead	EPA 7010 (2007)	
Selenium	EPA 7010 (2007)	
Thallium	EPA 7010 (2007)	
Arsenic	EPA 7062	
Chromium VI	EPA 7195	
Mercury, Liquid Waste	EPA 7470A_1_1994	3
Mercury, Solid Waste	EPA 7471B_(1/98)	
Selenium	EPA 7742	
Glycols	EPA 8015B_2_1996	
Benzene	EPA 8021B_2_1996	
Ethylbenzene	EPA 8021B_2_1996	
m+p-xylene	EPA 8021B_2_1996	
o-Xylene	EPA 8021B_2_1996	
Toluene	EPA 8021B_2_1996	

Matrix/Analyte	Method	Notes
Xylenes (total)	EPA 8021B_2_1996	
4,4'-DDD	EPA 8081B_(2/07)	
4,4'-DDE	EPA 8081B_(2/07)	
4,4'-DDT	EPA 8081B_(2/07)	
Alachlor	EPA 8081B_(2/07)	
Aldrin	EPA 8081B_(2/07)	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
alpha-Chlordane	EPA 8081B_(2/07)	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
Chlordane (tech.)	EPA 8081B_(2/07)	
delta-BHC	EPA 8081B_(2/07)	
Dieldrin	EPA 8081B_(2/07)	
Endosulfan I	EPA 8081B_(2/07)	
Endosulfan II	EPA 8081B_(2/07)	
Endosulfan sulfate	EPA 8081B_(2/07)	
Endrin	EPA 8081B_(2/07)	
Endrin aldehyde	EPA 8081B_(2/07)	
Endrin ketone	EPA 8081B_(2/07)	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
gamma-Chlordane	EPA 8081B_(2/07)	
Heptachlor	EPA 8081B_(2/07)	
Heptachlor epoxide	EPA 8081B_(2/07)	
Hexachlorobenzene	EPA 8081B_(2/07)	
Isodrin	EPA 8081B_(2/07)	
Methoxychlor	EPA 8081B_(2/07)	
Mirex	EPA 8081B_(2/07)	
Permethrin (total)	EPA 8081B_(2/07)	
Toxaphene (Chlorinated camphene)	EPA 8081B_(2/07)	
trans-Nonachlor	EPA 8081B_(2/07)	
Aroclor-1016 (PCB-1016)	EPA 8082A_(2/07)	
Aroclor-1221 (PCB-1221)	EPA 8082A_(2/07)	
Aroclor-1232 (PCB-1232)	EPA 8082A_(2/07)	
Aroclor-1242 (PCB-1242)	EPA 8082A_(2/07)	
Aroclor-1248 (PCB-1248)	EPA 8082A_(2/07)	
Aroclor-1254 (PCB-1254)	EPA 8082A_(2/07)	
Aroclor-1260 (PCB-1260)	EPA 8082A_(2/07)	

Matrix/Analyte	Method	Notes
Azinphos-methyl (Guthion)	EPA 8141B_(11/00)	
Bolstar (Sulprofos)	EPA 8141B_(11/00)	
Chlorpyrifos	EPA 8141B_(11/00)	
Coumaphos	EPA 8141B_(11/00)	
Demeton	EPA 8141B_(11/00)	
Demeton-o	EPA 8141B_(11/00)	
Demeton-s	EPA 8141B_(11/00)	
Diazinon	EPA 8141B_(11/00)	
Dichlorovos (DDVP, Dichlorvos)	EPA 8141B_(11/00)	
Dimethoate	EPA 8141B_(11/00)	
Disulfoton	EPA 8141B_(11/00)	
EPN	EPA 8141B_(11/00)	
Ethoprop	EPA 8141B_(11/00)	
Fensulfothion	EPA 8141B_(11/00)	
Fenthion	EPA 8141B_(11/00)	
Malathion	EPA 8141B_(11/00)	
Merphos	EPA 8141B_(11/00)	
Methyl parathion (Parathion, methyl)	EPA 8141B_(11/00)	
Mevinphos	EPA 8141B_(11/00)	
Naled	EPA 8141B_(11/00)	
Parathion, ethyl	EPA 8141B_(11/00)	
Phorate	EPA 8141B_(11/00)	
Ronnel	EPA 8141B_(11/00)	
Sulfotepp	EPA 8141B_(11/00)	
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8141B_(11/00)	
Tokuthion (Prothiophos)	EPA 8141B_(11/00)	
Trichloronate	EPA 8141B_(11/00)	
2,4,5-T	EPA 8151A_(1/98)	
2,4-D	EPA 8151A_(1/98)	
2,4-DB	EPA 8151A_(1/98)	
Dalapon	EPA 8151A_(1/98)	
Dicamba	EPA 8151A_(1/98)	
Dichlorprop	EPA 8151A_(1/98)	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A_(1/98)	
MCPA	EPA 8151A_(1/98)	
MCPP	EPA 8151A_(1/98)	

Matrix/Analyte	Method	Notes
Pentachlorophenol	EPA 8151A_(1/98)	
Silvex (2,4,5-TP)	EPA 8151A_(1/98)	
Acetaldehyde	EPA 8315A_1_1996	
Formaldehyde	EPA 8315A_1_1996	
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330B_(10/06)	
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330B_(10/06)	
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330B_(10/06)	
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330B_(10/06)	
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330B_(10/06)	
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330B_(10/06)	
2-Nitrotoluene	EPA 8330B_(10/06)	
3-Nitrotoluene	EPA 8330B_(10/06)	
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330B_(10/06)	
4-Nitrotoluene	EPA 8330B_(10/06)	
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330B_(10/06)	
Nitrobenzene	EPA 8330B_(10/06)	
Nitroglycerin	EPA 8330B_(10/06)	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (	EPA 8330B_(10/06)	
Pentaerythritoltetranitrate (PETN)	EPA 8330B_(10/06)	
Picramic Acid	EPA 8330B_(10/06)	
Picric Acid	EPA 8330B_(10/06)	
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330B_(10/06)	
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330B_(10/06)	
Organo-tins	Krone 1988	
Nitroguanidine	LCP-NITG	
OTTO Fuel	SOC-OTTO	
Total Pet Hydrocarbons - Diesel	WDOE NWTPH-Dx_(1997)	
Total Pet Hydrocarbons - Gasoline	WDOE NWTPH-Gx_(1997)	
1,1,1,2-Tetrachloroethane	EPA 8260C_(8/06)	
1,1,1-Trichloro-2,2,2-trifluoroethane	EPA 8260C_(8/06)	
1,1,1-Trichloroethane	EPA 8260C_(8/06)	
1,1,2,2-Tetrachloroethane	EPA 8260C_(8/06)	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260C_(8/06)	
1,1,2-Trichloroethane	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
1,1-Dichloroethane	EPA 8260C_(8/06)	
1,1-Dichloroethylene	EPA 8260C_(8/06)	
1,1-Dichloropropene	EPA 8260C_(8/06)	
1,2,3-Trichlorobenzene	EPA 8260C_(8/06)	
1,2,3-Trichloropropane	EPA 8260C_(8/06)	
1,2,3-Trimethylbenzene	EPA 8260C_(8/06)	
1,2,4-Trichlorobenzene	EPA 8260C_(8/06)	
1,2,4-Trimethylbenzene	EPA 8260C_(8/06)	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260C_(8/06)	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260C_(8/06)	
1,2-Dichlorobenzene	EPA 8260C_(8/06)	
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260C_(8/06)	
1,2-Dichloropropane	EPA 8260C_(8/06)	
1,3,5-Trimethylbenzene	EPA 8260C_(8/06)	
1,3-Dichlorobenzene	EPA 8260C_(8/06)	
1,3-Dichloropropane	EPA 8260C_(8/06)	
1,3-Dichloropropene	EPA 8260C_(8/06)	
1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
1,4-Dichlorobenzene	EPA 8260C_(8/06)	
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260C_(8/06)	
1-Chlorohexane	EPA 8260C_(8/06)	
2,2-Dichloro-1,1,1-trifluoroethane (Freon 123)	EPA 8260C_(8/06)	
2,2-Dichloropropane	EPA 8260C_(8/06)	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260C_(8/06)	
2-Chloroethyl vinyl ether	EPA 8260C_(8/06)	
2-Chlorotoluene	EPA 8260C_(8/06)	
2-Hexanone	EPA 8260C_(8/06)	
2-Methylpentane (Isohexane)	EPA 8260C_(8/06)	
2-Nitropropane	EPA 8260C_(8/06)	
3-Methylpentane	EPA 8260C_(8/06)	
4-Bromofluorobenzene	EPA 8260C_(8/06)	
4-Chlorotoluene	EPA 8260C_(8/06)	
4-Isopropyltoluene (p-Cymene)	EPA 8260C_(8/06)	
4-Methyl-2-pentanone (MIBK)	EPA 8260C_(8/06)	
Acetone	EPA 8260C_(8/06)	
Acetonitrile	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
Acrolein (Propenal)	EPA 8260C_(8/06)	
Acrylonitrile	EPA 8260C_(8/06)	
Allyl chloride (3-Chloropropene)	EPA 8260C_(8/06)	
Benzene	EPA 8260C_(8/06)	
Bromobenzene	EPA 8260C_(8/06)	
Bromochloromethane	EPA 8260C_(8/06)	
Bromodichloromethane	EPA 8260C_(8/06)	
Bromoform	EPA 8260C_(8/06)	
Carbon disulfide	EPA 8260C_(8/06)	
Carbon tetrachloride	EPA 8260C_(8/06)	
Chlorobenzene	EPA 8260C_(8/06)	
Chlorodibromomethane	EPA 8260C_(8/06)	
Chloroethane (Ethyl chloride)	EPA 8260C_(8/06)	
Chloroform	EPA 8260C_(8/06)	
Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260C_(8/06)	
cis & trans-1,2-Dichloroethene	EPA 8260C_(8/06)	
cis-1,2-Dichloroethylene	EPA 8260C_(8/06)	
cis-1,3-Dichloropropene	EPA 8260C_(8/06)	
cis-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
Cyclohexane	EPA 8260C_(8/06)	
Dibromochloropropane	EPA 8260C_(8/06)	
Dibromofluoromethane	EPA 8260C_(8/06)	
Dibromomethane (Methylene bromide)	EPA 8260C_(8/06)	
Dichlorodifluoromethane (Freon-12)	EPA 8260C_(8/06)	
Dichlorofluoromethane (Freon 21)	EPA 8260C_(8/06)	
Diethyl ether	EPA 8260C_(8/06)	
Ethanol	EPA 8260C_(8/06)	
Ethyl acetate	EPA 8260C_(8/06)	
Ethyl acrylate	EPA 8260C_(8/06)	
Ethyl methacrylate	EPA 8260C_(8/06)	
Ethyl tert-Butyl alcohol	EPA 8260C_(8/06)	
Ethylbenzene	EPA 8260C_(8/06)	
Ethylene oxide	EPA 8260C_(8/06)	
Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropan	EPA 8260C_(8/06)	
Hexachlorobutadiene	EPA 8260C_(8/06)	
Iodomethane (Methyl iodide)	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260C_(8/06)	
Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260C_(8/06)	
Isopropylbenzene	EPA 8260C_(8/06)	
m+p-xylene	EPA 8260C_(8/06)	
Methacrylonitrile	EPA 8260C_(8/06)	
Methyl acetate	EPA 8260C_(8/06)	
Methyl acrylate	EPA 8260C_(8/06)	
Methyl bromide (Bromomethane)	EPA 8260C_(8/06)	
Methyl chloride (Chloromethane)	EPA 8260C_(8/06)	
Methyl methacrylate	EPA 8260C_(8/06)	
Methyl tert-butyl ether (MTBE)	EPA 8260C_(8/06)	
Methylcyclohexane	EPA 8260C_(8/06)	
Methylcyclopentane	EPA 8260C_(8/06)	
Methylene chloride (Dichloromethane)	EPA 8260C_(8/06)	
m-Xylene	EPA 8260C_(8/06)	
Naphthalene	EPA 8260C_(8/06)	
n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260C_(8/06)	
n-Butylbenzene	EPA 8260C_(8/06)	
n-Heptane	EPA 8260C_(8/06)	
n-Hexane	EPA 8260C_(8/06)	
n-Octane	EPA 8260C_(8/06)	
n-Propanol (1-Propanol)	EPA 8260C_(8/06)	
n-Propylbenzene	EPA 8260C_(8/06)	
o-Xylene	EPA 8260C_(8/06)	
Propionitrile (Ethyl cyanide)	EPA 8260C_(8/06)	
p-Xylene	EPA 8260C_(8/06)	
sec-Butylbenzene	EPA 8260C_(8/06)	
Styrene	EPA 8260C_(8/06)	
tert-amylmethylether (TAME)	EPA 8260C_(8/06)	
tert-Butyl alcohol	EPA 8260C_(8/06)	
tert-Butylbenzene	EPA 8260C_(8/06)	
Tetrachloroethylene (Perchloroethylene)	EPA 8260C_(8/06)	
Tetrahydrofuran (THF)	EPA 8260C_(8/06)	
Toluene	EPA 8260C_(8/06)	
trans-1,2-Dichloroethylene	EPA 8260C_(8/06)	
trans-1,3-Dichloropropylene	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
trans-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
Trichloroethene (Trichloroethylene)	EPA 8260C_(8/06)	
Trichlorofluoromethane (Freon 11)	EPA 8260C_(8/06)	
Vinyl acetate	EPA 8260C_(8/06)	
Vinyl chloride	EPA 8260C_(8/06)	
Xylenes (total)	EPA 8260C_(8/06)	
1,2,4,5-Tetrachlorobenzene	EPA 8270D_(2/07)	
1,2,4-Trichlorobenzene	EPA 8270D_(2/07)	
1,2-Dichlorobenzene	EPA 8270D_(2/07)	
1,2-Diphenylhydrazine	EPA 8270D_(2/07)	
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D_(2/07)	
1,3-Dichlorobenzene	EPA 8270D_(2/07)	
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D_(2/07)	
1,4-Dichlorobenzene	EPA 8270D_(2/07)	
1,4-Naphthoquinone	EPA 8270D_(2/07)	
1,4-Phenylenediamine	EPA 8270D_(2/07)	
1-Chloronaphthalene	EPA 8270D_(2/07)	
1-Naphthylamine	EPA 8270D_(2/07)	
2,3,4,6-Tetrachlorophenol	EPA 8270D_(2/07)	
2,4,5-Trichlorophenol	EPA 8270D_(2/07)	
2,4,6-Trichlorophenol	EPA 8270D_(2/07)	
2,4-Dichlorophenol	EPA 8270D_(2/07)	
2,4-Dimethylphenol	EPA 8270D_(2/07)	
2,4-Dinitrophenol	EPA 8270D_(2/07)	
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D_(2/07)	
2,6-Dichlorophenol	EPA 8270D_(2/07)	
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D_(2/07)	
2-Acetylaminofluorene	EPA 8270D_(2/07)	
2-Chloronaphthalene	EPA 8270D_(2/07)	
2-Chlorophenol	EPA 8270D_(2/07)	
2-Methylnaphthalene	EPA 8270D_(2/07)	
2-Methylphenol (o-Cresol)	EPA 8270D_(2/07)	
2-Naphthylamine	EPA 8270D_(2/07)	
2-Nitroaniline	EPA 8270D_(2/07)	
2-Nitrophenol	EPA 8270D_(2/07)	
2-Picoline (2-Methylpyridine)	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
3,3'-Dichlorobenzidine	EPA 8270D_(2/07)	
3,3'-Dimethylbenzidine	EPA 8270D_(2/07)	
3-Methylcholanthrene	EPA 8270D_(2/07)	
3-Methylphenol (m-Cresol)	EPA 8270D_(2/07)	
3-Nitroaniline	EPA 8270D_(2/07)	
4,4'-Methylenebis(2-chloroaniline)	EPA 8270D_(2/07)	
4,6-Dinitro-2-methylphenol	EPA 8270D_(2/07)	
4-Aminobiphenyl	EPA 8270D_(2/07)	
4-Bromophenyl phenyl ether	EPA 8270D_(2/07)	
4-Chloro-3-methylphenol	EPA 8270D_(2/07)	
4-Chloroaniline	EPA 8270D_(2/07)	
4-Chlorophenyl phenylether	EPA 8270D_(2/07)	
4-Methylphenol (p-Cresol)	EPA 8270D_(2/07)	
4-Nitroaniline	EPA 8270D_(2/07)	
4-Nitrophenol	EPA 8270D_(2/07)	
5-Nitro-o-toluidine	EPA 8270D_(2/07)	
7,12-Dimethylbenz(a) anthracene	EPA 8270D_(2/07)	
a,a-Dimethylphenethylamine	EPA 8270D_(2/07)	
Acenaphthene	EPA 8270D_(2/07)	
Acenaphthylene	EPA 8270D_(2/07)	
Acetophenone	EPA 8270D_(2/07)	
Aniline	EPA 8270D_(2/07)	
Anthracene	EPA 8270D_(2/07)	
Aramite	EPA 8270D_(2/07)	
Atrazine	EPA 8270D_(2/07)	
Benzidine	EPA 8270D_(2/07)	
Benzo(a)anthracene	EPA 8270D_(2/07)	
Benzo(a)pyrene	EPA 8270D_(2/07)	
Benzo(g,h,i)perylene	EPA 8270D_(2/07)	
Benzo(k)fluoranthene	EPA 8270D_(2/07)	
Benzo[b]fluoranthene	EPA 8270D_(2/07)	
Benzoic acid	EPA 8270D_(2/07)	
Benzyl alcohol	EPA 8270D_(2/07)	
Biphenyl	EPA 8270D_(2/07)	
bis(2-Chloroethoxy)methane	EPA 8270D_(2/07)	
bis(2-Chloroethyl) ether	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
bis(2-Chloroisopropyl) ether	EPA 8270D_(2/07)	
Butyl benzyl phthalate	EPA 8270D_(2/07)	
Carbazole	EPA 8270D_(2/07)	
Chlorobenzilate	EPA 8270D_(2/07)	
Chrysene	EPA 8270D_(2/07)	
Di(2-ethylhexyl)phthalate	EPA 8270D_(2/07)	
Diallate	EPA 8270D_(2/07)	
Dibenzofuran	EPA 8270D_(2/07)	
Diethyl phthalate	EPA 8270D_(2/07)	
Dimethoate	EPA 8270D_(2/07)	
Dimethyl phthalate	EPA 8270D_(2/07)	
Di-n-butyl phthalate	EPA 8270D_(2/07)	
Di-n-octyl phthalate	EPA 8270D_(2/07)	
Diphenylamine	EPA 8270D_(2/07)	
Famphur	EPA 8270D_(2/07)	
Fluoranthene	EPA 8270D_(2/07)	
Fluorene	EPA 8270D_(2/07)	
Hexachlorobutadiene	EPA 8270D_(2/07)	
Hexachlorocyclopentadiene	EPA 8270D_(2/07)	
Hexachloroethane	EPA 8270D_(2/07)	
Hexachlorophene	EPA 8270D_(2/07)	
Hexachloropropene	EPA 8270D_(2/07)	
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07)	
Isodrin	EPA 8270D_(2/07)	
Isophorone	EPA 8270D_(2/07)	
Isosafrole	EPA 8270D_(2/07)	
Kepone	EPA 8270D_(2/07)	
Malathion	EPA 8270D_(2/07)	
Methapyrilene	EPA 8270D_(2/07)	
Methyl methanesulfonate	EPA 8270D_(2/07)	
Methyl parathion (Parathion, methyl)	EPA 8270D_(2/07)	
Naphthalene	EPA 8270D_(2/07)	
Nitrobenzene	EPA 8270D_(2/07)	
Nitroquinoline-1-oxide	EPA 8270D_(2/07)	
N-Nitrosodiethylamine	EPA 8270D_(2/07)	
N-Nitrosodimethylamine	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
N-Nitroso-di-n-butylamine	EPA 8270D_(2/07)	
N-Nitroso-di-n-propylamine	EPA 8270D_(2/07)	
N-Nitrosodiphenylamine	EPA 8270D_(2/07)	
N-Nitrosomethylethalamine	EPA 8270D_(2/07)	
N-Nitrosomorpholine	EPA 8270D_(2/07)	
N-Nitrosopiperidine	EPA 8270D_(2/07)	
N-Nitrosopyrrolidine	EPA 8270D_(2/07)	
o,o,o-Triethyl phosphorothioate	EPA 8270D_(2/07)	
o-Toluidine	EPA 8270D_(2/07)	
Parathion	EPA 8270D_(2/07)	
p-Benzoquinone	EPA 8270D_(2/07)	
Pentachlorobenzene	EPA 8270D_(2/07)	
Pentachloronitrobenzene	EPA 8270D_(2/07)	
Pentachlorophenol	EPA 8270D_(2/07)	
Phenacetin	EPA 8270D_(2/07)	
Phenanthrene	EPA 8270D_(2/07)	
Phenol	EPA 8270D_(2/07)	
Phorate	EPA 8270D_(2/07)	
Pronamide (Kerb)	EPA 8270D_(2/07)	
Pyrene	EPA 8270D_(2/07)	
Pyridine	EPA 8270D_(2/07)	
Safrole	EPA 8270D_(2/07)	
1-Methylnaphthalene	EPA 8270D_(2/07) SIM	
Acenaphthene	EPA 8270D_(2/07) SIM	
Acenaphthylene	EPA 8270D_(2/07) SIM	
Anthracene	EPA 8270D_(2/07) SIM	
Benzo(a)anthracene	EPA 8270D_(2/07) SIM	
Benzo(a)pyrene	EPA 8270D_(2/07) SIM	
Benzo(g,h,i)perylene	EPA 8270D_(2/07) SIM	
Benzo(k)fluoranthene	EPA 8270D_(2/07) SIM	
Benzo[b]fluoranthene	EPA 8270D_(2/07) SIM	
Chrysene	EPA 8270D_(2/07) SIM	
Dibenz(a,h) anthracene	EPA 8270D_(2/07) SIM	
Fluoranthene	EPA 8270D_(2/07) SIM	
Fluorene	EPA 8270D_(2/07) SIM	
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07) SIM	

Matrix/Analyte	Method	Notes
Naphthalene	EPA 8270D_(2/07) SIM	
Pentachlorophenol	EPA 8270D_(2/07) SIM	
Phenanthrene	EPA 8270D_(2/07) SIM	
Pyrene	EPA 8270D_(2/07) SIM	
3-Hydroxycarbofuran	EPA 8321B_(1/98)	
Aldicarb (Temik)	EPA 8321B_(1/98)	
Aldicarb sulfone	EPA 8321B_(1/98)	
Aldicarb sulfoxide	EPA 8321B_(1/98)	
Aminocarb	EPA 8321B_(1/98)	
Barban	EPA 8321B_(1/98)	
Benomyl	EPA 8321B_(1/98)	
Bromacil	EPA 8321B_(1/98)	
Carbaryl (Sevin)	EPA 8321B_(1/98)	
Carbofuran (Furaden)	EPA 8321B_(1/98)	
Chloropropham	EPA 8321B_(1/98)	
Chloroxuron	EPA 8321B_(1/98)	
Diuron	EPA 8321B_(1/98)	
Fenuron	EPA 8321B_(1/98)	
Fluometuron	EPA 8321B_(1/98)	
Linuron (Lorox)	EPA 8321B_(1/98)	
Methiocarb (Mesurol)	EPA 8321B_(1/98)	
Methomyl (Lannate)	EPA 8321B_(1/98)	
Mexacarbate	EPA 8321B_(1/98)	
Monuron	EPA 8321B_(1/98)	
Neburon	EPA 8321B_(1/98)	
Oxamyl	EPA 8321B_(1/98)	
Propham	EPA 8321B_(1/98)	
Propoxur (Baygon)	EPA 8321B_(1/98)	
Prosulfocarb	EPA 8321B_(1/98)	
Siduron	EPA 8321B_(1/98)	
Tebuthiuron	EPA 8321B_(1/98)	
Fecal coliform-count	SM 9221 B (LTB) + E1 (EC) + C MPN	5
Particle Size Distribution	ASTM D 422	
Ignitability	EPA 1020A_1_1992	
Corrosivity	EPA 1110A-02	

Matrix/Analyte	Method	Notes
Particle Size Distribution (Sed)	PSEP 1986 Wet Sieve	

Accredited Parameter Note Detail

(1) Accreditation does not apply to NPDES testing due to the sample holding time requirment for pH. (2) Method not approved for NPDES testing. (3) Accrediltation is limited to liquid matrix only. (4) Provisional accreditation pending submittal of additional, acceptable Proficiency Testing (PT) results (WAC 173-50-110). (5) Interim accreditation pending the successful completion of an on-site audit to verify method capabilities (WAC 173-50-100). (6) Colilert accreditation includes the use of both Colilert 24 and Colilert 18 formulations.

07/26/2013

Authentication Signature
Alan D. Rue, Lab Accreditation Unit Supervisor

Date

Parameters Not Accredited

ALS Environmental - Kelso

Kelso, WA

Analyte	Method	Notes	Matrix
2,4-Dichlorophenol	EPA 1653_A_1997	a	N
2,6-Dichlorophenol	EPA 1653_A_1997	a	N
2,6-Dichlorosyringaldehyde	EPA 1653_A_1997	a	N
2-Chlorosyringaldehyde	EPA 1653_A_1997	a	N
3,4-Dichlorocatechol	EPA 1653_A_1997	a	N
3,4-Dichloroguaiacol	EPA 1653_A_1997	a	N
3,6-Dichlorocatechol	EPA 1653_A_1997	a	N
4,5-Dichloro-2-methoxyphenol	EPA 1653_A_1997	a	N
4,5-Dichlorocatechol	EPA 1653_A_1997	a	N
4,6-Dichloroguaiacol	EPA 1653_A_1997	a	N
4-Chlorocatechol	EPA 1653_A_1997	a	N
4-Chloroguaiacol	EPA 1653_A_1997	a	N
4-Chlorophenol	EPA 1653_A_1997	a	N
5,6-Dichlorovanillin	EPA 1653_A_1997	a	N
5-Chlorovanillin	EPA 1653_A_1997	a	N
6-Chlorovanillin	EPA 1653_A_1997	a	N
1,7-Dimethylxanthine	EPA 1694	a	N
4-Epianhydrochlortetracycline (EACTC)	EPA 1694	a	N
4-Epianhydrotetracycline (EATC)	EPA 1694	a	N
4-Epichlortetracycline (ECTC)	EPA 1694	a	N
4-Epioxytetracycline (EOTC)	EPA 1694	a	N
4-Epitetracycline (ETC)	EPA 1694	a	N
Albuterol	EPA 1694	a	N
Ampicillin	EPA 1694	a	N
Anhydrochlortetracycline (ACTC)	EPA 1694	a	N
Anhydrotetracycline (ATC)	EPA 1694	a	N
Azithromycin	EPA 1694	a	N
Carbadox	EPA 1694	a	N
Carbamazepine	EPA 1694	a	N
Cefotaxime	EPA 1694	a	N
Chlortetracycline (CTC)	EPA 1694	a	N
Cimetidine	EPA 1694	a	N
Ciprofloxacin	EPA 1694	a	N
Clarithromycin	EPA 1694	a	N
Clinafloxacin	EPA 1694	a	N
Cloxacillin	EPA 1694	a	N
Codeine	EPA 1694	a	N
Cotinine	EPA 1694	a	N
Dehydronifedipine	EPA 1694	a	N
Demeclocycline	EPA 1694	a	N
Digoxigenin	EPA 1694	a	N

Analyte	Method	Notes	Matrix
Digoxin	EPA 1694	a	N
Diltiazem	EPA 1694	a	N
Diphenhydramine	EPA 1694	a	N
Doxycycline	EPA 1694	a	N
Enrofloxacin	EPA 1694	a	N
Erythromycin	EPA 1694	a	N
Erythromycin anhydrate	EPA 1694	a	N
Flumequine	EPA 1694	a	N
Isochlortetracycline (ICTC)	EPA 1694	a	N
Lincomycin	EPA 1694	a	N
Lomefloxacin	EPA 1694	a	N
Metformin	EPA 1694	a	N
Miconazole	EPA 1694	a	N
Minocycline	EPA 1694	a	N
Norfloxacin	EPA 1694	a	N
Norgestimate	EPA 1694	a	N
Ofloxacin	EPA 1694	a	N
Ormetoprim	EPA 1694	a	N
Oxacillin	EPA 1694	a	N
Oxolinic acid	EPA 1694	a	N
Oxytetracycline (OTC)	EPA 1694	a	N
Penicillin G	EPA 1694	a	N
Penicillin V	EPA 1694	a	N
Ranitidine	EPA 1694	a	N
Roxithromycin	EPA 1694	a	N
Sarafloxacin	EPA 1694	a	N
Sulfachloropyridazine	EPA 1694	a	N
Sulfadiazine	EPA 1694	a	N
Sulfadimethoxine	EPA 1694	a	N
Sulfamerazine	EPA 1694	a	N
Sulfamethazine	EPA 1694	a	N
Sulfamethizole	EPA 1694	a	N
Sulfamethoxazole	EPA 1694	a	N
Sulfanilamide	EPA 1694	a	N
Sulfathiazole	EPA 1694	a	N
Tetracycline (TC)	EPA 1694	a	N
Thiabendazole	EPA 1694	a	N
Triclocarban	EPA 1694	a	N
Tylosin	EPA 1694	a	N
Virginiamycin	EPA 1694	a	N
Warfarin	EPA 1694	a	N
Ammonia as N	EPA 350.1_2_1993	a	N
Surfactants - MBAS	EPA 425.1_1971	a	N
2,4'-DDD	EPA 508.1_2_1995	a	D
Alachlor	EPA 508.1_2_1995	a	D
Atrazine	EPA 508.1_2_1995	a	D
Butachlor	EPA 508.1_2_1995	a	D
Chlorobenzilate	EPA 508.1_2_1995	a	D

Analyte	Method	Notes	Matrix
Chloroneb	EPA 508.1_2_1995	a	D
Chlorothalonil	EPA 508.1_2_1995	a	D
cis-Permethrin	EPA 508.1_2_1995	a	D
Cyanazine	EPA 508.1_2_1995	a	D
Dacthal (DCPA)	EPA 508.1_2_1995	a	D
Decachlorobiphenyl	EPA 508.1_2_1995	a	D
Etridiazole	EPA 508.1_2_1995	a	D
Hexachlorobenzene	EPA 508.1_2_1995	a	D
Hexachlorocyclopentadiene	EPA 508.1_2_1995	a	D
Metolachlor	EPA 508.1_2_1995	a	D
Metribuzin	EPA 508.1_2_1995	a	D
Propachlor (Ramrod)	EPA 508.1_2_1995	a	D
Simazine	EPA 508.1_2_1995	a	D
trans Permethrin	EPA 508.1_2_1995	a	D
Trifluralin (Treflan)	EPA 508.1_2_1995	a	D
1-Chlorobutane	EPA 524.2_4.1_1995	a	D
2-Nitropropane	EPA 524.2_4.1_1995	a	D
Acrolein (Propenal)	EPA 524.2_4.1_1995	a	D
Acrylonitrile	EPA 524.2_4.1_1995	a	D
Allyl chloride (3-Chloropropene)	EPA 524.2_4.1_1995	a	D
Chloroacetonitrile	EPA 524.2_4.1_1995	a	D
Diethyl ether	EPA 524.2_4.1_1995	a	D
Ethyl methacrylate	EPA 524.2_4.1_1995	a	D
Hexachloroethane	EPA 524.2_4.1_1995	a	D
Methacrylonitrile	EPA 524.2_4.1_1995	a	D
Methyl methacrylate	EPA 524.2_4.1_1995	a	D
Nitrobenzene	EPA 524.2_4.1_1995	a	D
Pentachloroethane	EPA 524.2_4.1_1995	a	D
Propionitrile (Ethyl cyanide)	EPA 524.2_4.1_1995	a	D
Tetrahydrofuran (THF)	EPA 524.2_4.1_1995	a	D
trans-1,4-Dichloro-2-butene	EPA 524.2_4.1_1995	a	D
2,2', 3,3', 4,4', 5-Heptachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2', 3,3', 4,4'5,5'-Octachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2', 4,5'-Tetrachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2',3,4,4',5',6-Heptachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2',3,4,5'-Pentachlorobiphenyl	EPA 525.2_2_1995	a	D
2,3-Dichlorobiphenyl	EPA 525.2_2_1995	a	D
2,4',5-Trichlorobiphenyl	EPA 525.2_2_1995	a	D
4,4'-DDD	EPA 525.2_2_1995	a	D
4,4'-DDE	EPA 525.2_2_1995	a	D
4,4'-DDT	EPA 525.2_2_1995	a	D
Aldrin	EPA 525.2_2_1995	a	D
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
alpha-Chlordane	EPA 525.2_2_1995	a	D
Aroclor-1016 (PCB-1016)	EPA 525.2_2_1995	a	D
Aroclor-1221 (PCB-1221)	EPA 525.2_2_1995	a	D
Aroclor-1232 (PCB-1232)	EPA 525.2_2_1995	a	D
Aroclor-1242 (PCB-1242)	EPA 525.2_2_1995	a	D

Analyte	Method	Notes	Matrix
Aroclor-1248 (PCB-1248)	EPA 525.2_2_1995	a	D
Aroclor-1254 (PCB-1254)	EPA 525.2_2_1995	a	D
Aroclor-1260 (PCB-1260)	EPA 525.2_2_1995	a	D
beta-BHC (beta-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
Chlordane (tech.)	EPA 525.2_2_1995	a	D
Chlorpyrifos	EPA 525.2_2_1995	a	D
Decachlorobiphenyl	EPA 525.2_2_1995	a	D
delta-BHC	EPA 525.2_2_1995	a	D
Dieldrin	EPA 525.2_2_1995	a	D
Disulfoton	EPA 525.2_2_1995	a	D
Endosulfan I	EPA 525.2_2_1995	a	D
Endosulfan II	EPA 525.2_2_1995	a	D
Endosulfan sulfate	EPA 525.2_2_1995	a	D
Endrin	EPA 525.2_2_1995	a	D
Endrin aldehyde	EPA 525.2_2_1995	a	D
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
gamma-Chlordane	EPA 525.2_2_1995	a	D
Heptachlor	EPA 525.2_2_1995	a	D
Heptachlor epoxide	EPA 525.2_2_1995	a	D
Hexachlorocyclopentadiene	EPA 525.2_2_1995	a	D
Methoxychlor	EPA 525.2_2_1995	a	D
Methyl paraoxon	EPA 525.2_2_1995	a	D
Pentachlorophenol	EPA 525.2_2_1995	a	D
Stirolos	EPA 525.2_2_1995	a	D
Toxaphene (Chlorinated camphene)	EPA 525.2_2_1995	a	D
Aldicarb (Temik)	EPA 531.1_3.1_1995	a	D
Aldicarb sulfone	EPA 531.1_3.1_1995	a	D
Aldicarb sulfoxide	EPA 531.1_3.1_1995	a	D
Carbaryl (Sevin)	EPA 531.1_3.1_1995	a	D
Carbofuran (Furaden)	EPA 531.1_3.1_1995	a	D
Methiocarb (Mesurol)	EPA 531.1_3.1_1995	a	D
Methomyl (Lannate)	EPA 531.1_3.1_1995	a	D
n-Methylcarbamates	EPA 531.1_3.1_1995	a	D
Oxamyl	EPA 531.1_3.1_1995	a	D
Propoxur (Baygon)	EPA 531.1_3.1_1995	a	D
Glyphosate	EPA 547_1990	a	D
Dalapon	EPA 552.2_1_1995	a	D
1,2,3-Trichlorobenzene	EPA 624	a	N
1,2,4-Trichlorobenzene	EPA 624	a	N
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 624	a	N
2-Chloro-1,3-butadiene (Chloroprene)	EPA 624	a	N
2-Picoline (2-Methylpyridine)	EPA 624	a	N
Dibromochloropropane	EPA 624	a	N
Diethyl ether	EPA 624	a	N
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 624	a	N
Naphthalene	EPA 624	a	N
Nitrobenzene	EPA 624	a	N
p-Dioxane	EPA 624	a	N

Analyte	Method	Notes	Matrix
p-Isopropyltoluene	EPA 624	a	N
1,2-Dichlorobenzene	EPA 625	a	N
1,3-Dichlorobenzene	EPA 625	a	N
1,4-Dichlorobenzene	EPA 625	a	N
1,4-Naphthoquinone	EPA 625	a	N
1-Chloronaphthalene	EPA 625	a	N
1-Naphthylamine	EPA 625	a	N
2,3,6-Trichlorophenol (4C)	EPA 625	a	N
2-Naphthylamine	EPA 625	a	N
4,4'-DDD	EPA 625	a	N
4,4'-DDE	EPA 625	a	N
4,4'-DDT	EPA 625	a	N
4-Chlorophenol	EPA 625	a	N
Aldrin	EPA 625	a	N
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 625	a	N
alpha-Terpineol	EPA 625	a	N
beta-BHC (beta-Hexachlorocyclohexane)	EPA 625	a	N
Chlordane (tech.)	EPA 625	a	N
delta-BHC	EPA 625	a	N
Di(2-ethylhexyl)adipate	EPA 625	a	N
Dieldrin	EPA 625	a	N
Endosulfan I	EPA 625	a	N
Endosulfan II	EPA 625	a	N
Endosulfan sulfate	EPA 625	a	N
Endrin	EPA 625	a	N
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 625	a	N
Heptachlor	EPA 625	a	N
Heptachlor epoxide	EPA 625	a	N
Hexachloropropene	EPA 625	a	N
Methoxychlor	EPA 625	a	N
n-Decane	EPA 625	a	N
n-Docosane	EPA 625	a	N
n-Dodecane	EPA 625	a	N
n-Eicosane	EPA 625	a	N
n-Hexadecane	EPA 625	a	N
N-Nitrosodiethylamine	EPA 625	a	N
N-Nitroso-di-n-butylamine	EPA 625	a	N
n-Octadecane	EPA 625	a	N
n-Tetradecane	EPA 625	a	N
Pentachloroethane	EPA 625	a	N
Toxaphene (Chlorinated camphene)	EPA 625	a	N
Copper	EPA 7010 (2007)	b	S
Arsenic	EPA 7060A (1994)	a	S
Chromium VI	EPA 7191	a	S
Lead	EPA 7420	a	S
Lead	EPA 7421	a	S
Selenium	EPA 7740	a	S
Thallium	EPA 7841	a	S

Analyte	Method	Notes	Matrix
Captafol	EPA 8081B_(2/07)	a	S
Chlorobenzilate	EPA 8081B_(2/07)	a	S
Chloroneb	EPA 8081B_(2/07)	a	S
Chloropropylate	EPA 8081B_(2/07)	a	S
Chlorothalonil	EPA 8081B_(2/07)	a	S
Dacthal (DCPA)	EPA 8081B_(2/07)	a	S
Diallate	EPA 8081B_(2/07)	a	S
Dichlone	EPA 8081B_(2/07)	a	S
Dicofol	EPA 8081B_(2/07)	a	S
Etridiazole	EPA 8081B_(2/07)	a	S
Halowax-1000	EPA 8081B_(2/07)	a	S
Halowax-1001	EPA 8081B_(2/07)	a	S
Halowax-1013	EPA 8081B_(2/07)	a	S
Halowax-1014	EPA 8081B_(2/07)	a	S
Halowax-1051	EPA 8081B_(2/07)	a	S
Halowax-1099	EPA 8081B_(2/07)	a	S
Hexachlorocyclopentadiene	EPA 8081B_(2/07)	a	S
Nitrofen	EPA 8081B_(2/07)	a	S
Perthane	EPA 8081B_(2/07)	a	S
Propachlor (Ramrod)	EPA 8081B_(2/07)	a	S
Strobane	EPA 8081B_(2/07)	a	S
Trifluralin (Treflan)	EPA 8081B_(2/07)	a	S
1,2-Phenylenediamine (o-Phenylenediamine)	EPA 8141B_(11/00)	a	S
Aspon	EPA 8141B_(11/00)	a	S
Atrazine	EPA 8141B_(11/00)	a	S
Azinphos-ethyl (Ethyl guthion)	EPA 8141B_(11/00)	a	S
Bendiocarb	EPA 8141B_(11/00)	a	S
Butylate	EPA 8141B_(11/00)	a	S
Carbophenothion	EPA 8141B_(11/00)	a	S
Chlorfenvinphos	EPA 8141B_(11/00)	a	S
Chlorpyrifos methyl	EPA 8141B_(11/00)	a	S
Crotoxyphos	EPA 8141B_(11/00)	a	S
Dichlorofenthion	EPA 8141B_(11/00)	a	S
Dicrotophos	EPA 8141B_(11/00)	a	S
Dioxathion	EPA 8141B_(11/00)	a	S
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 8141B_(11/00)	a	S
Ethion	EPA 8141B_(11/00)	a	S
Famphur	EPA 8141B_(11/00)	a	S
Fenitrothion	EPA 8141B_(11/00)	a	S
Fonophos	EPA 8141B_(11/00)	a	S
Hexamethylphosphoramide (HMPA)	EPA 8141B_(11/00)	a	S
Leptophos	EPA 8141B_(11/00)	a	S
Methiocarb (Mesurol)	EPA 8141B_(11/00)	a	S
Molinate	EPA 8141B_(11/00)	a	S
Monocrotophos	EPA 8141B_(11/00)	a	S
Pebulate	EPA 8141B_(11/00)	a	S
Phosmet (Imidan)	EPA 8141B_(11/00)	a	S
Phosphamidon	EPA 8141B_(11/00)	a	S

Analyte	Method	Notes	Matrix
Propham	EPA 8141B_(11/00)	a	S
Prosulfocarb	EPA 8141B_(11/00)	a	S
Simazine	EPA 8141B_(11/00)	a	S
Terbufos	EPA 8141B_(11/00)	a	S
Tetraethyl pyrophosphate (TEPP)	EPA 8141B_(11/00)	a	S
Thionazin (Zinophos)	EPA 8141B_(11/00)	a	S
Triallate	EPA 8141B_(11/00)	a	S
Trichlorfon	EPA 8141B_(11/00)	a	S
Tri-o-cresylphosphate (TOCP)	EPA 8141B_(11/00)	a	S
3,5-Dichlorobenzoic acid	EPA 8151A_(1/98)	a	S
4-Nitrophenol	EPA 8151A_(1/98)	a	S
5-Hydroxydicamba	EPA 8151A_(1/98)	a	S
Acifluorfen	EPA 8151A_(1/98)	a	S
Bentazon	EPA 8151A_(1/98)	a	S
Chloramben	EPA 8151A_(1/98)	a	S
Dacthal (DCPA)	EPA 8151A_(1/98)	a	S
DCPA di acid degradate	EPA 8151A_(1/98)	a	S
Picloram	EPA 8151A_(1/98)	a	S
1,1,1-Trichloro-2-propanone	EPA 8260C_(8/06)	a	S
1,1,2-Trichlorofluoroethane	EPA 8260C_(8/06)	a	S
1,1-Dichloro-1-fluoroethane	EPA 8260C_(8/06)	a	S
1,2,3,4-Diepoxybutane	EPA 8260C_(8/06)	a	S
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	EPA 8260C_(8/06)	a	S
1,2-Dichloro-1,1,2-trifluoroethane	EPA 8260C_(8/06)	a	S
1,2-Dimethoxyethane	EPA 8260C_(8/06)	a	S
1,3-Butanediol	EPA 8260C_(8/06)	a	S
1,3-Dichloro-2-propanol	EPA 8260C_(8/06)	a	S
1,4-Butanediol	EPA 8260C_(8/06)	a	S
1,4-Difluorobenzene	EPA 8260C_(8/06)	a	S
1-Butene	EPA 8260C_(8/06)	a	S
1-Chloro-1,2,2-trifluoroethane (Freon 133)	EPA 8260C_(8/06)	a	S
1-Chlorobutane	EPA 8260C_(8/06)	a	S
1-Heptene	EPA 8260C_(8/06)	a	S
1-Hexene	EPA 8260C_(8/06)	a	S
1-Methyl-2-n-propylbenzene	EPA 8260C_(8/06)	a	S
1-Propene	EPA 8260C_(8/06)	a	S
2,2,4-Trimethylpentane	EPA 8260C_(8/06)	a	S
2,2-Dimethylbutane	EPA 8260C_(8/06)	a	S
2,2'-Oxybis(1-chloropropane)	EPA 8260C_(8/06)	a	S
2,3,4-Trimethylpentane	EPA 8260C_(8/06)	a	S
2,3-Dichloropropene	EPA 8260C_(8/06)	a	S
2,3-Dimethylbutane	EPA 8260C_(8/06)	a	S
2,3-Dimethylpentane	EPA 8260C_(8/06)	a	S
2,4-Dimethylpentane	EPA 8260C_(8/06)	a	S
2-Bromofluorobenzene	EPA 8260C_(8/06)	a	S
2-Chloro-2-methybutane (tert-Amyl chloride)	EPA 8260C_(8/06)	a	S
2-Chloroethanol	EPA 8260C_(8/06)	a	S
2-Ethylhexanol (2-Ethyl-1-hexanol)	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
2-Ethyltoluene	EPA 8260C_(8/06)	a	S
2-Hexene	EPA 8260C_(8/06)	a	S
2-Hydroxypropionitrile	EPA 8260C_(8/06)	a	S
2-Methoxyethanol (Methyl cellosolve)	EPA 8260C_(8/06)	a	S
2-Methyl-1,3-dioxolane	EPA 8260C_(8/06)	a	S
2-Methyl-2-Butene	EPA 8260C_(8/06)	a	S
2-Methylaniline (o-Toluidine)	EPA 8260C_(8/06)	a	S
2-Methylbutadiene (Isoprene)	EPA 8260C_(8/06)	a	S
2-Methylbutane (Isopentane)	EPA 8260C_(8/06)	a	S
2-Methylheptane	EPA 8260C_(8/06)	a	S
2-Methylhexane	EPA 8260C_(8/06)	a	S
2-methylpropane (Isobutane)	EPA 8260C_(8/06)	a	S
2-Pentanone	EPA 8260C_(8/06)	a	S
2-Picoline (2-Methylpyridine)	EPA 8260C_(8/06)	a	S
3-Bromofluorobenzene	EPA 8260C_(8/06)	a	S
3-Butene-1-ol	EPA 8260C_(8/06)	a	S
3-Chloropropionitrile	EPA 8260C_(8/06)	a	S
3-Ethyltoluene	EPA 8260C_(8/06)	a	S
3-Methyl-1-Butene	EPA 8260C_(8/06)	a	S
3-Methylheptane	EPA 8260C_(8/06)	a	S
3-Methylhexane	EPA 8260C_(8/06)	a	S
4-Ethyltoluene	EPA 8260C_(8/06)	a	S
4-Methyl-1-Pentene	EPA 8260C_(8/06)	a	S
4-Methylaniline (p-Toluidine)	EPA 8260C_(8/06)	a	S
Acetamide	EPA 8260C_(8/06)	a	S
Acetylene	EPA 8260C_(8/06)	a	S
Acrylamide	EPA 8260C_(8/06)	a	S
Acrylic acid	EPA 8260C_(8/06)	a	S
Adsorbable Organic Halides (AOX)	EPA 8260C_(8/06)	a	S
Allyl alcohol	EPA 8260C_(8/06)	a	S
alpha-Methylstyrene	EPA 8260C_(8/06)	a	S
beta-Propiolactone	EPA 8260C_(8/06)	a	S
bis(2-Chloroethyl) sulfide	EPA 8260C_(8/06)	a	S
bis(Chloromethyl)ether	EPA 8260C_(8/06)	a	S
Bromoacetone	EPA 8260C_(8/06)	a	S
Bromoethane (Ethyl Bromide)	EPA 8260C_(8/06)	a	S
Bromoethene	EPA 8260C_(8/06)	a	S
Butyl acetate	EPA 8260C_(8/06)	a	S
Chloral hydrate	EPA 8260C_(8/06)	a	S
Chloroacetonitrile	EPA 8260C_(8/06)	a	S
Chlorodifluoromethane (Freon-22)	EPA 8260C_(8/06)	a	S
Chloromethyl methyl ether	EPA 8260C_(8/06)	a	S
cis-2-Butene	EPA 8260C_(8/06)	a	S
cis-2-Hexene	EPA 8260C_(8/06)	a	S
cis-2-pentene	EPA 8260C_(8/06)	a	S
Cycloate	EPA 8260C_(8/06)	a	S
Cyclohexanol	EPA 8260C_(8/06)	a	S
Cyclohexanone	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
Cyclopentane	EPA 8260C_(8/06)	a	S
Cyclopentene	EPA 8260C_(8/06)	a	S
Decanal	EPA 8260C_(8/06)	a	S
Dichlorotetrafluoroethane	EPA 8260C_(8/06)	a	S
Dicyclopentadiene	EPA 8260C_(8/06)	a	S
Diethylamine	EPA 8260C_(8/06)	a	S
Diethylene glycol	EPA 8260C_(8/06)	a	S
Dimethyl disulfide	EPA 8260C_(8/06)	a	S
Dimethyl sulfoxide	EPA 8260C_(8/06)	a	S
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260C_(8/06)	a	S
Ethane	EPA 8260C_(8/06)	a	S
Ethene	EPA 8260C_(8/06)	a	S
Ethylene glycol	EPA 8260C_(8/06)	a	S
Ethylene thiourea	EPA 8260C_(8/06)	a	S
Ethyleneimine	EPA 8260C_(8/06)	a	S
Fluorobenzene	EPA 8260C_(8/06)	a	S
Fluoromethane (Freon 41)	EPA 8260C_(8/06)	a	S
Heptanal	EPA 8260C_(8/06)	a	S
Hexachloroethane	EPA 8260C_(8/06)	a	S
Isopropyl acetate	EPA 8260C_(8/06)	a	S
Malononitrile	EPA 8260C_(8/06)	a	S
Methane	EPA 8260C_(8/06)	a	S
Methanol	EPA 8260C_(8/06)	a	S
Methyl formate	EPA 8260C_(8/06)	a	S
n, n-Dimethylformamide	EPA 8260C_(8/06)	a	S
n-Amyl acetate	EPA 8260C_(8/06)	a	S
n-Amyl alcohol	EPA 8260C_(8/06)	a	S
n-Butane	EPA 8260C_(8/06)	a	S
n-Butylcyclopentane	EPA 8260C_(8/06)	a	S
Nitrobenzene	EPA 8260C_(8/06)	a	S
N-Nitroso-di-n-butylamine	EPA 8260C_(8/06)	a	S
n-Nonane	EPA 8260C_(8/06)	a	S
n-Pentane	EPA 8260C_(8/06)	a	S
n-Propane	EPA 8260C_(8/06)	a	S
n-Propylamine	EPA 8260C_(8/06)	a	S
p-Diethylbenzene	EPA 8260C_(8/06)	a	S
Pentachloroethane	EPA 8260C_(8/06)	a	S
Pentafluorobenzene	EPA 8260C_(8/06)	a	S
Propargyl alcohol	EPA 8260C_(8/06)	a	S
Propyne	EPA 8260C_(8/06)	a	S
Purgeable Organic Halides	EPA 8260C_(8/06)	a	S
Pyridine	EPA 8260C_(8/06)	a	S
Sec-Amyl Alcohol (2-Pentanol)	EPA 8260C_(8/06)	a	S
S-Methyl thioacetate (S-Methyl etanethioate)	EPA 8260C_(8/06)	a	S
tert-Amyl alcohol (TAA)	EPA 8260C_(8/06)	a	S
tert-Amyl ethyl ether (TAEE)	EPA 8260C_(8/06)	a	S
trans-2-Butene	EPA 8260C_(8/06)	a	S
trans-2-Hexene	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
trans-2-pentene	EPA 8260C_(8/06)	a	S
Triethylamine	EPA 8260C_(8/06)	a	S
Trifluoromethane (Freon 23)	EPA 8260C_(8/06)	a	S
Vinyl bromide	EPA 8260C_(8/06)	a	S
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8270D_(2/07)	a	S
1,2-Dinitrobenzene	EPA 8270D_(2/07)	a	S
1,4-Dinitrobenzene	EPA 8270D_(2/07)	a	S
1-Acetyl-2-thiourea	EPA 8270D_(2/07)	a	S
1-Methylnaphthalene	EPA 8270D_(2/07)	a	S
2,4,5-Trimethylaniline	EPA 8270D_(2/07)	a	S
2,4-Diaminotoluene	EPA 8270D_(2/07)	a	S
2-Aminoanthraquinone	EPA 8270D_(2/07)	a	S
2-Cyclohexyl-4,6-dinitrophenol	EPA 8270D_(2/07)	a	S
3-(Chloromethyl) pyridine hydrochloride	EPA 8270D_(2/07)	a	S
3,3'-Dimethoxybenzidine	EPA 8270D_(2/07)	a	S
3-Amino-9-ethylcarbazole	EPA 8270D_(2/07)	a	S
4,4'-DDD	EPA 8270D_(2/07)	a	S
4,4'-DDE	EPA 8270D_(2/07)	a	S
4,4'-DDT	EPA 8270D_(2/07)	a	S
4,4'-Methylenebis(n, n-dimethylaniline)	EPA 8270D_(2/07)	a	S
4,4'-Oxydianiline	EPA 8270D_(2/07)	a	S
4-Chloro-1,2-phenylenediamine	EPA 8270D_(2/07)	a	S
4-Chloro-1,3-phenylenediamine	EPA 8270D_(2/07)	a	S
4-Chlorophenol	EPA 8270D_(2/07)	a	S
4-Dimethyl aminoazobenzene	EPA 8270D_(2/07)	a	S
4-Nitrobiphenyl	EPA 8270D_(2/07)	a	S
5,5-Diphenylhydantoin	EPA 8270D_(2/07)	a	S
5-Chloro-2-methylaniline	EPA 8270D_(2/07)	a	S
5-Nitroacenaphthene	EPA 8270D_(2/07)	a	S
5-Nitro-o-anisidine	EPA 8270D_(2/07)	a	S
Aldrin	EPA 8270D_(2/07)	a	S
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
alpha-Terpineol	EPA 8270D_(2/07)	a	S
Aminoazobenzene	EPA 8270D_(2/07)	a	S
Anilazine	EPA 8270D_(2/07)	a	S
Aroclor-1016 (PCB-1016)	EPA 8270D_(2/07)	a	S
Aroclor-1221 (PCB-1221)	EPA 8270D_(2/07)	a	S
Aroclor-1232 (PCB-1232)	EPA 8270D_(2/07)	a	S
Aroclor-1242 (PCB-1242)	EPA 8270D_(2/07)	a	S
Aroclor-1248 (PCB-1248)	EPA 8270D_(2/07)	a	S
Aroclor-1254 (PCB-1254)	EPA 8270D_(2/07)	a	S
Aroclor-1260 (PCB-1260)	EPA 8270D_(2/07)	a	S
Azinphos-methyl (Guthion)	EPA 8270D_(2/07)	a	S
Barban	EPA 8270D_(2/07)	a	S
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
Bromoxynil octanate	EPA 8270D_(2/07)	a	S
Captafol	EPA 8270D_(2/07)	a	S
Captan	EPA 8270D_(2/07)	a	S

Analyte	Method	Notes	Matrix
Carbaryl (Sevin)	EPA 8270D_(2/07)	a	S
Carbofuran (Furaden)	EPA 8270D_(2/07)	a	S
Carbophenothion	EPA 8270D_(2/07)	a	S
Chlordane (tech.)	EPA 8270D_(2/07)	a	S
Chlorfenvinphos	EPA 8270D_(2/07)	a	S
Chlorpyrifos	EPA 8270D_(2/07)	a	S
Coumaphos	EPA 8270D_(2/07)	a	S
Crotoxyphos	EPA 8270D_(2/07)	a	S
delta-BHC	EPA 8270D_(2/07)	a	S
Demeton	EPA 8270D_(2/07)	a	S
Demeton-o	EPA 8270D_(2/07)	a	S
Demeton-s	EPA 8270D_(2/07)	a	S
Di(2-ethylhexyl)adipate	EPA 8270D_(2/07)	a	S
Dibenz(a,h) acridine	EPA 8270D_(2/07)	a	S
Dibenz(a,h) anthracene	EPA 8270D_(2/07)	a	S
Dibenz(a,j) acridine	EPA 8270D_(2/07)	a	S
Dibenzo(a,e) pyrene	EPA 8270D_(2/07)	a	S
Dibenzothiophene	EPA 8270D_(2/07)	a	S
Dichlone	EPA 8270D_(2/07)	a	S
Dichlorovos (DDVP, Dichlorvos)	EPA 8270D_(2/07)	a	S
Dicrotophos	EPA 8270D_(2/07)	a	S
Dieldrin	EPA 8270D_(2/07)	a	S
Diethyl sulfate	EPA 8270D_(2/07)	a	S
Diethylstilbestrol	EPA 8270D_(2/07)	a	S
Dihydrosafrole	EPA 8270D_(2/07)	a	S
Dinocap	EPA 8270D_(2/07)	a	S
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D_(2/07)	a	S
Disulfoton	EPA 8270D_(2/07)	a	S
Endosulfan I	EPA 8270D_(2/07)	a	S
Endosulfan II	EPA 8270D_(2/07)	a	S
Endosulfan sulfate	EPA 8270D_(2/07)	a	S
Endrin	EPA 8270D_(2/07)	a	S
Endrin aldehyde	EPA 8270D_(2/07)	a	S
Endrin ketone	EPA 8270D_(2/07)	a	S
EPN	EPA 8270D_(2/07)	a	S
Ethion	EPA 8270D_(2/07)	a	S
Ethyl carbamate (Urethane)	EPA 8270D_(2/07)	a	S
Ethyl methanesulfonate	EPA 8270D_(2/07)	a	S
Fensulfothion	EPA 8270D_(2/07)	a	S
Fenthion	EPA 8270D_(2/07)	a	S
Fluchloralin	EPA 8270D_(2/07)	a	S
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
Heptachlor	EPA 8270D_(2/07)	a	S
Heptachlor epoxide	EPA 8270D_(2/07)	a	S
Hexachlorobenzene	EPA 8270D_(2/07)	a	S
Hexamethylphosphoramide (HMPA)	EPA 8270D_(2/07)	a	S
Hydroquinone	EPA 8270D_(2/07)	a	S
Leptophos	EPA 8270D_(2/07)	a	S

Analyte	Method	Notes	Matrix
Maleic anhydride	EPA 8270D_(2/07)	a	S
Mestranol	EPA 8270D_(2/07)	a	S
Methoxychlor	EPA 8270D_(2/07)	a	S
Mevinphos	EPA 8270D_(2/07)	a	S
Mexacarbate	EPA 8270D_(2/07)	a	S
Mirex	EPA 8270D_(2/07)	a	S
Monocrotophos	EPA 8270D_(2/07)	a	S
Naled	EPA 8270D_(2/07)	a	S
n-Hexadecane	EPA 8270D_(2/07)	a	S
Nicotine	EPA 8270D_(2/07)	a	S
Nitrofen	EPA 8270D_(2/07)	a	S
n-Tetradecane	EPA 8270D_(2/07)	a	S
o-Anisidine	EPA 8270D_(2/07)	a	S
Octamethyl pyrophosphoramide	EPA 8270D_(2/07)	a	S
p-Cresidine	EPA 8270D_(2/07)	a	S
Phenobarbital	EPA 8270D_(2/07)	a	S
Phosalone	EPA 8270D_(2/07)	a	S
Phosmet (Imidan)	EPA 8270D_(2/07)	a	S
Phosphamidon	EPA 8270D_(2/07)	a	S
Phthalic anhydride	EPA 8270D_(2/07)	a	S
Piperonyl sulfoxide	EPA 8270D_(2/07)	a	S
Propylthiouracil	EPA 8270D_(2/07)	a	S
Resorcinol	EPA 8270D_(2/07)	a	S
Strychnine	EPA 8270D_(2/07)	a	S
Sulfallate	EPA 8270D_(2/07)	a	S
Terbufos	EPA 8270D_(2/07)	a	S
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270D_(2/07)	a	S
Tetraethyl dithiopyrophosphate	EPA 8270D_(2/07)	a	S
Tetraethyl pyrophosphate (TEPP)	EPA 8270D_(2/07)	a	S
Thionazin (Zinophos)	EPA 8270D_(2/07)	a	S
Thiophenol (Benzenethiol)	EPA 8270D_(2/07)	a	S
Toluene diisocyanate	EPA 8270D_(2/07)	a	S
Toxaphene (Chlorinated camphene)	EPA 8270D_(2/07)	a	S
Trifluralin (Treflan)	EPA 8270D_(2/07)	a	S
Trimethyl phosphate	EPA 8270D_(2/07)	a	S
Tri-p-tolyl phosphate	EPA 8270D_(2/07)	a	S
tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D_(2/07)	a	S
1,2-Phenylenediamine (o-Phenylenediamine)	EPA 8321B_(1/98)	a	S
2,4,5-T	EPA 8321B_(1/98)	a	S
2,4-D	EPA 8321B_(1/98)	a	S
2,4-DB	EPA 8321B_(1/98)	a	S
Asulam	EPA 8321B_(1/98)	a	S
Butylate	EPA 8321B_(1/98)	a	S
Carbendazim	EPA 8321B_(1/98)	a	S
Carbosulfan	EPA 8321B_(1/98)	a	S
Dalapon	EPA 8321B_(1/98)	a	S
Dicamba	EPA 8321B_(1/98)	a	S
Dichlorovos (DDVP, Dichlorvos)	EPA 8321B_(1/98)	a	S

Analyte	Method	Notes	Matrix
Dichlorprop	EPA 8321B_(1/98)	a	S
Dimethoate	EPA 8321B_(1/98)	a	S
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8321B_(1/98)	a	S
Disperse blue 14	EPA 8321B_(1/98)	a	S
Disperse blue 3	EPA 8321B_(1/98)	a	S
Disperse brown 1	EPA 8321B_(1/98)	a	S
Disperse orange 3	EPA 8321B_(1/98)	a	S
Disperse orange 30	EPA 8321B_(1/98)	a	S
Disperse red 1	EPA 8321B_(1/98)	a	S
Disperse red 13	EPA 8321B_(1/98)	a	S
Disperse red 5	EPA 8321B_(1/98)	a	S
Disperse red 60	EPA 8321B_(1/98)	a	S
Disperse yellow 5	EPA 8321B_(1/98)	a	S
Disulfoton	EPA 8321B_(1/98)	a	S
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 8321B_(1/98)	a	S
Famphur	EPA 8321B_(1/98)	a	S
Fensulfothion	EPA 8321B_(1/98)	a	S
Formetanate hydrochloride	EPA 8321B_(1/98)	a	S
MCPA	EPA 8321B_(1/98)	a	S
MCPP	EPA 8321B_(1/98)	a	S
m-Cumenyl methylcarbamate	EPA 8321B_(1/98)	a	S
Merphos	EPA 8321B_(1/98)	a	S
Methyl parathion (Parathion, methyl)	EPA 8321B_(1/98)	a	S
Metolcarb	EPA 8321B_(1/98)	a	S
Molinate	EPA 8321B_(1/98)	a	S
Monocrotophos	EPA 8321B_(1/98)	a	S
Naled	EPA 8321B_(1/98)	a	S
Pebulate	EPA 8321B_(1/98)	a	S
Phorate	EPA 8321B_(1/98)	a	S
Physostigmine	EPA 8321B_(1/98)	a	S
Physostigmine salicylate	EPA 8321B_(1/98)	a	S
Promecarb	EPA 8321B_(1/98)	a	S
Silvex (2,4,5-TP)	EPA 8321B_(1/98)	a	S
Solvent red 23	EPA 8321B_(1/98)	a	S
Solvent red 3	EPA 8321B_(1/98)	a	S
Thiodicarb	EPA 8321B_(1/98)	a	S
Thiofanox	EPA 8321B_(1/98)	a	S
Thiophanate-methyl	EPA 8321B_(1/98)	a	S
Triallate	EPA 8321B_(1/98)	a	S
Trichlorfon	EPA 8321B_(1/98)	a	S
tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8321B_(1/98)	a	S
Vernolate	EPA 8321B_(1/98)	a	S
2,4,6-Trinitrobenzene	EPA 8330B_(10/06)	a	S

Analyte	Method	Notes	Matrix

Denied Parameter Accreditation Footnotes

(a) Withdrawn at laboratory request. (b) Denied pending receipt of acceptable PT results (WAC 173-50-140).

Matrix Definitions - D = Drinking Water; N = Non-potable Water; S = Solid and Chemical Material; A = Air and Emissions.

APPENDIX C

ALS ENVIRONMENTAL QUALITY ASSURANCE MANUAL

QUALITY ASSURANCE MANUAL

ALS Environmental
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QUALITY ASSURANCE MANUAL

ALS-KELSO

SOPID:	KL-QAM	Rev. Number:	22	Effective Date:	06/15/2013

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2.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

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 CE-GEN001, Laboratory Ethics and Data Integrity (corporate) and in this Quality Assurance Manual (QAM). ALS Environmental, 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. ALS Environmental, Kelso 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 QAM 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.

3.0 PROGRAM DESCRIPTION

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 of Columbia Analytical:

> "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

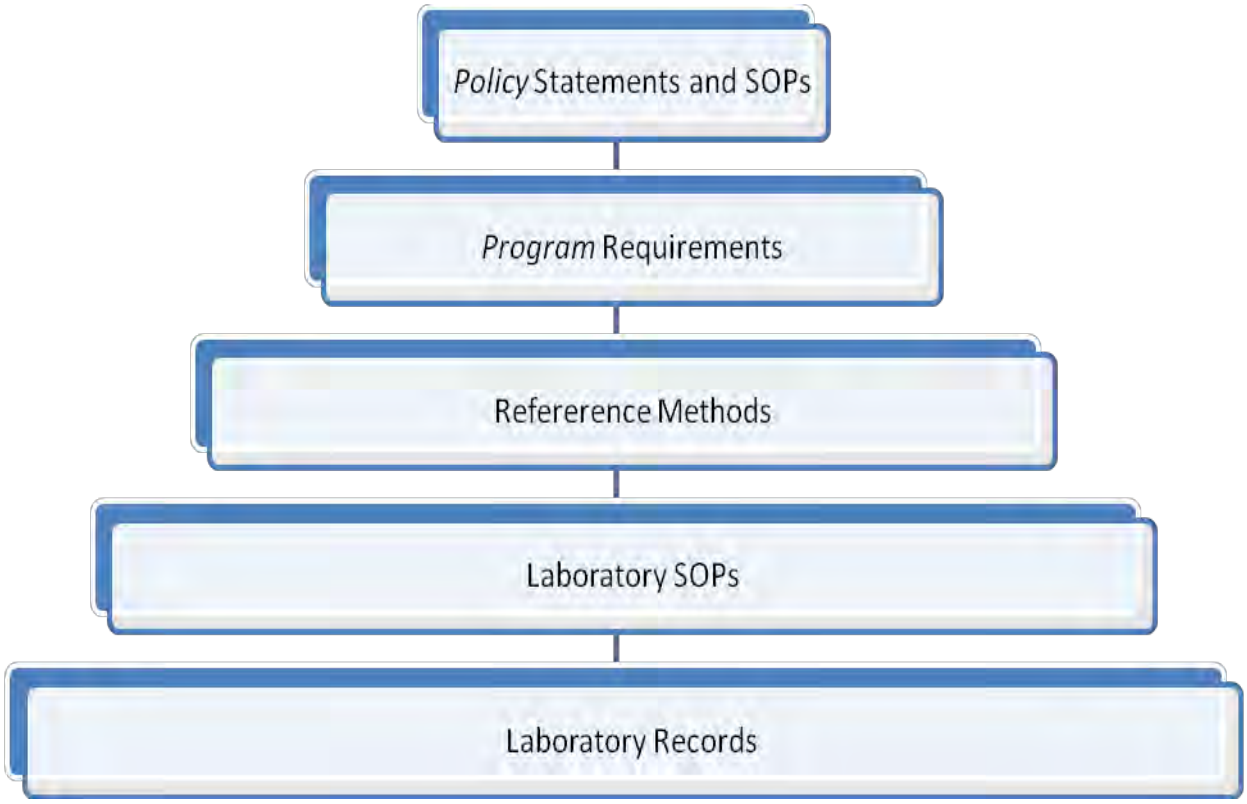
In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager with corporate oversight by the Manager of Quality Assurance, USA. These systems 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. Figure 3-1 shows the relationships of the quality systems and associated documentation. Quality systems include:

- Standard Operating Procedures
- Sample Management and Chain of Custody procedures
- Statistical Control Charting
- Standards Traceability
- Ethics Training
- Document Control
- Corrective Action Program
- Management Reviews
- Demonstration of Capability

The effectiveness of the quality system is assessed in several ways, including:

- Internal and External Audits covering all aspects of the organization
- Annual Management Reviews
- Analysis of Customer Feedback
- Internal and External Proficiency Testing

Figure 3-1
Relationships of Quality Management Systems and Documentation



3.2 Facilities, Equipment, and Security

ALS Environmental, Kelso 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 Environmental, 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
- AA Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography/High Performance Liquid Chromatography Laboratory
- Gas Chromatography/Mass Spectrometry Laboratory (2)
- Semi-volatile Organics Drinking Water Laboratories (2)
- 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
- Information Technology (IT) and LIMS

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Figure 3-2 shows the facility floor plan. 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. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

3.3 Technical Elements of the Quality Assurance Program

The laboratory's technical procedures are based upon procedures published by various agencies or organizations (See Section 17). The Quality Assurance Program provides to the laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained by the QA department. This includes method approvals and audit administration. In addition, internal

audits are performed to assess compliance with policies and procedures. SOPs are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A and SOPs in Appendix F.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventive maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

3.4 Operational Assessments and Service to the Client

The laboratory uses a number of systems to assess its daily operations. In addition to the routine quality control (QC) measurements, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients including; on-time performance, customer complaints, training reports and non-conformity reports. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

ALS Environmental, Kelso utilizes a number of different methods to ensure that adequate resources are available for service demands. Senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. 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 cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Project Plans (QAPPs) if available. Status/production meetings are also conducted regularly with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, or project requirements.

When a customer 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 QA PM 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 shall afford 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. CE-GEN010, *Handling Customer Feedback* is in place for these events.

3.5 Document Control and Records

Procedures for control and maintenance of documents are described in 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, Kelso documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QA PM, 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 CE-QA007, *Making Entries into Logbooks and onto Benchsheets*. The entries made into laboratory logbooks 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 ADM-ARCH, *Data Archiving.*

External documents relative to the management system are managed by the QA PM. 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.

3.6 Subcontracting

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 CE-QA004, *Qualification of Subcontract Laboratories.* The Quality Assurance staff is responsible for maintaining a list of qualified subcontract laboratories.

3.7 Procurement

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

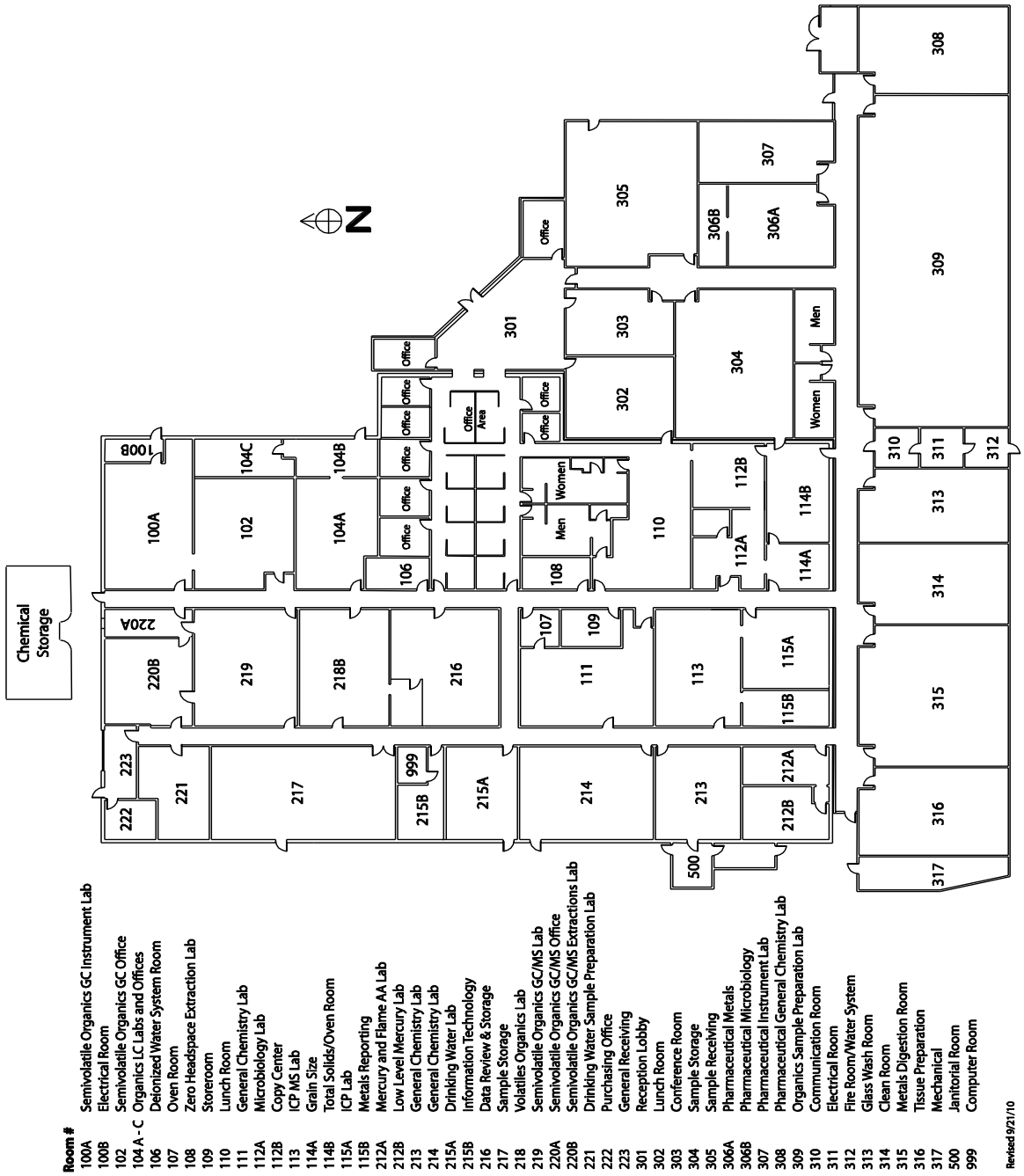
assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. CE-QA012, *Quality of Reagents and Standards* and ADM-RLT, *Reagent and Standards Login and Tracking* provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in CE-GEN007, *Procurement and Control of Laboratory Services and Supplies*. Also, refer to section 9.4 for a discussion of reference materials.

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 ADM-RLT, *Reagent and Standards Login and Tracking*.

3.8 Review of Requests, Tenders and Contracts (Procedures for Accepting New Work)

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.

Figure 3-2
ALS Environmental, Kelso 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

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4.0 PROFESSIONAL CONDUCT, DATA INTEGRITY, AND ETHICS

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.

4.1 Professional Conduct

To promote quality, ALS, Kelso requires certain standards of conduct and ethical performance among employees. The following examples of documented CAS 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.
- It is the responsibility of all ALS Environmental, Kelso 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 proprietary company/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.

4.2 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 are described in the Policy for Internal Quality Assurance Audits and details are listed in laboratory administrative SOPs. 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.

4.3 Laboratory Data Integrity and Ethics Training

Each employee receives in-depth core Data Integrity/Ethics Training. New employees are given a QA and Ethics orientation within the first month of hire, followed by the core training within 1 year of hire. On an ongoing basis, all employees receive semi-annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA PM to ensure that the training is conducted as described.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

4.4 Management and Employee Commitment

ALS Environmental, 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.

All employees are required to sign and adhere to the requirements set forth in the ALS Environmental *Confidentiality Agreement* and *Code of Conduct Policy*.

5.0 ORGANIZATION AND RESPONSIBILITIES

The ALS Environmental, Kelso staff, consisting of approximately 150 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.

CAS is committed to providing an environment that encourages excellence. All employees share the responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 5-1 lists the ALS Environmental, Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B.

- 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 the financial performance of the (Location) facility. 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.
- The **Quality Assurance Manager (QAM)** has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities within the laboratory, ensuring that all personnel understand their contributions to the quality system, ensuring communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, evaluating the effectiveness of training; and monitor trends and continually improve the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews can all are used to support quality system implementation. The QAM is responsible for ensuring compliance with NELAC standards (and ISO, DoD QSM, etc. as applicable). The QAM works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QAM is responsible 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 such as metrological records, archived logbooks, PT results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; and performing internal QA audits.

  The QAM reports directly to the Laboratory Director and also reports indirectly to the 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 QAMs regulatory compliance efforts (NELAC, ISO, DOD, etc). The Manager of Quality

Assurance, USA performs annual internal audits at each laboratory; maintains a database of laboratory certification/accreditation programs; approves company-wide SOPs; maintains a database of approved subcontract laboratories; provides assistance to the laboratory QA staff and laboratory managers; prepares a quarterly QA activity report; etc.

- 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).
- In the event that work is stopped in response to quality problems, only the Laboratory Director or Quality Assurance Manager has the authority to resume work.

- The **Environmental Health and Safety Officer** (EH&S) 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 ALS Kelso's EH&S Director.
- The **Client Services Manager** is responsible for the Client Services Department defined for the laboratory (i.e. Project Managers, electronic deliverables, etc.) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. Sample management handles all activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.
- 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, contract, and regulatory-specific requirements. This entails coordinating with the ALS Environmental, Kelso laboratory and administrative staff to ensure that client-specific needs are understood and that the services ALS Environmental, Kelso provides are properly executed and satisfy the requirements of the client.
- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a QC program meeting department needs. Each **Department Manager and Supervisor** has the responsibility to ensure that QC functions are carried out as planned, and to guarantee 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. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.
- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory, and by assisting in the archival of all laboratory results. The sample management office staff is also responsible for the proper disposal of samples after analysis.
- **Information Technology** (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) generation, and data back-up, archival and integrity operations.

Table 5-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Jeff Grindstaff, B.S.	23	Laboratory Director
Suzanne LeMay, B.S.	25	Quality Assurance Program Manager
Lynda Huckestein, B.S.	23	Client Services Manager Sample Management Office Manager
Jeff Coronado, B.S.	22	Metals Department Manager
Harvey Jacky, B.S.	23	General Chemistry Department Manager
Loren Portwood	23	Semi-Volatile Organics Department Manager
Jon James, B.A.	21	HPLC, GC/MS Organics Department Manager
Christina Kerksieck, B.S.	4	Microbiology Technical Manager
Eileen Arnold, B.A.	30	Environmental Health and Safety Officer
Mike Sullivan, B.S.	12	Information Technology

6.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. CAS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major computing equipment.

6.1 Software Quality Assurance Plan

ALS Environmental, Kelso has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the *ALS Information Management Policy*. The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of this plan are policies for software validation and control.

6.2 IT Support

The local ALS Environmental, Kelso Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the *ALS Information Management Policy*.

In addition to the local IT department, ALS Environmental, Corporate IT provides support for network-wide systems. ALS Environmental also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

6.3 Information Management Systems

ALS Environmental, Kelso has various systems in place to address specific data management needs. The ALS Environmental, Kelso Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system defines sample identification, analysis specifications, and provides a means of sample tracking. This system is used during sample login to generate the internal service request. Included on the service request is a summary of client information, sample identification, required analyses, work instructions, deliverable requirements. The LIMS is used to track the status of a sample and is important in maintaining internal chain of custody.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows2003® domain). This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from

many available computer stations, improving efficiency and flexibility. The server is also used for data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats, including Staged Electronic Data Deliverable (SEDD) format.

6.4 Backup and Security

ALS Environmental, Kelso laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential backups are performed on all file server information once per day, Sunday through Thursday. Full backups are performed each Friday night. Tapes are physically stored in a locked media cabinet within a locked, temperature controlled computer room, with every other full backup also securely stored offsite.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-ALS Environmental, Kelso access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS Environmental, Kelso uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

7.0 SAMPLE MANAGEMENT

7.1 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 Environmental, 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

ALS Environmental, Kelso 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 *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 7-1 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 Environmental, Kelso routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased as precleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for the sample containers are available to clients if requested. 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 foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), 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 7-1 shows the chain-of-custody form routinely used at ALS Environmental, Kelso and included with sample kits. For large sample container shipments, the containers may be shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to Columbia Analytical. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

If any returning shipping cooler exhibits an odor or other abnormality after receipt and subsequent decontamination by laboratory personnel, a second, more vigorous decontamination process is employed. Containers exhibiting an odor or abnormality after the second decontamination process are promptly and properly discarded. ALS Environmental, Kelso keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. ALS Environmental, Kelso also provides courier service that makes regularly scheduled trips to the Greater Portland, Oregon Metropolitan area.

When ALS Environmental, Kelso ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures (SMO-GEN) for maintaining the samples' chain of custody, packaging and shipment. Dry ice or gel ice is the only temperature preservative used by ALS Kelso, unless otherwise specified by the client or receiving laboratory.

7.2 Sample Receipt and Handling

Standard Operating Procedures (SMO-GEN) are established for the receiving of samples into the laboratory. 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 delivered to the ALS Environmental, Kelso sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRF - See Figure 7-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. 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). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. 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. The LIMS generates a Service Request that 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 appropriate Project Manager for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are stored as per method requirements until they undergo analysis, unless otherwise specified, using various refrigerators or freezers, or designated secure areas. ALS Environmental, Kelso has five walk-in cold storage units which house the majority of sample containers received at the laboratory. In addition, there are four additional refrigerators, including dedicated refrigerated storage of VOC samples. The dedicated storage areas for VOC samples are monitored using storage blanks, as described in VOC-BLAN, *VOA Storage Blanks*. ALS Environmental, Kelso also has nine sub-zero freezers capable of storing samples at -10 to -30° C primarily used for tissue and sediment samples requiring specialized storage conditions. The temperature of each sample storage unit is monitored real time with an electronic temperature monitoring system.

ALS Environmental, Kelso adheres to the method-prescribed or project-specified holding times for all analyses. The sampling date and time are entered into the LIMS system at the time of sample receipt and login. Analysts then 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. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so holding time compliance can be demonstrated. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative). Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples and sample extracts 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. 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.* All waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with applicable local and Federal 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.

7.3 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. This is described in *SMO-GEN, Sample Receiving*. Figure 7-1 is a copy of the chain-of-custody form routinely used at Columbia Analytical.

Facility security and access is important in maintaining the integrity of samples received at Columbia Analytical-Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded entry, except for the reception area and sample receiving doors, which are manned 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

ALS Environmental, Kelso facility is equipped with an alarm system and ALS Environmental, Kelso 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 while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-SCOC).*

7.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. 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. 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. To communicate and specify project-specific requirements, a Tier V form (Figure 7-3) is used and accompanies the service request form.

Table 7-1
Sample 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]
Fecal Streptococci (SM 9230B)	W	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
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 4500NH3)	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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500CN 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 4500CN I)	W,S	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron (CAS SOP)	W, D	G Amber	Cool, 4°C	24 hours
Fluoride (EPA 300.0, SM 4500 F-C)	W,S	P,G	Cool, 4°C	28 days
Fluoride (EPA 9056)	W,S	P,G	Cool, 4°C	Analyze immediately
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
Nitrocellulose	S	G	Cool, 4°C	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
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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Phenolics, Total (EPA 420.1,9056)	W, S	G Amber	Cool, 4°C, H_2SO_4 to pH<4	28 days
Perchlorate (EPA 314.0)	W, DW,S	P,G	Protect from temp. extremes	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total (SM 2540B)	W	P,G	Cool, 4°C	7 days
Residue, Filterable (TDS) (SM2540C)	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, Volatile (EPA 160.4)	W	P,G	Cool, 4°C	7 days
Silica (SM 4500SiO2 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 (SM 4500S2 D)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500S2 F)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (9030/934)	W, S	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sullfides, Acid Voaltile	S	G	Cool, 4°C	14 days
Sulfite (SM 4500SO3 B)	W	P,G	None Required	24 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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
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, Total (EPA 9020)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2, No headspace	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon-Lined Cap	Cool, 4°C, HNO_3 to pH<2	6 months
Metals				
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4°C	24 hours
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
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO_3 to pH<2	28 days
Mercury (7471)	S	P,G	Cool, 4°C	28 days
1631E	W	F	Cool, 4°C, HCl or H_2SO_4 to pH<2	90 days
1631E	S	F	Freeze < -15°C	1 Yr
Methyl Mercury 1630	W,S,T	F	HCL to pH<2	6 months
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4°C	28 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8021, 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, 8021, 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 (8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 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, 8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs 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	7 days
EDB and DBCP (EPA 8260)	W,S	G, Teflon-Lined Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	28 days
Vinyl chloride,styrene, 2-chloroethyl vinyl ether (8260)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, Minimize Headspace	7 days
Vinyl chloride,styrene, 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	H2SO4 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	W	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Resin and Fatty Acids (NCASI 85.02)	W	G, Teflon-Lined Cap	NaOH to pH >10, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4°C	30 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
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
PBDE/PBB – ROHS GC/MS	W,S,T	G	Cool, 4°C	40 days after extraction
Pharma Personal Care Products 1694	W	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/Nitoramines 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	H2SO4 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°Cg	7[f] days until extraction;40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Chlorinated Herbicides (EPA 8151)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H2SO4 to pH<2, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Darkg	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 Darkg	7[f] days until extraction;40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7f 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)	DW	G, Teflon-Lined, Septum cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Carbamates, Carbamoyloximes (EPA 531.1)	DW	G, Amber, Teflon-Lined Cap	1.8 mL monochloroacetic acid to pH<3; 80 mg/L $Na_2S_2O_3$ if Res.Cl.; Cool, 4°C	28 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/4omL NaS; Cool , <6°C	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 4°C	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$ if Res.Cl.Cool 4°C	7days 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

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Glyphosate (EPA 547)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$,Cool, 4°C	14 days
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
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 ext'n;
			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 ext'n;
			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 ext'n;
			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 ext'n;
Volatile Organics (EPA 1311/8260)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C , Minimize Headspace	14 days until TCLP ext'n;

			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

a For EPA SW-846 methods the method number is 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

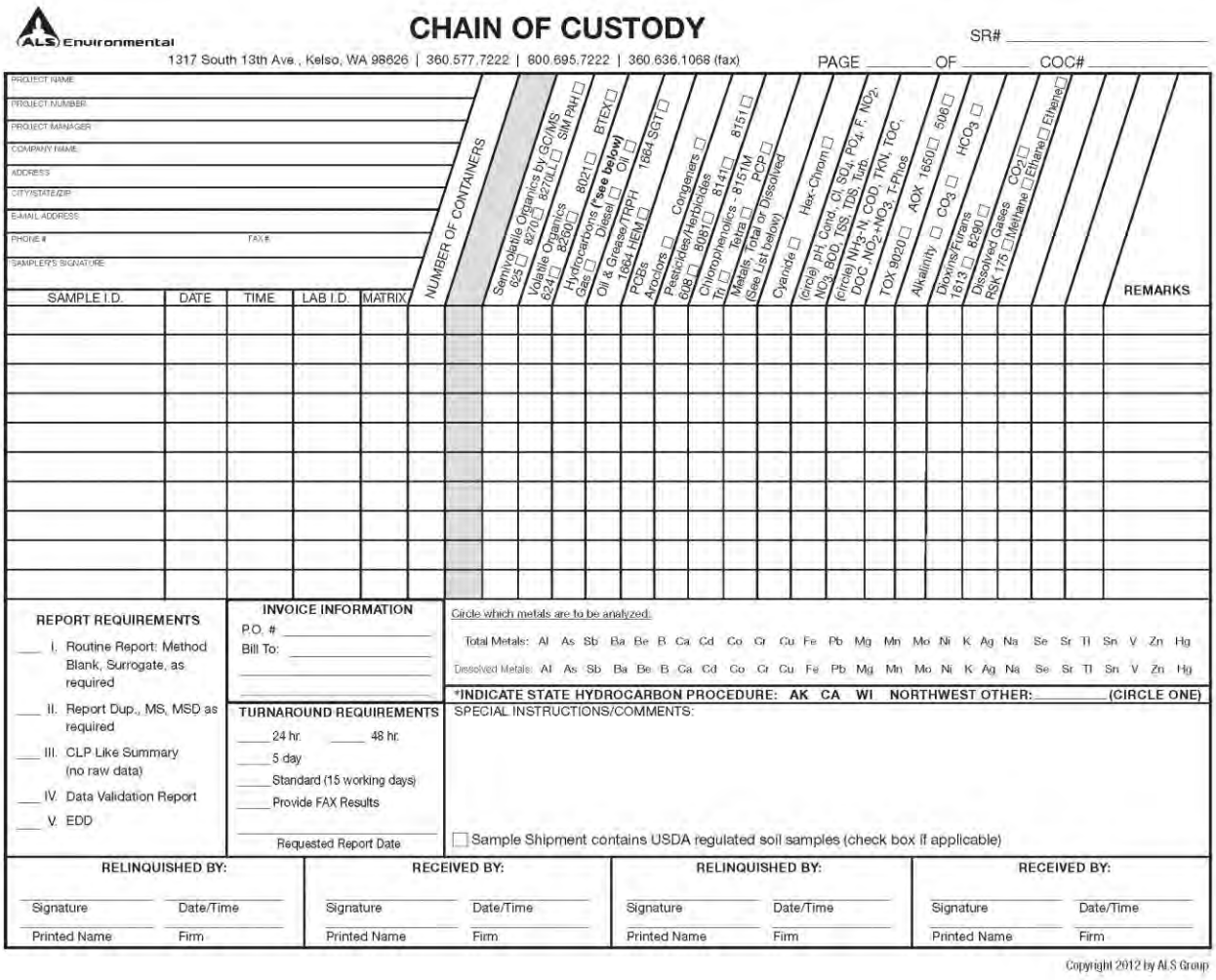
d For chlorinated water samples

e The maximum holding time is dependent upon the geographical proximity of sample source to the laboratory.

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.

Figure 7-1
Chain of Custody Form



ALS Environmental

CHAIN OF CUSTODY

SR# _____

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE _____ OF _____ COC# _____

PROJECT NAME
PROJECT NUMBER
PROJECT MANAGER
COMPANY NAME
ADDRESS
CITY/STATE/ZIP
E-MAIL ADDRESS
PHONE # FAX #
SAMPLER'S SIGNATURE

NUMBER OF CONTAINERS

Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐
Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐
Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐
Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐
PCBs Aroclors☐ Congeners☐
Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐
Chlorophenolics 8151M PCP☐
Tri☐ Tetra☐ Metals Total or Dissolved (See List below)
Cyanide☐ Hex-Chrom☐
(circle) pH Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb. (circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3-N, T-Phos
TOX 9020☐ AOX 1650☐ 508☐
Alkalinity ☐ CO_3 ☐ HCO_3 ☐
Dioxins/Furans 1613☐ 8290☐
Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX		REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 day
____ Standard (15 working days)
____ Provide FAX Results

Requested Report Date _____

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

ALS Environmental

LANDFILL CHAIN OF CUSTODY

1317 South 13th Ave. • Kelso, WA 98626 • (360) 577-7222 • (800) 695-7222 • FAX (360) 636-1068

SR#_____

PAGE_____ OF_____ COC#_____

PROJECT NAME:
PROJECT NUMBER:
PROJECT MANAGER:
COMPANY NAME:
ADDRESS:
CITY/STATE/ZIP:
E-MAIL ADDRESS:
PHONE # FAX #
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Volatile Organics 524.2 ☐ 8260 ☐ TICs ☐	Base / Neutral / Acid Organics 625 ☐ 8270 ☐ TICs ☐	Metals, Total or Dissolved (list below)	pH, Cond., TDS, TSS, BOD, Turb, Color	Orthophosphate, Tan/n/Lignin (circle)	COD, TOC, Total Phos, TKN, NH_3, (circle)	ALK, HCO_3, CO_3; Hardness (circle)	Anion (circle) Cl, SO_4 NO_3 NO_2 F	Anion:Cation Ratio	☐ Enterococcus ☐ E. coli ☐ T-Coliform ☐ F-Coliform	Cyanide ☐	TOX	Dissolved Silica								REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 day
____ Standard (15 working days)

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: As Sb Ba Be Ca Cd Co Cr Cu Fe Pb Mg Mn Na Ni K Ag Se Si Ti V Zn Hg
Dissolved Metals: As Sb Ba Be Ca Cd Co Cr Cu Fe Pb Mg Mn Na Ni K Ag Se Si Ti V Zn Hg

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RELINQUISHED BY:		RELINQUISHED BY:		RELINQUISHED BY:	
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Figure 7-2

PC_____

Cooler Receipt and Preservation Form

Client / Project:_____ Service Request *K13*_____

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_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

lient / Project:_____ Service Request *K13*_____

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:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Page_____of_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

Client / Project:_____ Service Request ***K13***_____

Notes, Discrepancies & Resolutions:

Page_____of_____

Figure 7-3

Tier V Form

Client:
Project Name:
Project Number:
Project Description:

Project Chemist:
Service Request:
LIMS Template ID:

QAPP/SOW Information:

Reporting

TierLevel:
In results field use:
Flagging Requirements:
Other Requirements:

PFD:

Report to:

Sample Considerations:

Sample Limitations:
Sample Prep/Analysis:
Non-Standard Holdtimes:
Historical Data:
Comments:

8.0 ANALYTICAL PROCEDURES

ALS Environmental, 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 Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 17.0. 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 limit, the concentration of the analyte 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 Environmental, Kelso is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix G. Further details are described below.

8.1 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 prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in CE-GEN005, *Document Control*. In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in CE-QA007, *Making Entries onto Analytical Records*. Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

8.2 Deviation from Standard Operating Procedures

When a customer 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 detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

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.

8.3 Modified Procedures

ALS Environmental, 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, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

8.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS Environmental, 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:
   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * 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. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.

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.

8.5 Specialized Procedures

ALS Environmental, 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, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs).

8.6 Sample Cleanup

ALS Environmental, Kelso 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.

9.0 CALIBRATION PROCEDURES

All equipment and instruments used at ALS Environmental, Kelso are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials.

Laboratory support equipment (thermometers, balances, and weights) are routinely verified on an annual basis by a vendor accredited to A2LA or ISO/IEC 17025:2005 International Standards. All analytical measurements generated at ALS Environmental, Kelso are performed using materials where possible and/or processes that are traceable to a reference material. 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 subjected to overloading or mishandling, or has been shown by verification to be 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.

9.1 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 for Support Equipment Monitoring and Calibration (ADM-SEMC).* The SOP also includes the use of acceptance criteria and correction factors.

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 A2LA or ISO/IEC 17025:2005 International Standard on an annual basis.

9.2 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.

9.3 Water Purification Systems

ALS Environmental, 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. Following a written SOP, the status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily in a bound record book. 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.

9.4 Source and Preparation of 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 Environmental, 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 (see section 11.3.5).

9.5 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.).

9.6 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.

9.7 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.

9.8 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 and reference method. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.9 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. *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.10 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 for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).

9.11 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.

9.12 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.

9.13 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.

9.14 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 $\geq$ 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.

9.15 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.

9.16 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.

9.17 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following 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.

9.18 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.

10.0 QUALITY CONTROL

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 Environmental, 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.

10.1 Quality Control Objectives

10.1.1 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.

10.1.2 Accuracy – Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is 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 (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination).

ALS Environmental, 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.

10.1.3 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.

10.1.4 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. 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 QA PM. The new control limits replace the previous limits and data is assessed using the new values. Current 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 CE-QA009, *Control Limits*.

10.1.5 Representativeness – Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, 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 Environmental, 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 appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

10.1.6 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.

10.2 Method Detection Limits, Method Reporting Limits, and Limits of Detection/Quantitation

Method Detection Limits (MDL) for methods performed at Columbia Analytical/(Location) is determined during initial method set up and if any 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 for Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantitation (ADM-MDL), 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 on an annual basis and cannot be lower than the lowest calibration standard. Current MDLs and MRLs are available from the laboratory.

10.3 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.

10.3.1 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.

10.3.2 Calibration Blanks

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.

10.3.3 Continuing Calibration Blanks

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.

10.3.4 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.

10.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed after calibration but prior to sample analysis, in order to verify the validity and accuracy of the standards used in for calibration. Once it is determined that there is no defect or error in the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

10.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) 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.

10.3.7 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.

10.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic 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.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.9 Laboratory Control Samples

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.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.10 Laboratory Fortified Blanks - LFB

A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. A LFB is required with every batch of drinking water samples.

10.3.11 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

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:

$$Recovery\ (\%) = (S - A) \times 100 \div T$$

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

10.3.12 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:

$$Relative\ Percent\ Difference\ (RPD) = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed 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.

10.3.13 Interference Check Samples

An interference check sample (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.

10.3.14 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.

10.3.15 Control Charting

The generation of control charts is routinely performed at Columbia Analytical. 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 CE-QA009, *Control Limits.*

10.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS Environmental, Kelso undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at Columbia Analytical; 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.

11.0 DATA PROCESSING, VALIDATION, AND REPORTING

ALS Environmental, Kelso reports the analytical data produced in its laboratories to the client via the certified analytical report. This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

11.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the 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. 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 from the software used to process the original data set (e.g., chromatographic software). 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 hardcopy is forwarded to the supervisor or second qualified analyst, who reviews the data for errors. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package is then placed into the appropriate service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Data review procedures are described in the *SOP for Laboratory Data Review Process (ADM-DREV).*

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 *CE-QA007, Making Entries onto Analytical Records*.

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 CE-QA002, *Manual Integration Policy and* ADM-MI*, Manual Integration of Chromatographic Peaks.*

11.2 Confirmation Analysis

11.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is

limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.

- The sample meets all of the following requirements:
    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.
    2. All analytes have been previously analyzed in sample(s) from the same source, identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

11.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).
    2. 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 Methods – Two criteria are used to verify identification:
    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.
    2. 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.

11.3 Data Review and Validation of Results

The integrity 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.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and 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.

11.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained analyst or chemist. 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. ALS Environmental, Kelso maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

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 Columbia Analytical-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.

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.

11.5 Documentation

ALS Environmental, 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)*.

11.5.1 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.

11.6 Deliverables

In order to meet individual project needs, ALS Environmental, Kelso provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 11-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) the following specialized deliverables:

- DoD QSM – Army Corp of Engineers, Air Force Center for Environmental Excellence, Navy
- Drinking water – State specific formats

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 CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

When requested, ALS Environmental, Kelso provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS Environmental, 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 11-1
Descriptions of ALS Environmental, Kelso Standard Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Chain of custody documents and sample/cooler receipt documentation
3. Sample analytical results
4. Method blank results
5. Surrogate recovery results and acceptance criteria for applicable organic methods
6. Dates of sample preparation and analysis for all tests
7. Case narrative – **optional**

Tier II. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
4. Case narrative – **optional**

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative – **required**
2. Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits

Note: Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS will be included.

Tier IV. Full Data Validation Package.

1. All raw data associated with the sample analysis, including but not limited to:
   a. Preparation and analysis bench sheets and instrument printouts,
   b. 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 hits, and the results and spectra of TIC compounds when requested.
   c. QC data,
   d. Calibration data (initial, verification, continuing, etc),
   e. Calibration blanks or instrument blanks (as appropriate to method).
2. If a project QAPP or program protocol applies, the report will be presented as required by the QAPP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Quality audits are an essential part of ALS Kelso's 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.

12.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of Columbia Analytical/Kelso are conducted regularly by various regulatory agencies and clients. Appendix G lists the certification and accreditation programs in which Columbia Analytical/Kelso participates. Programs and certifications are added as required. Additionally, internal system audits of Columbia Analytical/Kelso are conducted regularly under the direction of the Quality Assurance Program Manager. The internal audit procedures are described in CE-QA001, *Internal Audits*. The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Technical/method audits – minimum of 3 per quarter
- Hardcopy report audits – minimum of 2 per quarter.
- Chromatographic electronic data audits – each applicable instrument per quarter.

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).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

12.2 Performance Audits

ALS Kelso also 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 CE-QA006, *Proficiency Sample Testing Analysis*. ALS Environmental, 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 PT studies, 2 per year.

- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. 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 reviewed by the QAM, Laboratory Director, the laboratory staff, and the Manager of Quality Assurance, USA. 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.

13.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at ALS Environmental, Kelso (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. 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.

An initial demonstration of analytical control is required on every instrument used at ALS Environmental, Kelso before it may be used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- 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 Columbia Analytical. 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. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. 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. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

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 table in Appendix E for a list of preventive maintenance activities and frequency for each instrument.

14.0 CORRECTIVE AND PREVENTIVE ACTION

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 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.

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 QA PM 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*.

In addition to internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The person who initially receives the feedback (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 QA PM for final resolution. The complaint and resolution are documented. The procedure is described in CE-GEN-010, *Handling Customer Feedback*.

15.0 QUALITY ASSURANCE REPORTS AND MANAGEMENT REVIEW

Quality assurance requires an active, ongoing commitment by ALS Environmental, Kelso personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. 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.

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data, accompanied by signature approval. 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, who in turn reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A case narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc.

The QA PM provides overview support to the Project Managers as required (e.g., contractually specified, etc.). The QAM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAM regularly communicates with the Laboratory Director to review the various QA/QC activities, priorities, and status of program implementation; including such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

An annual management review of the quality and testing systems is performed as described in CE-QA005, *Laboratory Management Review*. This is done to identify any necessary changes or improvements to the quality system or quality assurance policies. This review is documented in a Managerial Review of the Laboratory's Quality Systems and Testing Activities and sent to senior management.

16.0 PERSONNEL TRAINING

Technical position descriptions are available 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 at ALS Environmental, Kelso are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS Environmental, Kelso when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at Columbia Analytical. 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.

Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s). Quality Systems training begins with Quality Assurance orientation for new employees and reading the Quality Assurance Manual. During the employees first year, the employee attends Core Ethics training and learns about ALS Environmental, Kelso quality systems. Each employee participates in annual Ethics Refresher training.

ALS Environmental, 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 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.

16.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (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" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples 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 16-1. 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.

16.2 Continuing Demonstration of Proficiency

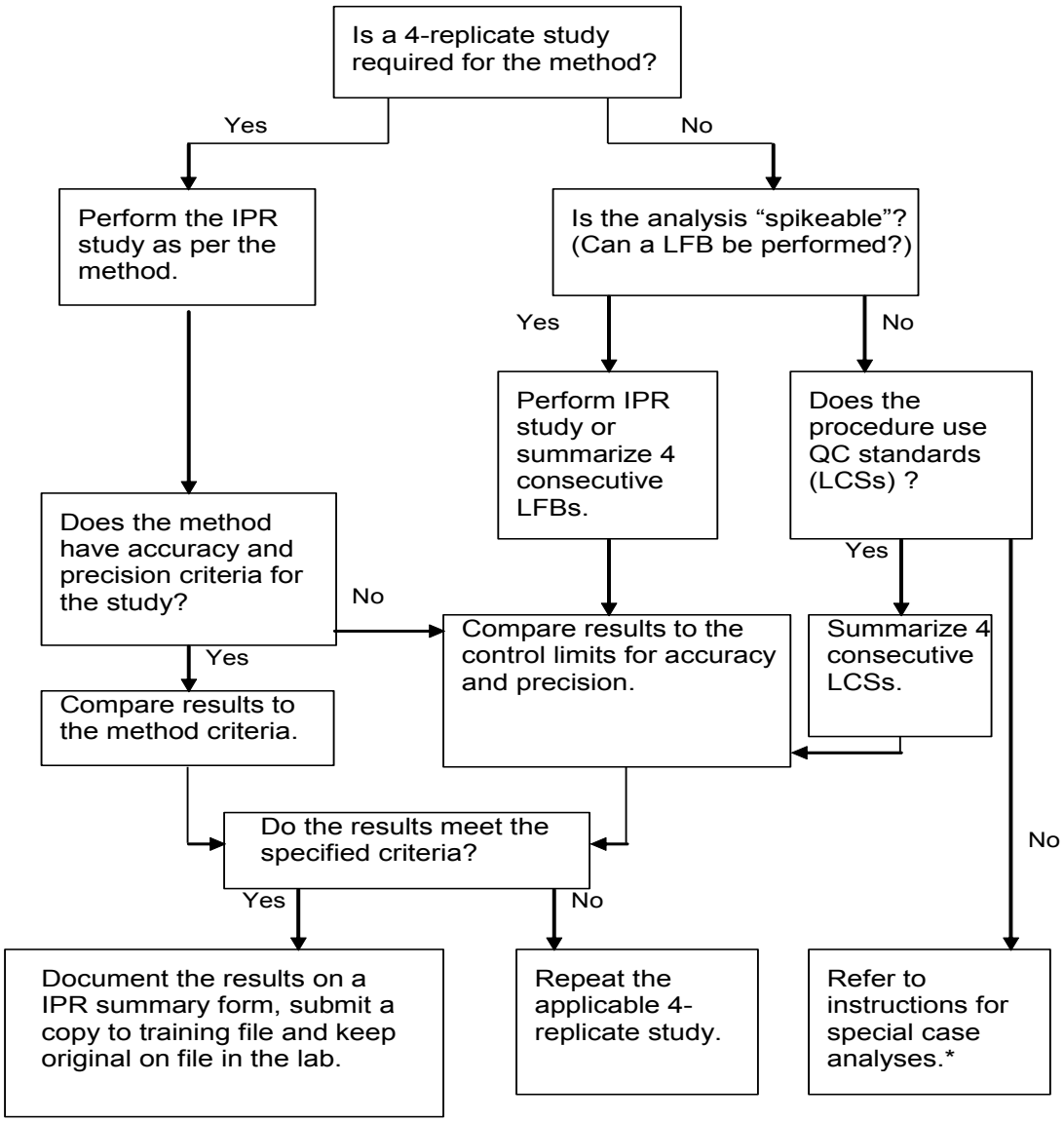
A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- 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.

16.3 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 ALS Environmental, Kelso resumes. QA maintains a database to record the various technical skills and training acquired while employed by Columbia Analytical. 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 ADM-TRAIN, *ALS-Kelso Training Procedure*.

Figure 16-1
Initial Demonstration of Capability Requirements



* Refer to the ADM-TRAIN for details.

17.0 REFERENCES FOR QUALITY SYSTEMS, EXTERNAL DOCUMENTS, MANUALS, STANDARDS, AND ANALYTICAL 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,* Version 4.2, 10/25/2010
- *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.
- 40 CFR Part 141, National Primary Drinking Water Regulations.
- *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).

18.0 ATTACHMENTS

- Appendix A: Approved Signatories, QA Program Documents, Corporate SOP List
- Appendix B: Organizational Chart and Resumes of Key Personnel
- Appendix C: Major Analytical Equipment
- Appendix D: Data Qualifiers and Acronyms
- Appendix E: Preventive Maintenance Procedures
- Appendix F: Standard Operating Procedures
- Appendix G: Laboratory Certifications and Accreditations

APPENDIX A

Approved Signatories

QA Program Documents

Corporate Policies

Administrative Corporate SOP List

APPROVED SIGNATORIES FOR ANALYTICAL REPORTS

ALS Environmental, Kelso, WA

ARNOLD, EILEEN
BAILEY, JOSH
CHAN, JIM
CORONADO, JEFFREY
DEGNER, CARL
DOMENIGHINI, LISA
GRINDSTAFF, JEFF
HADERLY, DOUGLAS
HARRIS, LISA
HOLMES, HOWARD
HUCKESTEIN, LYNDA
JACKY, HARVEY
JAMES, JON
KENNEDY, LES
LEAF, CHRIS
MALLOCH, JANET
MIHAI-LAZAR, CARMEN
MOORE, RACHEL
MURRY, SHANE
PORTWOOD, LOREN
REASONER, KAREN
SALATA, GREGORY
SAMY, SHAR
SHELDON, BRIAN

Update: April 19, 2013 Approved by: Lynda Huckestein/Client Services Manager

QA Program Files

Program	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
Software Quality Assurance Plan	Corp IT
CAS-Kelso Certifications/Accreditations	Cert_kel.xls
Columbia Analytical Services MDL Tracking Spreadsheet	Q:\MDL Tracking\MDL_LIST.r1.XLS
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR dept
Personnel Job Descriptions	HR Department
CAS/KELSO DATA QUALITY OBJECTIVES	CAS Kelso DQO 20XX.rX.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedure Database	Q:\ENVIRONMENTAL\1 SOP & Policy Statements\1_ Kelso SOP.xls

Corporate SOPs

SOP TITLE	SOP Code	Rev	SOP Date
LABORATORY ETHICS AND DATA QUALITY	CE-GEN001	1.00	09/15/12
BP LABORATORY MANAGEMENT PROGRAM SOP	CE-GEN002	1.00	11/1/12
RECORDS MANAGEMENT POLICY	CE-GEN003	00.0	7/15/12
PREVENTIVE ACTION	CE-GEN004	00.0	7/1/12
DOCUMENT CONTROL	CE-GEN005	00.0	9/1/12
DATA RECALL	CE-GEN006	00.0	9/1/12
PROCUREMENT CONTROL OF LABORATORY SERVICES AND SUPPLIES	CE-GEN007	00.0	9/1/12
METHOD DEVELOPMENT	CE-GEN008	0.00	12/01/12
ESTABLISHING STANDARD OPERATING PROCEDURES	CE-GEN009	0.00	01/01/13
HANDLING CUSTOMER FEEDBACK	CE-GEN010	0.00	02/15/13
ASSIGNING A TSR TO A PROJECT	CE-GEN011	0.00	04/01/13
INTERNAL AUDITS	CE-QA001	00.0	1/1/12
MANUAL INTEGRATION POLICY	CE-QA002	00.0	3/15/12
TRAINING POLICY	CE-QA003	00.0	8/1/12
QUALIFICATION OF SUBCONTRACT LABORATORIES	CE-QA004	00.0	8/1/12
LABORATORY MANAGEMENT REVIEW	CE-QA005	00.0	9/1/12
PROFICIENCY TESTING SAMPLE ANALYSIS	CE-QA006	00.0	9/15/12

SOP TITLE	SOP Code	Rev	SOP Date
MAKING ENTRIES ONTO ANALYTICAL RECORDS	CE-QA007	00.0	9/1/12
NONCONFORMITY AND CORRECTIVE ACTION	CE-QA008	00.0	10/1/12
CONTROL LIMITS	CE-QA009	0.00	12/01/12
ESTIMATION OF UNCERTAINTY OF ANALYTICAL MEASUREMENTS	CE-QA010	0.00	01/15/13
PERFORMING METHOD DETECTION LIMIT STUDIES AND ESTABLISHING LIMITS OF DETECTION AND QUANTITATION	CE-QA011	0.00	02/15/13
QUALITY OF REAAGENTS AND STANDARDS	CE-QA012	0.00	02/15/13

Forms

FORM	FILE NAME	DATE
Complaint Report	G:\QA\QA_Forms/Complaint Report_r121509	09/10/12
Critical Job Function Authorization Statement	G:\QA\QA_Forms\IDC-CDC Certification Statements/Critical Job Function Authorization	12/15/09
Data Re-submittal Request Form	G:\QA\QA_Forms/Data Resubmittal Request Form_r112107	11/21/07
Demonstration of Capability Certification Statement (no table version)	G:\QA\QA_Forms\IDC-CDC Certification Statements/DOC Certification Statement_r071206-	06/10/11
Extraction Solvent Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	2012
Laboratory Training Certification	LAB-TRNG_r092109	9/21/09
Metals Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Metals Evaluation xxxx	2012
Method Detection Limit Study Calculation Spreadsheet	R:\LAB MDL LOD LOQ/MDL_FORMR4_r030510	3/5/10
New Vendor Evaluation	G:\QA\QA_Forms\Purchasing/ New Vendor Evaluation 092612	10/15/09
Pipettes Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Pipettes	11/08/11
Procedure Change Form	Q:\ENVIRONMENTAL\1 SOP & Policy Statements/SOP DISTRIBUTION FORMS	12/16/10
Reagent/Consumable Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	5/3/11
Standard Operating Procedure Change Form	G:\QA\QA_Forms//SOP Change Form	9/21/09
LOD Verification	G \QA\QA_Forms\LOD Verification071610.xls	07/16/10

LOQ Verification	G \QA\QA_Forms\LOQ Verification022410.xls	02/24/10
Various Training Plans	G:\QA\QA_Forms\Training Plans\	NA

APPENDIX B

ORGANIZATIONAL CHARTS and RESUMES OF KEY PERSONNEL

USA
March 2013

Sally Roan
Sales & Marketing Director N. America

- Jarrod Evans, Marketing Manager, North America
- Paola Rivera, Technical Sales Coordinator, USA

Les Arnold
Director of Operations Eastern USA

- Peter Frick, Laboratory Director, Middletown, PA
- Jeff Ogle, Laboratory Director, Cincinnati, OH
- Chris Schepcoff, Laboratory Director, Houston, TX
- Jeff Glaser, Laboratory Director, Holland, MI
- Brian Weigel, Laboratory Director, Jacksonville, FL
- Jim Plassard, Laboratory Director – Dioxins, Houston, TX
- Mike Perry, Laboratory Director, Rochester, NY
- Paul Painter, Laboratory Director, South Charleston, West Virginia
- Idelis Williams, QA Manager, USA

Jeff Christian
Director of Operations Western USA

- Ralph Poulsen, Laboratory Director, Tucson, AZ
- Kelly Horiuchi, Laboratory Director, Simi Valley, CA
- Roy French, Laboratory Director, Fort Collins, CO
- Brent Stephens, Laboratory Director, Salt Lake City, UT
- Rick Bagan, Laboratory Director, Everett, WA
- Jeff Grindstaff, Laboratory Director, Kelso, WA

Hoai Van
Technical Director USA

Ann Yeager
Director, HR USA Life Sciences and Tribology

- Alene Albright, HR Business Partner Tribology, USA
- Cindy Richarsdon, Payroll Supervisor
- Tambra Charles, Benefits and Disability Specialist
- Joetta Ozuna, HR Business Partner Western USA
- Sharon Warren, HR Business Partner Eastern USA

Tish Davis
Corporate Controller USA Life Sciences and Tribology

- Phillip Zagotti, Assistant Corporate Controller, USA
- John Hall, Senior Accountant, USA
- Jan Jenkins, Senior Buyer, USA
- Lynn Pope, AP Group Leader, USA
- Dana Gohr, AR Group Leader, USA

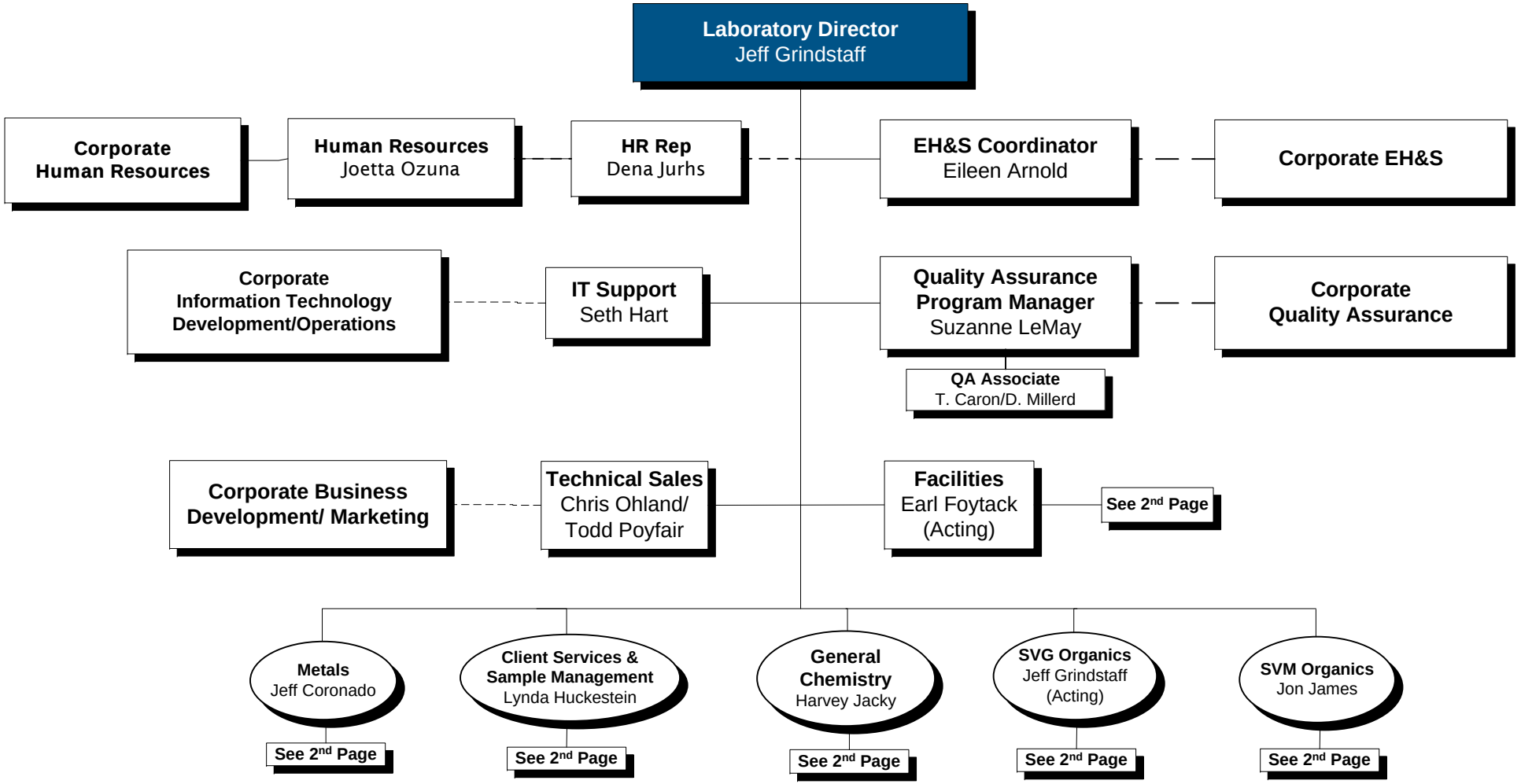
Albert Valle
LIMS Manager USA

Hiren Prajapati
IT Manager USA

Corporate Support Group

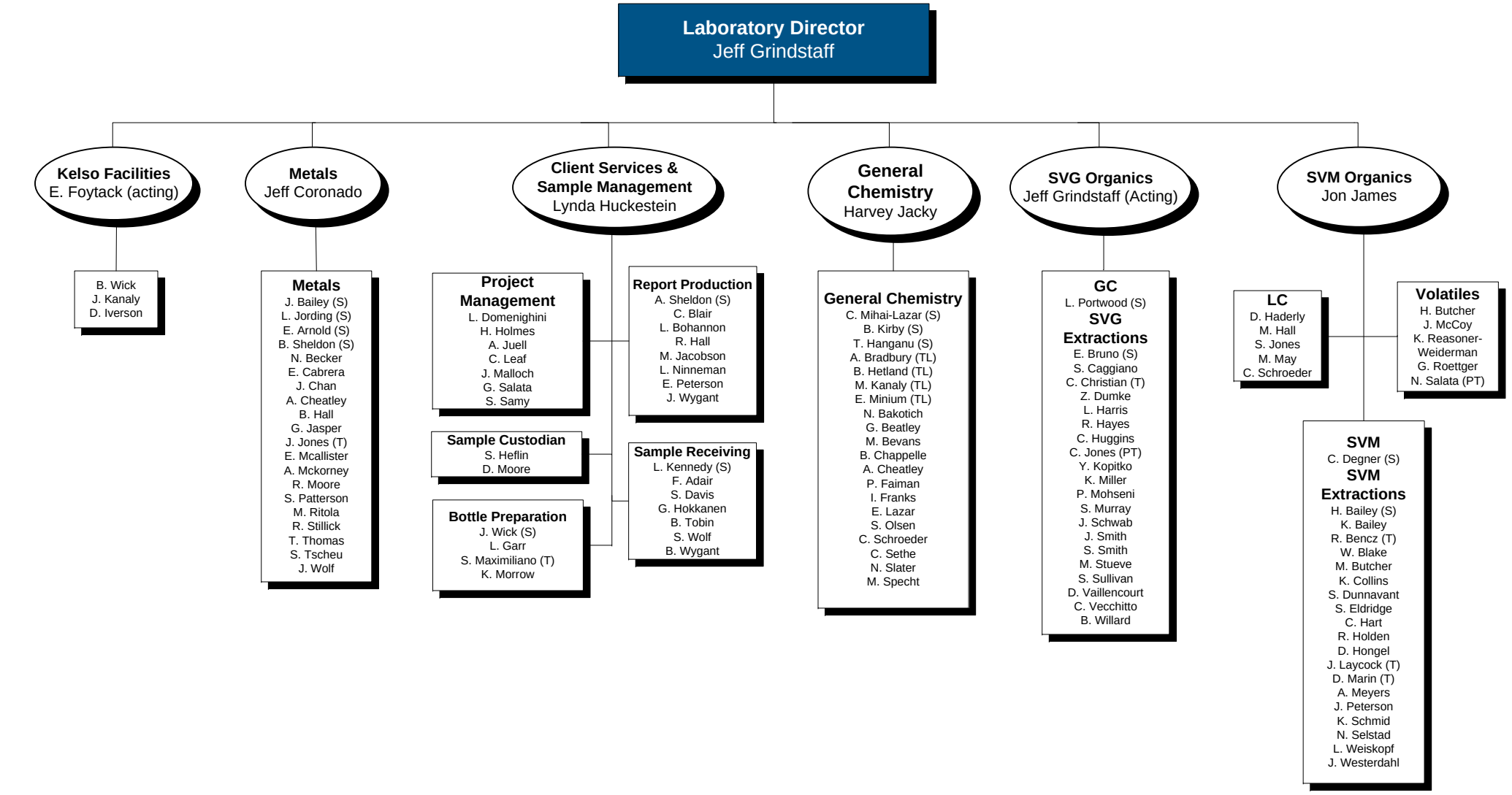
Kelso, Washington Laboratory

February 4, 2013



Kelso, Washington Laboratory

February 4, 2013
Operations



Jeffrey A. Grindstaff

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

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 – Columbia.

Laboratory Director

2010 - 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
Technical Manager III, Pharmaceutical, GC/MS VOA and Semi-VOA Laboratories, '97-'10

Primary responsibilities include leadership of the Pharmaceutical, GC/MS VOA and Semi-VOA 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, 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

Responsibilities 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 customer 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 Service
San Luis Obispo, CA
GC/MS Chemist, VOA Laboratory, '90-'91

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.

Suzanne LeMay

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

Education

University of Oregon – Eugene, OR
BS Geology, 1981

Ethics and Integrity Training; ORELAP/OELA Workshop, **2007**
How to Be a QA Manager; Advanced Systems, Inc., **2007**
Assessments for ISO/IEC 17025 and NELAC (ASI Course 300); Advanced Systems, Inc., **2005**
Introduction to Assessments; Advanced Systems, Inc., **2005**
Environmental Training, Quality Assurance/Quality Control (ASI Course 103); Advanced Systems, Inc., **2004**
Manager/Supervisor Training; Portland General Electric, **1998**
Statistics for Methodology Development; AOAC Short Course, **1994**
Quality Assurance for Analytical Laboratories, AOAC, **1991**

Quality Assurance Manager

2012 – Present

Responsible for the overall implementation of the laboratory QA program. Oversees implementation of Quality management systems including: Quality Assurance Manual, Certifications, SOP Control, Proficiency Testing (PT), Non-Conformity, Preventative Actions, Internal Auditing, Control Charting, Documentation of Training, and Metrology. Conducts employee QA training including orientations, sop, and ethics. Maintains state, agency and program certifications/accreditations. Acts as primary point of contact during laboratory audits coordinates audit responses and corrective actions.

Previous Experience

Test America — **Quality Assurance Manager, '00 – '10**
Portland, OR.

Developed and implemented a Quality System compliant with state and national regulatory standards, including: Safe Drinking Water Act, Clean Water Act, and Resource Conservation and Recovery Act. Acquired and maintained multiple laboratory accreditations including Oregon Environmental Laboratory Accreditation Program (ORELAP), Alaska Department of Environmental Conservation, Washington Department of Ecology, and California Environmental Laboratory Accreditation Program. Developed and implemented an internal compliance auditing program. Lead Quality Management projects designed to improve laboratory productivity, quality, and customer service. Organized and directed activities designed to anticipate and address quality issues in the laboratory. Oversight of laboratory support systems and equipment including the DI water system, cold storage, foreign soil storage and disposal, and calibration of balances, thermometers, pipettes, etc. Provided Quality Systems and Ethics training to laboratory staff.

Oregon Analytical Laboratory — **QA/QC Chemist, '92 – '00**
Beaverton, OR.

Developed and implemented a lab quality system encompassing certifications, proficiency testing, corrective actions, internal auditing, training, and maintenance of lab support systems and equipment. Wrote the lab QA Manual and developed and implemented document control procedures. Obtained and maintained multiple laboratory accreditations and transitioned the quality system toward compliance with the emerging NELAP. Directed a lab QA committee and participated in Total Quality Management and process improvement teams.

Oregon Analytical Laboratory — **Asbestos Team Leader, '90 – '92**
Beaverton, OR.

Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP). Analyzed samples for bulk and airborne asbestos and supervised department analysts. Provided method, quality and ethics training. Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP).

Oregon Analytical Laboratory — **Analyst/Technician, '85 – '90**
Beaverton, OR.

Performed sample preparation and analysis in the areas of bulk and airborne asbestos, transformer oil analysis, lube/fuel oil analysis, water chemistry, and particle analysis.

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.

Lynda A. Huckestein

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ALS Environmental

Education

Oregon State University, Corvallis, OR
BS in Microbiology, 1983

Client Services Manager IV

1998 - 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 $2 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

Columbia Analytical Services, Inc. — **Project Chemist**, '92-'98
Kelso, WA

Primary responsibilities included technical project management and client service in areas of pulp & paper, marine sediment and tissue services, mining, and DOD. Also responsible for providing technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory.

Columbia Analytical Services, Inc. — **Project Chemist and Dept. Manager**, General Chemistry Laboratory, '89-'92
Kelso, WA

Responsible for management of the General Chemistry laboratory for routine wastewater, bioassay, and microbiological analyses. Also responsible for supervision of staff, data review, and reporting.

Columbia Analytical Services, Inc. — **Analyst III**, 1989
Kelso, WA

Primary responsibilities included coliform testing, total recoverable petroleum hydrocarbon extractions and analysis, BODs, ammonias, and TKN, in addition to miscellaneous wet chemistry analyses.

Coffey Laboratories — **Microbiologist/Chemist**, 1983
Portland, OR

Was responsible for Coliform analysis; water chemistry.

Oregon State University — **Laboratory Assistant**, 1983
Corvallis, OR

Performed wheat spike dissection and tissue culture.

Jeffrey A. Coronado

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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,**
Kelso, WA **'92 – present**

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,**
Kelso, WA **'89 – '92**

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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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.

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

Jonathan (Jon) James

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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, Semivolatile 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. **Manager VOA and PHC/HPLC**
Kelso, WA **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. **Scientist IV, VOA Laboratory,**
Kelso, WA **'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. **Project Chemist, Supervisor**
Kelso, WA **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. **Analyst, SVOC GC Lab**
Kelso, WA **'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. **Analyst, Organic Extractions**
Kelso, WA **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..

Lester "Les" Kennedy

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Education

Lower Columbia College, Longview, WA
Coursework, general Studies, 1988 - 1990

Portland Bible College
Portland, OR
Batchelor ofTheology, 2009

Sample Custodian/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. **Project Manager** '99 -'11
Kelso, WA **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. **Supervisor Organic Extractions**
Kelso, WA **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. **Senior Analyst, GC/MS Laboratory**,
Kelso, WA '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. **Senior Analyst, Organic Extractions**
Kelso, WA **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. **Analyst, Organic Extractions**
Kelso, WA **Laboratory,** '91-'93

Duties primarily as listed above

APPENDIX C

MAJOR ANALYTICAL EQUIPMENT

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (16):			
Precisa,Mettler,OHOUS, Adams models	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
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 Meters (2):			
YSI Model 3200	2004	LM	4
VWR	2001	LM	4
Digestion Systems (5):			
COD (4)	1987, 1989	LM	4
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (3)	1987, 1988, 1991	LM	4
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	5
Drying Ovens (12):	1990-2010		
Shel-Lab and VWR models		LM	13
Air Drying Cabinets	2011	LM	NA
Flash Point Testers (2):			
ERDCO Setaflash Tester	1991	LM	3
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
Dionex ICS-2000 with Chromchem Data System	2006	LM	3
Dionex ICS-1600 with Chromchem Data System	2009	LM	
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	1990	LM	4
	1992	LM	4
Microscope - Olympus	1988	LM	1

Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY (continued)			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
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 (2) Coulemetrics Model 5012 Teledyne Tekmar Fusion 1	 1997 2009	 LM LM	 3 3
Total Organic Halogen (TOX) Analyzers (2): Mitsubishi TOX-100	 2001	 LM	 2
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (3): Beckman-Coulter DU520 Perkin Elmer Lambda 25 Abrazix	 1986 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		

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 (5): Varian SpectrAA Zeeman/220 AA (2) CETAC Mercury Analyzer M-6000A Perkin Elmer AAnalyst 200 Flame AA CETAC Mercury Analyzer M-6100	 2000 2000 2005 2010	 LM LM MM MM	 2 2 2 2
Buck AA Spectrophotometer Model 205	2008	LM	2
Atomic Fluorescence Spectrophotometer Brooks-Rand Model III (1) Leeman Mercury Analyzer (1)	 1996, 2005 2006	 LM LM	 3 2
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	3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS): VG Excell Thermo X-Series Nexion Model 300D	 2001 2006 2011	 MM MM MM	 3 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 (4) Mettler PM480, BB300 ,AG204 OHaus EP613	1999 - 2011	MM	12
Centrifuge – Beckman J-6B	1988	LM	12
Drying Ovens (2) Fisher Model 655G VWR Model 1305U	 1991 1999	 LM LM	 12 12
Evaporators/concentrators Organomation N-Evap (8) Organomation S-Evap (8) Zymark Turbovap (2)	 1990-2010 1990-2010 1998-2000	 LM LM LM	 12 12 12
Extractor Heaters: Lab-Line Multi-Unit Models for Continuous Liquid-Liquid and Soxhlet Extractions (102)	1987-2007	LM	8
Solids Extractors: Sonic Bath VWR (2) Sonic Horn (5) Soxhtherm Gerhardt (2) OI Analytical (6)	 1991 -1994 1994 2000 2008	 LM LM LM	 6 6 6
Extractors, TCLP (10): Millipore TCLP Zero Headspace Extractors (5) TCLP Extractor - Tumbler (12 position)	 1987-1992 1989	 LM LM	 2 2
Gel Permeation Chromatography (GPC) (6) ABC single column (3) J2 Scientific AccuPrep (2)	 1998, 1999, 2007 2005, 2010	 LM LM	 4 4
Muffle Furnace - 4	1994-2006	LM	4
Solid Phase Extractors (18) – Horizon SPE-Dex 4790	2003, 2006,2008	LM	4

GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Gas Chromatographs (17):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors	1990 – 1995	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FPD Detectors	1991	LM	3
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, 2012	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		
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
Thermo 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 (12):			
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 5890/5970 with ATAS Optic2 LVI and HP 7673 Autosampler	1994	LM	6
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (3)	1993, 1994, 1998	LM	6
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	2007	LM	6
Agilent7890A/5975C with Agilent 7693 Autosampler (4)	2010	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	4
Drying Oven - Fisher Model 630F	1991	LM	4
Evaporator – Turbo Vap	2009	LM	4
Centrifuge Marathon 21K	1996	LM	4
High-Performance Liquid Chromatographs (3):			
HP 1090M Series II with Diode Array UV Detector	1999	LM	2
HP 1050/1100 Series with Fluorescence & Diode Array UV Detectors	2004	LM	2
Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	2
High-Performance LC/MS (3)			
Spectrometer - Thermo Electron TSQ Quantum LC/MS/MS and Autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC Autosampler	2008	MM	2
AB Sciex 5500 and Schimadzo DGU 20A5	2011	MM	2
Agilent 1100 HPLC -UV/Fluoescence detectors- Pickering PCX-5200 Post-column derivitization unit	2003	LM	2

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 (2):			
Boekel 107801	1989	LM	5
VWR 1305 U	1991	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 5890/5971	1991	LM	5
Tekmar 3000 Purge and Trap Concentrator	2001	LM	5
Dynatech ARCHON 5100 Autosampler	1995	LM	5
Agilent 6890/5973	2001	LM	5
Tekmar 3100 Purge and Trap Concentrator	2001	LM	5
Varian Archon Autosampler	2001	LM	5
Agilent 6890/5973	2005	LM	5
Tekmar Velocity Purge and Trap Concentrator	2005	LM	5
Tekmar Aquatech Autosampler	2005	LM	5
Agilent 6890/5973 (2)	2007	LM	5
Tekmar 3000 Purge and Trap Concentrator	2007	LM	5
Varian Archon 5100 Autosampler	2007	LM	5
Agilent 7980A/5975C (2)	2010, 2011	LM	5
Teledyne Tekmar-Automx	2010,2011	LM	5
Hewlett-Packard 5890 Series II with PID/PID/FID	1991	LM	2
EST-ENCON Purge and Trap Concentrator	1991		
Dynatech Archon 5100 Autosampler	1992		

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1-WAN: LIMS Sample Manager using Oracle 10g & 11g DBMS running on Redhat Advanced Server 4.0 (Linux) platform connected/linked via both fiber and MPLS circuits.	1994-2007	LM	NA
1 - Network Server Pentium 4 class, 1 for Reporting and Data Acquisition running Windows 2003 SP2 Advanced Server, 1 for Applications running Windows 2003 Advanced Server SP2. Data acquisition capacity at 195 GB with redundant tape and disk arrays.	2004-2008	LM	NA
Approximately 80+ HP, Dell, Kyocera Laserjet printers (various types including models III, 4, 5, 8150, 4000, 4041, 4050, 4200 4250, 8150, 1720dn, W5300, 1300D, M4000)	1991 - 2010	LM	NA
Approximately 280 + Gateway/Dell/HP PC/Workstations running Windows 2000/XP on LAN connected via 10BT/100BT and TCP/IP for LIMs Terminal Emulation	1993 - 2010	LM	NA
Microsoft Office 2003 Professional as the base application for all PC/Workstations. Some systems using Office 2000/97, Office 2007.	1996 - 2010	LM	NA
E-Mail with link to SMTP for internal/external messaging. Web mail via Outlook Web Access interface. Microsoft Outlook 2003.	1994 - 2006	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Facsimile Machines - Brother 4750e; Brother 2920; Brother 1860	1991 - 2010	LM	NA
Copiers/Scanners: Konica BizHub 420 (1), BizHub 600 (1), BizHub 920 (2), BizHub Pro 1050 (3), BizHub Pro 1051 (1). All are accessible via LAN for network scanning.	2000 - 2010	LM	NA
Dot Matrix Panasonic KX-P1150	1991 - 2004	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS reporting software systems.	1998 - 2004	LM	NA
Data processing terminals (74) Enviroquant (63) Target (10)			

Saturn (1)			

NA: Not applicable. This equipment administered by IT staff but may be used by all staff.

APPENDIX D

DATA QUALIFIERS AND ACRONYMS

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria are 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 that was detected outside the quantitation range.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 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 matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Metals Data Qualifiers

#	The control limit criteria are not applicable. See case narrative.
J	The result is an estimated value that was detected outside the quantitation range.
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 4.1 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 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 were outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criterion 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 estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value that was detected outside the quantitation range.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria were 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 4.1 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.

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
LUFT	Leaking Underground Fuel Tank
LOD	Limit of Detection
LOQ	Limit of Quantitation
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
TPH	Total Petroleum Hydrocarbons

APPENDIX E

PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Activity	Maint[a]	Frequency
Refrigerators and Coolers	Record temperatures	LM	Daily
	Clean coils	LM	Annually
	Check coolant	LM	Annually or if temperature outside limits
Vacuum Pumps	Clean and change pump oil	LM	Every month or as needed
Fume Hoods	Face velocity measured	LM	Quarterly
	Sash operation	LM	As needed
	Change filters	LM	Annually
	Inspect fan belts	LM	Annually
Ovens	Clean	LM	As needed or if temperature outside lim.
	Record temperatures	LM	Daily, when in use
Incubators	Record temperatures	LM	Daily, morning and evening
Water Baths	Record temperatures	LM	Daily, morning and evening
	Wash with disinfectant solution	LM	When water is murky, dirty, or when growth appears
Autoclave	Check sterility	LM	Every month
	Check temperature	LM	Every month
	Clean	LM	When mold or growth appears
	Calibrate thermometer	VM	Once a year
Analytical Balances	Check alignment	LM	Before every use
	Verify calibration	LM	Daily
	Clean pans and compartment	LM	After every use
	Certified calibration	VM	Once a year
Dissolved Oxygen Meter	Change membrane	LM	When fluctuations occur
pH probes	Condition probe	LM	When fluctuations occur
Fluoride ISE	Store in storage solution	LM	Between uses
Ammonia ISE	Store in storage solution	LM	Between uses
UV-visible Spectrophotometer	Wavelength check	VM	Twice a year

Instrument	Activity	Maint[a]	Frequency
Total Organic Carbon Analyzers	Check IR zero	LM	Weekly
	Check digestion/condensation vessels	LM	Each use
	Clean digestion chamber	LM	Every 2000 hours, or as needed
	Clean permeation tube	LM	Every 2000 hours, or as needed
	Clean six-port valves	LM	Every 200 - 2000 hours, or as needed
	Clean sample pump	LM	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	LM	Every 200 - 2000 hours, or as needed
	Clean IR cell	LM	Every 2000 - 4000 hours, or as needed
Total Organic Carbon Analyzers	Change cell electrolyte	LM	Daily
	Change electrode fluids	LM	Daily
	Change pyrolysis tube	LM	As needed
	Change inlet and outlet tubes	LM	As needed
	Change electrodes	LM	As needed
Flow Injection Analyzer	Check valve flares	LM	Each use
	Check valve ports	LM	Each use
	Check pump tubing	LM	Each use
	Check light counts	LM	Each use
	Check flow cell flares	LM	Quarterly
	Change bulb	LM	As needed
	Check manifold tubing	LM	Each use
	Check T's and connectors	LM	Each use
Discrete Auto Analyzer	Clean probe, wash reservoirs	LM	Every 2 weeks
	Replace peristaltic pump tubing	LM	Every 3 months
	Replace hydraulic circuit tubing	LM	Once/year

Instrument	Activity	Maint[a]	Frequency
Ion Chromatographs	Change column	LM	Every six months or as needed
	Change valve port face & hex nut	LM	Every six months or as needed
	Clean valve slider	LM	Every six months or as needed
	Change tubing	LM	Annually or as needed
	Eluent pump	LM	Annually
Atomic Absorption Spectro-photometers - FAA and CVAA	Check gases	LM	Daily
	Clean burner head	LM	Daily
	Check aspiration tubing	LM	Daily
Atomic Absorption Spectro-photometers - GFAA	Clean optics	LM	Every three months
	Empty waste container	LM	Weekly
	Check gases	LM	Daily
	Check argon dewar	LM	Daily
	Change graphite tube	LM	Daily, as needed
	Clean furnace windows	LM	Monthly
ICP - AES	Check argon dewar	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Empty waste container	LM	Weekly
	Clean nebulizer, spray chamber, and torch	LM	Every two weeks
	Replace water filter	LM	Quarterly
	Replace vacuum air filters	LM	Monthly
ICP - MS	Check argon dewar	LM	Daily
	Check water level in chiller	LM	Daily
	Complete instrument log	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Clean sample and skimmer cones	LM	As needed
	Clean RF contact strip	LM	As needed
	Inspect nebulizer, spray chamber, and torch	LM	Clean as needed
	Clean lens stack/extraction lens	LM	As needed

	Check rotary pump oil	LM	Monthly
	Change rotary pump oil	LM	Every six months

Instrument	Activity	Maint[a]	Frequency
Gel-Permeation Chromatographs	Clean and repack column	LM	As needed
	Backflush valves	LM	As needed
HPCL Chromatographs	Backflush guard column	LM	As needed
	Backflush column	LM	As needed
	Change guard column	LM	As needed when back pressure too high
	Change column	LM	Annually or as needed
	Change in-line filters	LM	As needed
	Leak check	LM	After column maintenance
	Change pump seals	LM	As needed
	Change pump diaphragm	LM	Annually
	Clean flow cell	LM	As needed
	Fluorescence detector check	LM	Daily
	Diode array absorbance check	LM	Daily
HPLC MS/MS	Clean ion transfer tube	LM	Daily or noticeable decrease in signal
	Clean inlet assembly	LM	Monthly or as needed
	Forepump	LM	Blast weekly; change oil every 3 months
Gas Chromatographs, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean FID	LM	Weekly or as needed
	Clean ECD	LM	Quarterly or as needed
	Leak test ECD	LM	Annually

Instrument	Activity	Maint[a]	Frequency
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily, when in use
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Clean source	LM	As needed when tuning problems
	Change pump oil	LM	As specified by service specifications
Purge and Trap Concentrators	Change trap	LM	Every four months or as needed
	Change transfer lines	LM	Every six months or as needed
	Clean purge vessel	LM	Daily
Gas Chromatographs, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean PID lamp	LM	As needed
	Clean FID	LM	As needed
	Change ion exchange resin	LM	Every 60 days
	Replace nickel tubing	LM	Quarterly or as needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily
	Clip first foot of capillary column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails

Instrument	Activity	Maint[a]	Frequency
	Clean source	LM	As needed when tuning problems
	Change pump oil		As specified by service specifications

APPENDIX F

LABORATORY
STANDARD OPERATING PROCEDURES

SOP TITLE	FILE NAME
KELSO ADMINISTRATIVE SOPS	
ALS KELSO TRAINING PROCEDURE	ADM-TRAIN
CHECKING VOLUMETRIC LABWARE	ADM-VOLWARE
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT
DATA ARCHIVING	ADM-ARCH
DATA REPORTING AND REPORT GENERATION	ADM-RG
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD
LABORATORY BALANCE MONITORING AND CALIBRATION	ADM-BAL
LABORATORY DATA REVIEW PROCESS	ADM-DREV
METHOD VALIDATION DOCUMENTATION	ADM-MDLC
PROJECT MANAGEMENT	ADM-PCM
REAGENT LOGIN AND TRACKING	ADM-RLT
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC
SAMPLE BATCHES	ADM-BATCH
SAMPLE MANAGEMENT SOPS	
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT
SAMPLE DISPOSAL	SMO-SDIS
SAMPLE RECEIVING	SMO-GEN
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC
KELSO FACILITY SOPS	
FACILITY AND LABORATORY CLEANING	FAC-CLEAN
OPERATION AND MAINTENANCE OF LABORATORY REAGENT WATER SYSTEMS	FAC-WATER

BIOLOGY SOPS

COLIFORM, FECAL	BIO-9221FC
COLIFORM, TOTAL	BIO-9221TC
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D
COLILERT® , COLILERT-18®, & COLISURE®	BIO-9223
ENTEROLERT	BIO-ENT
HEPTEROTROPHIC PLATE COUNT	BIO-HPC
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN

EXTRACTION SOPS

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520
SOLID PHASE EXTRACTION	EXT-3535
SOXHLET EXTRACTION	EXT-3540
AUTOMATED SOXHLET EXTRACTION	EXT-3541
ULTRASONIC EXTRACTION	EXT-3550
WASTE DILUTION EXTRACTION	EXT-3580
SILICA GEL CLEANUP	EXT-3630
GEL PERMEATION CHROMATOGRAPHY	EXT-3640A
REMOVAL OF SULFUR USING COPPER	EXT-3660
REMOVAL OF SULFUR USING MERCURY	EXT-3660M

SULFURIC ACID CLEANUP	EXT-3665
CARBON CLEANUP	EXT-CARCU
DIAZOMETHANE PREPARATION	EXT-DIAZ
DMD SYNTHESIS	EXT-DMD
FLORISIL CLEAN-UP	EXT-FLOR
ORGANICS EXTRACTIONS GLASSWARE CLEANING	EXT-GC
PERCENT LIPIDS IN TISSUE	EXT-LIPID
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER AND TISSUE	EXT-OSWT
PREPARATION OF REAGENTS AND BLANK MATRICES USED IN SEMIVOLATILE ORGANICS COMPOUNDS	EXT-REAG
ADDITION OF SPIKES AND SURROGATES	EXT-SAS
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL

GENERAL CHEMISTRY SOPS

FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020
COLOR	GEN-110.2
TOTAL SOLIDS	GEN-160.3
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4
SETTEABLE SOLIDS	GEN-160.5
HALIDES, ADSORBABLE ORGANIC (AOX)	GEN-1650
GRAVIMETRIC DETERMINATION OF HEAXANE EXTRACTABLE MATERIAL (1664)	GEN-1664
ALKALINITY TOTAL	GEN-2320
HARDNESS, TOTAL	GEN-2340
DETERMINATION OF INORGANIC ANIONS IN DRINKING WATER BY ION CHROMATOGRAPHY	GEN-300.1

ACIDITY	GEN-305.2
PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314.0
CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330.4
TOTAL RESIDUAL CHLORINE - METHOD 330.5	GEN-330.5
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-4500 NH3E
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3
PHENOLICS, TOTAL	GEN-420.1
ORTHOPHOSPHATE DETERMINATION USING COLORIMETRIC PROCEDURE	GEN-4500-PE
DISSOLVED SILICA	GEN-4500 -SIO_2C
SILICA DETERMINATION USING SMARTCHEM METHOD	GEN-4500-SIO2E
GRAVIMETRIC SULFATE	GEN-4500 SO4 C
NITRITE BY COLORIMETRIC PROCEDURE	GEN-4500NO2 B
SULFIDE, METHYLENE BLUE	GEN-4500S2D
SULFIDE, TITRIMETRIC (IODINE)	GEN-4500S2F
TRIAZINES AS ATRAZINE by QUANTITATIVE IMMUNOASSAY	GEN-4670
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B
AQUATIC HUMIC SUBSTANCES	GEN-5510B

DETERMINATION OF METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)	GEN-5540C
TANNIN AND LIGNIN	GEN-5550
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030
TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076
CARBON, TOTAL ORGANIC IN SOIL	GEN-ASTM
AUTOFLUFF	GEN-AUTOFLU
SULFIDES, ACIDS VOLATILE	GEN-AVS
HEAT OF COMBUSTION	GEN-BTU
CHLOROPHYLL-a BY COLORIMETRY	GEN-CHLOR
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-CN
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD
CHEMICAL OXYGEN DEMAND	GEN-COD
CONDUCTIVITY IN WATER AND WASTES	GEN-COND
CORROSIVITY TOWARDS STEEL	GEN-CORR
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6
STANDARD TEST METHODS FOR DETERMINING SEDIMENT CONCENTRATION IN WATER SAMPLES	GEN-D3977
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109
FDA EXTRACTABLES	GEN-FDAEX

FERROUS IRON IN WATER	GEN-FeII
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26
HYDROGEN PEROXIDE BY PERMANGANATE TITRATION	GEN-H2O2
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD
TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS
ION CHROMATOGRAPHY	GEN-IONC
COLOR, NCASI	GEN-NCAS
NITROCELLULOSE IN SOIL	GEN-NCEL
OXYGEN CONSUMPTION RATE	GEN-O2RATE
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU
Ph IN SOIL AND SOLIDS	GEN-Phs
Ph IN WATER	GEN-Phw
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM
PARTICLE SIZE DETERMINATION	GEN-PSP
SULFIDES, REACTIVE	GEN-RS
TOTAL SULFIDE BY PSEP	GEN-S2PS
SULFITE	GEN-SO3
SPECIFIC GRAVITY	GEN-SPGRAV
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-TDS

THIOCYANATE	GEN-THIOCN
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN
TOTAL NITROGEN AND TOTAL PHOSPHORUS BY ALKALINE PERSULFATE DIGESTION NCASI METHOD TNTP-W10900	GEN-TNTP
TOTAL ORGANIC CARBON IN WATER	GEN-TOC
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-TSS
TURBIDITY MEASUREMENT	GEN-TURB
ULTIMATE BOD	GEN-UBOD
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH

ORGANIC LIQUID CHROMATOGRAPHY SOPS

PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS HPLC/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-1694
DETERMINATION OF TRIAZINE PESTICIDES AND THEIR DEGRADATES IN WATER BY LIQUID CHROMATOGRAPHY ELECTROSPRAY IONOIZATION TANDEM MASS SPECTROMETRY.	LCP-536
DETERMINATION OF SELECTED PERFLORINATED ALKL ACIDS IN DRINING WATER BY SOLID PHASE EXTRASCTION AND TANDEM LC/MS/MS.	LCP-537
ALDEHYDES BY HPLC	LCP-8315
DETERMINATION OF HORMONES IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY ELECTROSPRAY IONIZATION TANDEM (LC/ESI-MS/MS)	LCP-539
POLYNUCLEAR AROMATIC HYDROCARBONS BY HPLC	LCP-610
QUANTITATIVE DETERMINATION OF CARBAMATE PESTICIDES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDAM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-8321
DETERMINATION OF CARBAMATES IN WATER BY EPA 8321 USING LC TANDEM MASS SPECTROMETRY	LCP-8321W

NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY(HPLC)	LCP-8330B
ACRYLAMIDE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)..	LCP-ACRYL
QUANTITATIVE DETERMINATION OF AFLATOXINS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-AFLA
QUANTITATIVE DETERMINATION OF 2,2-DIBROMO-3-NITRILOPROPIONAMIDE BY HPLC	LCP-DBNPA
DIOCTYL SULFOSUCCINATE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)..	LCP-DOS
QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-MS/MS)	LCP-LCMS4
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	LCP-NITG
QUANTITATION OF NITROPHENOLS IN SOILS BY LIQUID CHROMATOGRAPHYAND TANDEM MASS SPECTORMETRY (LC-MS/MS)	LCP-NITRO
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	LCP-OALC
QUANTITATIVE DETERMINATION OF OPTICAL BRIGHTENER 220 BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)	LCP-OPBR
PERFLUORINATED COMPOUNDS BY HPLC/MS/MS	LCP-PFC
DETERMINATION FO PHTHALATES IN FOOD BY LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MSMS)	LCP-PHT
DETERMINATION OF MANNOSE AND GALACTOSE IN WATER BY HPLC/MS/MS	LCP-SUGAR
TOTAL OLEANOLIC ACID SAPONINS IN WATER BY ACID HYDROLYSIS AND HPLC/MS/MS	SOC-LCMS3
PICRIC ACID AND PICRAMIC ACID BY HPLC	SOC-PICRIC
DIQUAT AND PARAQUAT BY HPLC	SVD-549

METALS SOPS

METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S
METHYL MERCURY IN TISSUE BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630T
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631
DETERMINATION OF ARSENIC SPECIES BY HYDRIDE GENERATION CRYOGENIC TRAPPING GAS CHROMATOGRAPY ATOMIC ABSORPTION SPECTROPOTOMETRY	MET-1632
DETERMINATION OF TRACE ELEMENTS IN AMBIENT WATERS BY ICP-MS	MET-1638
DETERMINATION OF TRACE METALS IN WATERS BY ON-LINE CHELATION PRECONCENTRATION AND INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY	MET-1640
MERCURY IN WATER	MET-245.1
METALS DIGESTION	MET-3010A
METALS DIGESTION	MET-3020A
METALS DIGESTION	MET-3050
CLOSED VESSEL OIL DIGESTION	MET-3051M
CLOSED VESSEL DIGESTION OF SILICEOUS AND ORGANICALLY BASED MATRICIES	MET-3052M
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CARBON, TOTAL ORGANIC IN SOIL

ASTM METHOD D4129-05, MODIFIED FOR SOIL AND SEDIMENT MATRICES (PUGET SOUND ESTUARY PROGRAM AND LLOYD KAHN)

ALS-KELSO

SOP ID:	GEN-ASTM	Rev. Number:	8	Effective Date:	06/15/2013

Approved By: _____ Date: 5/29/13
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Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

for

CARBON, TOTAL ORGANIC IN SOIL

1. SCOPE AND APPLICATION

1.1. This procedure is applicable to the determination of Total Organic Carbon (TOC) using ASTM method D4129-05, modified for soil and sediment matrices (Puget Sound Estuary Program and Lloyd Kahn). Total organic carbon is a measure of the total amount nonvolatile, partially volatile and particulate organic compounds in a sample. Sample should be treated to remove inorganic carbon (carbonates, bicarbonates, free CO_2 etc.), prior to analysis, as these compounds will interfere with true readings.

1.2. This method is applicable to all soils and sediments and most matrices that can be dried and ground to a fine powder.

1.3. Results are reported as percent (%) carbon, and the applicable range is the MDL - 100%. The Method Reporting Limit (MRL) for TOC on soils is 0.05%, dry weight basis. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The Method Detection Limit (MDL) has been determined at 0.02%.

2. METHOD SUMMARY

2.1. Samples are combusted in an oxygen atmosphere to convert organic and inorganic forms of carbon to CO_2. The combustion temperature is selected to completely oxidize all carbon forms. The combustion product gases are swept through a barium chromate catalyst/scrubber to ensure that all of the carbon is oxidized to CO_2. Other potentially interfering product gases such as SO_2, SO_3, HX, and NO_x are removed from the gas stream in a series of chemical scrubbers. The CO_2 is then swept to the coulometer where it is detected by automatic, coulometric titration, with coulometric end point indication.

2.2. The coulometer cell is filled with a partially aqueous medium containing ethanolamine and a colorimetric indicator. When a gas stream passes through the solution, CO_2 is quantitatively absorbed. CO_2 reacts with the ethanolamine to form a strong titratable acid which caused the indicator to fade. The titration current automatically turns on and electrically generates base to return the solution to its original color.

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.

3.2. 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.

3.3. **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.

3.4.4. Nonaqueous Liquid – Any organic liquid with <15% settleable solids.

3.4.5. Animal tissue – Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.4.6. Solids – Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.4.7. 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.

3.4.8. 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, auto fluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.

3.5. 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 mid point of the calibration range or at levels specified by a project analysis plan.

3.6. 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.

3.7. 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. 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.

3.10. 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.

3.11. 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. Acidic and other gases, including SO_2, SO_3, H_2S, HCl, HBr, HI, Cl_2, and NO_x can be effectively removed using scrubbers such as KI, Ag_2SO_4, $AgNo_3$, and MnO_2.

4.2. Volatile organics may be lost in the decarbonization process.

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. Disconnect teflon tubing from furnace at check valve whenever system is not in use or when O_2 flow is turned off or furnace temperature is reduced. If the carbon cathode solution should be siphoned through a failed check valve into the magnesium perchlorate scrubber potentially explosive DMSO-perchlorate could be formed.

5.5. Do not attempt to combust large samples of organic or other materials that will react with pure oxygen. Such samples can cause the pyrolysis tube to explode.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

Samples can be collected in glass or plastic containers. Samples are preserved by storage at 4±2°C. Samples are analyzed within 28 days of collection.

7. APPARATUS AND EQUIPMENT

7.1. Induction furnace, Coulometrics Incorporated.

7.2. Analytical balance, 0.1mg accuracy.

7.3. Desiccator.

7.4. Quartz combustion boats.

7.5. Sample scoop.

7.6. Porcelain dishes.

7.7. Glass ladles and miscellaneous laboratory glassware,

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. 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 ADM-RTL,

Reagent/Standards Login and Tracking for the complete procedure and documentation requirements.

8.2. Standards

8.2.1. Urea – 20% carbon. Use 10 µg.

8.2.2. Nutrients in Soil, purchased standard with a known TOC value (typically ERA #542). Use 50 mg for LCS.

8.3. Reagents

8.3.1. Hydrochloric acid, 50% and 10%.

8.3.1.1. 10%: Bring 20mL HCl to 200mL final volume
8.3.1.2. 50%: Bring 100mL HCl to 200mL final volume

8.3.2. Carbon Cathode Solution. Dimethyl Sulfoxide; DMSO. Purchased from Coulometrics Inc. as a prepared solution. Used for coulometer solution.

8.3.3. Anode Solution. Dimethyl Sulfoxide and potassium iodide. Purchased from Coulometrics Inc. as prepared solution.

8.3.4. Manganese dioxide. Gas scrubber solution.

8.3.5. Potassium Hydroxide. Gas scrubber solution.

8.3.6. Potassium Iodide. Anode chemical.

8.3.7. Magnesium Perchlorate desiccant

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. Documenting method proficiency, as described in ADM-TRAIN, ALS – Kelso Training Procedure, is also the responsibility of the department supervisor/manager.

10. PREVENTIVE MAINTENANCE

10.1. 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 10. The entry in the log must

include: date of event, the initials of who performed the work, and a reference to analytical control.

Maintenance is performed as follows:

Maintenance Item	Frequency
Cell	Clean daily with methanol and water to clean frit
Mg Perchlorate Scrubber	change daily
KOH Scrubber	change monthly
NOX scrubber	change as needed
Repack Precombustion Column	as needed
Repack Combustion Column	as needed

11. PROCEDURE

11.1. Sample Preparation.

11.1.1. Turn furnace on to ≈1000ºC. Allow furnace to warm-up for about 1/2 hours. Turn on oxygen to ≈5 psi and 75 to 125 ml/min at flowmeter.

11.1.2. Clean quartz boats. Scrape out old sample and rinse boats with DI water. Place boats in crucible and muffle for at least 10-15 minutes. Remove boats and place in desiccator until ready for use.

11.1.3. Samples should be dried at 70ºC and homogenized prior to analysis. Homogenization of dried solid sample should include grinding with a mortar and pestle or shatter box. A shatter box should be used with a larger sample size (i.e. 20+ grams) if the sample exhibits a high degree of heterogeneity. Samples should be ground to a fine, homogenous, powder.

11.1.4. Ground samples must be stored in individual sealed vials. In addition, sample vials analyzed under PSEP methodology must be stored in a desiccator prior to sample analysis.

11.1.5. As a rule, the darker (or closer to black) a sample is, the more carbon it contains. Place a small portion of sample on a watch glass. Add 1 drop of 10% HCl. Watch for effervescence or bubbling. If bubbles are present, the sample contains inorganic carbon (CO_3). If sample bubbles, reduce sample size to prevent sample from bubbling out of boat. If sample is dark, wood product or sludge reduce sample volume to 5 - 10mg. Normal sample volume = 50mg. After boats are loaded with sample add 1 to 2 drops 10% HCl to each sample, LCS, and method blank. Place boats in 70ºC oven to dry. If samples bubbled when acid was added, add 1 to 2 drops more acid and dry at 70ºC. Continue acidifying and drying until samples no longer bubble. Place samples in desiccator until ready for analysis.

11.2. Apparatus Preparation.

11.2.1. Fill cell with carbon cathode solution to 100 – 125 ml, drop in stir bar. Place cell top on snug.

11.2.2. Cover bottom of anode cell with KI. About 2 small scoops.

11.2.3. Add carbon anode solution to cell such that when anode is inserted in the anode cell, the anode solution level is the same as the cathode solution level.

11.2.4. Place cell in coulometer cell holder.

11.2.5. Turn on detector lamp and stir plate. (Power on)

11.2.6. Turn adjust knob to 122 (all the way to the right) then turn back down to 100. Rotate cell until maximum transmittance is obtained.

11.2.7. With oxygen bubbling to cell and maximum transmittance obtained, turn on the current to the anode and cathode. The carbon cathode solution will begin to titrate to a blue color.

11.2.8. Change Magnesium Perchlorate desiccant daily.

11.2.9. The instrument is now ready to run.

11.3. Calibration and Standardization.

11.3.1. Burn both ladles for five minutes each to remove any residual TOC.

11.3.2. Establish baseline.

11.3.2.1. After placing ladles in sample inlet, allow system to purge for 1 minute.

11.3.2.2. Burn three empty boats five minutes each. The average of the three runs is the baseline.

11.4. Analysis.

11.4.1. Place one platinum or quartz boat in a ladle. Place the ladle in the sample inlet and purge for 1 minute. Simultaneously insert the sample into the furnace, press the reset button on the coulometer and start the timer for five minutes.

11.4.2. After five minutes, obtain a reading from the instrument. Remove the ladle from the furnace. (Occasionally, a high sample may require longer than 5 minutes to complete the titration).

11.4.3. Load the other ladle with the next platinum (or quartz) boat. Remove the ladle in use from the inlet port and insert the next ladle.

11.4.4. Repeat steps 11.4.1 through 11.4.3 until all samples are analyzed.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

The precision and accuracy 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's are prepared and analyzed. The RSD should be <20% and average recovery must be within LCS recovery limits (see laboratory DQO Tables).

12.2. Method Detection Limits and Method Reporting 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. Analyze a minimum of seven spiked blank replicates at a level near 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.* The MDL study must be verified annually.

12.2.2. Calculate the average concentration found (x) in the *sample concentration*, 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.

12.2.3. Limits of Quantification (LOQ)

12.2.3.1. The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 75-125% of the true values to verify the data reporting limit. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

12.2.4. The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.3. 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).*

12.4. The QC criteria discussed in the following sections are summarized in Table 1.

12.4.1. LCS – An LCS must be analyzed with each batch of 20 or fewer samples. Analyze 50mg of the purchased standard (see 8.1.2) is used. The acceptance criteria for the LCS are listed in Table 1.

12.4.2. Method Blank – Analyze one method blank per batch of 20 or fewer samples. Add one to two drops of 10% HCl to an empty boat and place the boat in a 70ºC oven to dry. Method Blank must be <0.05% carbon.

12.4.3. CCV (Continuing Calibration Verification) – A CCV must be analyzed every tenth analysis. Analyze ~10mg urea. The CCV must be 18.0% – 22.0% carbon.

12.4.4. CCB (Continuing Calibration Blank) – A CCB must be analyzed following every CCV.

12.4.5. Sample duplicate – ASTM D 4129: One duplicate sample per batch of 20 or fewer samples must be analyzed in duplicate. TOC analysis by PSEP methodology requires one sample to be analyzed in triplicate per batch of 20 or fewer samples. Samples analyzed under Lloyd Kahn methodology must all be analyzed in duplicate. All duplicates and triplicates, regardless of the method cited, should be within 20% RPD, if > five times the MRL.

12.4.6. Matrix Spike – One spike must be analyzed with each batch of 20 or fewer samples. The acidified sample will be spiked with a known amount of urea.

12.4.7. See Table 1 for a summary of acceptance criteria and corrective actions.

13. DATA REDUCTION AND REPORTING

13.1. Calculate % carbon as follows:

$$\%Carbon = \frac{(Gross\ reading\ -baseline\ \mu g)(0.1)}{mg\ sample\ analyzed}$$

13.1.1. Total organic carbon is reported as % carbon, normally on a dry weight basis. Results may be reported on an as received basis.

13.2. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

where S1 = Sample with higher value
S2 = Sample with lower value
Avg = Average of the two sample values

13.3. Calculate percent recovery as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

where X = Concentration of the analyte recovered
X1 = Concentration of unspiked analyte
TV = True value of amount spiked

13.4. Data Review and Assessment

13.4.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative. All data will be initialed, dated and attached to required data quality worksheet.

13.5. Reporting

13.5.1. Refer to ADM-RG, *Data Reporting and Report Generation* for reporting guidelines.

13.5.2. The analyst enters data directly into LIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.5.3. As an alternative, reports are generated using Excel© templates located in R:\WET. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates.

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. METHOD PERFORMANCE

15.1. This method is validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available. The method detection limit (MDL) is established using the procedure described in CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

15.2. Method Reporting Limits are established for this method *based on MDL studies and as specified in* CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

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.

16.4. This method uses a base. Waste base is hazardous to the sewer system and to the environment. All 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. METHOD MODIFICATIONS

17.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

18. REFERENCES

18.1. Coulometrics Inc. Instruction Manual, Model 5020.

18.2. Total Organic Carbon (TOC), Conventional Sediment Variables, Puget Sound Estuary Program, March 1986.

18.3. Determination of Total Organic Carbon in Sediment, Lloyd and Kahn, U.S.E.P.A Region II, July 1988.

18.4. ASTM Method D4129-05.

19. CHANGES SINCE THE LAST REVISION

19.1. Reformatted method per ALS branding
19.2. Changed "CAS" references to "ALS"
19.3. Updated SOP references
19.4. Sec. 1.2: replaced "shatter boxed" with "ground"
19.5. Sec 8.3.1: Added preparation of 10% and 50% HCl
19.6. Sec 11.1.1: Deleted "#5"
19.7. Sec 11.1.5: Added LCS and MB to sample preparation (addition of acid)
19.8. Sec 11.3.2.2: Corrected word order
19.9. Sec 12.1: Referred to DQO tables for LCS recovery limits
19.10. Sec 12.4.2: Added method blank preparation
19.11. Table 1: Referred to DQO Tables for LCS and MS recovery limits.

TABLE 1
Summary of Corrective Actions

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
ASTM D4129 PSEP Lloyd Kahn	CCV	Verify calibration by analyzing prior to samples, after every 10 analysis and after the last sample	±10%	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn	LCS	Include with each analysis batch (up to 20 samples)	See DQO Tables	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn	Method Blank	Include with each analysis batch (up to 20 samples)	< 0.05%	If target exceeds 0.05%, clean boats and re-analyze.
ASTM D4129 PSEP Lloyd Kahn	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if the there is a matrix effect or analytical error
ASTM D4129 PSEP Lloyd Kahn	Sample Duplicates	Include with each analysis batch (up to 20 samples)	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
ASTM D4129 PSEP Lloyd Kahn	Sample Triplicate	Include with each analysis batch (up to 20 samples)	≤ 20 % RSD	Re-homogenize and re-analyze if result is > 5 X the MRL
ASTM D4129 PSEP Lloyd Kahn	Sample Duplicates	All samples in each analysis batch	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL

APPENDIX I

BENCHSHEETS

Columbia Analytical Services, Inc.

Service Request #: _____ Method: ASTM D4129-82M/EPA Lkahn/ PSEP (Combustion/Coulometric)

Analysis For: Total Organic Carbon (TOC) Matrix: Soil / Dry Weight Basis

Sample Number	mg Sample Injected	Sample Reading, µg C	Baseline Reading, µg C	Net µg C	% Carbon	% Carbon Reported
CCV-1					#VALUE!	#VALUE!
CCB-1	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
LCS-1					#VALUE!	#VALUE!
MB-1	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
CCV-2					#VALUE!	#VALUE!
CCB-2	50.0		0.0	#VALUE!	#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
					#VALUE!	#VALUE!
CCV-3					#VALUE!	#VALUE!
CCB-3	50.0		0.0	#VALUE!	#VALUE!	#VALUE!

R:\WET\ANALYSES\TOC\TEMPLATE\TOCsoil_LIMS 011612

Revision 2

Acid Purge Time: 1 minute **Reading Time:** 5 minutes **TOC % =** $\frac{\text{(Net Reading)(µg 0.1)}}{\text{mg Sample Injected}}$

LCS: ERA Cat#: 542 Lot#: D068-542 ID#: TOCS/2-89-A TV = 0.28%C %REC=

CCV : Urea EMD (lot #3229B230) ID#: TOCS/1-11-M TV = 20.0%C

CCV1 = #VALUE! CCV2 = #VALUE! CCV3= #VALUE!

HCl: 10% ID#Toc/2-80-____ Balance: K-Balance-

Oven ID# Thermometer ID#

Kms =mg x 20 /= % REC= RSD= x=

Kmsd =mg x 20 / = % REC=

date time

Analyzed By:	Date:
Reveiwed By:	Date:

Sample #	mg Sample	Reading	Date Baked	Baseline
CCV-1			#VALUE!	
CCB-1	50.0			
LCS-1			#VALUE!	
MB-1	50.0			AVG
				0.0
CCV-2			#VALUE!	
CCB-2	50.0			
CCV-3			#VALUE!	
CCB-3	50.0			
CCV-4			#VALUE!	
CCB-4	50.0			
CCV-5			#VALUE!	
CCB-5	50.0			
CCV-6			#VALUE!	
CCB-6	50.0			
CCV-7			#VALUE!	
CCB-7	50.0			
CCV-8			#VALUE!	
CCB-8	50.0			
CCV-9			#VALUE!	
CCB-9	50.0			

Analyst	Date	Time
0	1/0/00	0:00

PH IN SOIL AND SOLIDS

EPA METHOD 9045D

ALS-KELSO

SOPID: GEN-PHS	Rev. Number: 13	Effective Date: 04/30/201313

Approved By: _____ Date: 4/18/13
Department Supervisor - Harvey Jacky

Approved By: _____ Date: 4/18/13
QA Manager - Suzanne LeMay

Approved By: _____ Date: 4/19/13
Laboratory Director - Jeff Grindstaff

Issue Date: _____	Doc Control ID#: _____	Issued To: _____

STANDARD OPERATING PROCEDURE

for

pH IN SOIL AND SOLIDS

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine pH in soil, solid, and certain waste samples using EPA Method 9045D.

1.2. When used to determine pH in multiphase wastes, the procedure is applicable if the aqueous phase constitutes less than 20% of the total volume of the waste.

2. METHOD SUMMARY

2.1. The pH is determined by potentiometric measurement of a soil slurry or aqueous solution using a standard combination glass pH electrode and pH meter.

2.2. The procedure uses methodology described in EPA Method 9045D, WDOE Test Method, and Oregon State Soil Methods.

3. DEFINITIONS

3.1. Analysis Batch - A sequence of samples, which are analyzed within a 24-hour period and include no more than 20 field samples.

3.2. Sample Duplicate - two aliquots of the same sample that are treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures.

3.3. Sample Triplicate – three aliquots of the same sample that are treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures.

4. INTERFERENCES

4.1. Samples with extreme pH results may give incorrect readings on the meter. Samples with a high sodium concentration and pH > 10 can cause error. Using a “low sodium error” electrode (such as Orion 8165, 8172 or equivalent) eliminates this issue to a pH of 12. If the pH is greater than 12, the sodium content of the sample may need to be determined and the pH result may need correction. Strong acid solutions with pH < 1 may give incorrect high pH readings.

4.2. Samples containing oil may coat the electrode and cause a sluggish response or inaccurate reading. If an electrode becomes coated with a material which cannot be rinsed off, the electrode can be cleaned with an ultrasonic bath, be washed with detergent and rinsed then

placed in 1:1 HCl so that the lower third of the electrode is submerged, then rinsed thoroughly with water.

4.3. Temperature fluctuations will cause instrument errors.

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 CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Sample bottles can either be glass or plastic and must be thoroughly cleaned and rinsed prior to use.

6.2. Samples must be stored refrigerated at 4 C (± 2ºC). Although there is no holding time established for soils, samples should be analyzed as soon as possible.

7. APPARATUS AND EQUIPMENT

7.1. Fisher Accumet pH meter, Model 25 or equivalent.

7.2. Combination electrode for pH with temperature probe (such as Orion 8165 or equivalent).

7.3. Conductivity jars, 50 ml.

7.4. Analytical balance capable of weighing 0.1 g.

7.5. Paint filters.

7.6. Erlenmeyer flasks, 250 ml.

7.7. Water bath capable of maintaining a constant temperature of 25°C. One large for all samples and buffers and one smaller bath for analyzing samples at 25°C ± 1°C.

7.8. Standard stir plate and submersible stir plate and stir bars.

7.9. Eight ounce or 16 ounce juice bottles and caps.

7.10. Wrist action shaker?

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. pH buffers: 1.00, 4.00, 7.00, 10.00, 12.45, (true value of buffers at 25° C).

8.2. Commercially available solutions should be validated and traceable to NIST standards and are recommended for routine use.

9. PREVENTIVE MAINTENANCE

9.1. The probe should contain filling solution past the coils to ensure accurate readings. Filling solution should be a non-AgCl containing solution.

9.2 Cleaning the probe

9.2.1 The probe should be emptied and refilled with filling solution once a week.

9.2.2 The glass bulb should be cleaned every other week, or more, by placing it in a beaker with approximately 40 ml of 0.1N HCl and allowed to sit while stirring for approximately 5 minutes. Then rinse the probe with DI water 3 times and blot with a kimwipe.

9.3 If the coils are no longer orange it means the electrode's ion reservoir is empty and it needs to be replaced.

10. RESPONSIBILITIES

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.

11. PROCEDURE

11.1. **Calibration**

11.1.1. All buffers are placed in conductivity jars, capped and stored in the large 25° C water bath. All readings need to be within 1°C of the buffer temperatures.

11.1.1.1. Buffer in conductivity jars needs to be replaced with buffer from the primary container daily.

11.1.1.2. Once a manufacture's bottle of buffer is open it's good for 3 months, because it becomes contaminated with carbon dioxide.

11.1.2. Perform calibration daily. Record calibration; buffer checks and buffer temperatures in instrument logbook or benchsheet with date and analyst's initials.

11.1.3. The slope of the calibration points should be between 95 and 105% or within the range set by the probe manufacturer. The meter displays the slope of calibration.

11.1.4. If the slope exceeds the above end points either the buffer(s) is contaminated or the probe is no longer functioning properly.

11.1.4.1. Replace buffers, rewarm and then re calibrate

11.1.4.2. Empty the probe rinse the inside 3 times with DI water, then refill with electrode filling solution and rise the outside of the probe and blot with kimwipe

11.1.5. Calibration (Fisher Accumet pH Meter 25)

11.1.5.1. Push "standardize"

11.1.5.2. Select 2

11.1.5.3. Push "standardize".

11.1.5.4. Select 1

11.1.5.5. Enter the first buffer value, 4.00. Push “enter”.

11.1.5.6. Place enough buffer solution in a conductivity jar so that the electrode is sufficiently submersed without coming into contact with the stir bar.

11.1.5.7. Rinse electrode

11.1.5.8. Immerse the electrode in the solution. Allow time to stabilize.

11.1.5.9. Push “enter”.

11.1.5.10. Record the buffer value to 0.01 pH units and the buffer temperature to the nearest °C. (4.00 and 25°C).

11.1.5.11. Repeat steps 11.2.2.1 through 11.2.2.9 for buffers 7.00 and 10.00. Also use the 12.45 and 1.00 buffers if needed.

11.1.6. Calibration (Fisher Accumet pH Meter AR25)

11.1.6.1. Calibrate according to the manufacturer’s specifications.

Note: Initial calibration is performed using the 4.00, 7.00, and 10.00 buffers. If any subsequent sample pH is outside the calibration range (greater than 10.00 or less than 4.00), the 1.00 and/or 12.45 buffers are added to the calibration and the applicable samples are reanalyzed.

11.2. **Soil samples preparation for EPA Method 9045D**.

11.2.1. Weigh out 10g of soil into a beaker. Add 10mL of reagent water, cover, and stir the suspension continuously for 5 minutes. Alternative sample volumes may be used as long as soil:water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.

11.2.2. Let the soil suspension stand for 1 hour to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.

11.2.3. Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.

11.3. **Waste material preparation for EPA Method 9045D.**

11.3.1. Wastes may be solids, sludges, or non-aqueous liquids. For multi-phase wastes by method 9045D, a determination of the percentage of the sample that is non-

aqueous must be made. This can be calculated from a % solids determination. If the non-aqueous phase is > 20%, continue with this section. If the non-aqueous phase is < 20%, analyze the sample by EPA Method 9040C see also SOP GEN-pHW.

11.3.2. Weigh out 20g of waste sample into a beaker. Add 20mL of reagent water, cover, and stir the suspension continuously for 5 minutes. Alternative sample volumes may be used as long as solid:water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.

11.3.3. Let the waste suspension stand for 15 minutes to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.

11.3.4. If the waste absorbs all the reagent water, begin the test again with 20g waste and 40mL of water.

11.3.5. If the supernatant is multi-phasic, decant the oily phase and perform the pH determination on the aqueous phase.

11.3.6. Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.

11.4. **Sample preparation for Washington DOE Test Method**.

11.4.1. Weigh three, 50.0g aliquots of each sample into either 3, 8-ounce or 3, 16-ounce juices bottles and add 50mL of D.I. water to each and cap tightly. Each sample is analyzed in triplicate.

11.4.2. Place all bottles on the wrist action shaker. The speed of the shaker should be adjusted so that the sample and water have maximum contact time however the shaking action should not be so vigorous as to cause absorption of CO_2 into the sample.

11.4.3. Filter the liquid through a paint filter into a clean conductivity jar for analysis.

11.5. **Oregon State Soil Methods sample preparation**

11.5.1. Weigh 20.0g of soil into a beaker and add 40mL of D.I. water.

11.5.2. Stir the suspension 2-3 times over a 30-minute period.

11.5.3. Analyze the supernatant.

11.6. **Sample Analysis**

11.6.1. Rinse and blot electrode, then immerse into the sample. Press pH and record the pH when stabilized, record the temperature to the nearest °C. Remove electrodes from sample after each measurement and rinse 3 times with D.I. water.

11.6.2. Regardless of the method employed, all pH readings must be within 2°C of the temperature of the buffer solutions.

11.6.3. If the pH of the sample is ≥11.00 control the temperature of the samples to 25°C±1°C.

12. QA/QC REQUIREMENTS

12.1. A buffer check is analyzed after every 10 readings. For buffer checks, use either pH 4.00 or 10.00, choosing whichever standard brackets the majority of the previous samples with pH 7.00. The buffer check should be within 0.05 pH units of the true value.

12.2. A laboratory control sample (LCS) is analyzed at a frequency of one per 20 samples, with acceptance criteria of 85-115% of the true value. Analyze the LCS prior to the sample set. The LCS is prepared identically to associated samples and documented on the benchsheet. If the LCS is outside of these limits, recalibrate.

12.3. A duplicate sample is analyzed at a frequency of 10% of the samples, with acceptance criteria of 10% RPD between the two readings. If the duplicate is outside of these limits, the sample is reanalyzed. Duplicates are documented on the benchsheet. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

Where S1 = Sample with higher value
S2 = Sample with lower value
Avg. = Average of the two sample values

12.4. For DOE/pH, all samples are analyzed in triplicate and the logarithmic average is reported.

12.5. Sum the antilog of the three pH readings obtained in section 11.5, divide by 3 then take the log.

Example:
Three pH readings obtained: 1.5 1.6 2.5

antilog(1.5) + antilog(1.6) + antilog(2.5) =
31.62 + 39.81 + 316.23 = 387.66
387.66 ÷ 3 = 129.22
log(129.22) = 2.11
pH(average) = 2.11

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Refer to ADM-DREV, *Laboratory Data Review Process* for general guidelines for data review.

13.2. All data and corrective actions must be recorded, dated, and signed or initialed by the analyst. 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 above. Average, RPD, and buffer level are entered on the benchsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

13.3. The data packet for the sequence is submitted for review by supervisor or designee.

13.4. Reporting

13.4.1. Refer to ADM-RG, *Data Reporting and Report Generation* for reporting guidelines.

13.4.2. Reports are generated in the CAS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be CAS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4.3. The pH is reported as pH units. Values are reported to 0.01 pH units.

13.4.4. The benchsheets, located in Appendix A, should be in use at all times during pH analysis.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Non Conformity 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

This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

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.

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 for a period of one week. 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.

17.1.4. 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. CHANGES SINCE THE LAST REVISION

18.1. Reformatted to ALS style.
18.2. CAS references changed to ALS
18.3. Attachment 1: Added a copy of the benchsheet.

19. REFERENCES

19.1. EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IIIIB, November 2004, Method 9045D, Revision 4.

19.2. Method 83-13, State of Washington, Department of Ecology.

19.3. Oregon State University, Methods of Soil Analysis Used in the Soil Testing Laboratory at Oregon State University.

ATTACHMENT 1
Benchsheet

COLUMBIA ANALYTICAL SERVICES, INC.

Service Request #: _____ Method: 9045D

Analysis: _____ pH Corrosivity _____ Matrix: Soil/Solid

Calibration						
Buffer	1.00	4.00	7.00	10.00	12.45	Value of Buffers at 25 °C
Reading						pH Slope:_____
Temp °C						

Sample Number	Sample Wt. (g)	Vol of Ext Sol (mLs)	pH	Time Analyzed	Temp °C	% Solids
Buffer Check	**Buffer Value:**					
LCS	--	--				
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					

LCS: ERA **Lot #:** **ID #:** **T. V. =** **% REC. =**

pH 4.00 buffer: 12-GEN. pH-001-21_____ pH 7.00 buffer: 12-GEN. pH-001-35_____ pH 10.00 buffer: 12-GEN. pH-001-49_____

ph 1.00 buffer Cond/1-73-_____pH 12.45 buffer Cond/1-82-_____ Extraction Solution: _____

Probe ID# rcl/1-79-1 Water Bath ID# K-wb-01 Thermometer ID# L82605

Meter ID# K-pH-01

Analyst:	Date:
Reviewed By:	Date:

R: WET/Analysis/PH/Templates/SOILPH Revison: 2

SOILPH2.xls

COLUMBIA ANALYTICAL SERVICES, INC.

Service Request #: _____ Method: 9045D

Analysis: pH Corrosivity Matrix: Soil /Solid

Sample Number	Sample Wt. (g)	Vol of Ext Sol (mLs)	pH	Time Analyzed	Temp °C	% Solids
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					
Buffer Check	**Buffer Value:**					

Comments: _____

Analyst:	Date:
Reviewed By:	Date:

SOILPH2.xls

STANDARD OPERATING PROCEDURE

PARTICLE SIZE DETERMINATION

GEN-PSP
Revision 7

Effective Date: November 25, 2011

Approved By:

Supervisor	10/26/11 Date
QA Manager	10/27/11 Date
Laboratory Manager	10/27/11 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

DOCUMENT CONTROL	
NUMBER:	
Initials:	Date:

PARTICLE SIZE DETERMINATION

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine the fraction of pre-determined sizes of particles in sediments. The procedures are based on Puget Sound Protocols, Plumb (1981) and a modified ASTM D422 methodology. Particle size can be characterized in a wide range of detail. The grossest divisions that generally are considered useful for characterizing particle size distributions are percentages of gravel, sand, silt, and clay. However, each of these size fractions can be subdivided further so that additional characteristics of the size distribution (e.g., mean diameter, skewness, and kurtosis) can be determined. Additionally, this procedure describes wet sieving protocols used when trace metals analysis are to be performed on the sieved fractions.

1.2. Detection limits are determined from accuracy of analytical balances. Samples are weighed to the nearest 0.01g and results are reported to the nearest 0.01 percent.

2. METHOD SUMMARY

2.1. Particle size is used to characterize the physical characteristics of sediments. Because particle size influences both chemical and biological variables, it can be used to normalize chemical concentrations according to sediment characteristics and to account for some of the variability found in biological assemblages. Particle size is also an important variable for marine engineering purposes. In addition to Plumb (1981), other references discuss the uses and measurement of particle size (e.g., Krumbein and Pettijohn 1938; Folk 1968; Buchanan 1984).

2.2. Particle size determinations can either include or exclude organic material. If organic material is removed prior to analysis, the "true" (i.e., primarily inorganic) particle size distribution is determined. If organic material is included in the analysis, the "apparent" (i.e., organic plus inorganic) particle size distribution is determined. Because true and apparent distributions may differ, detailed comparisons between samples analyzed by these different methods are questionable. It is therefore desirable that all samples within each study (at a minimum) and among different studies (if possible) be analyzed using only one of these two methods.

3. DEFINITIONS

3.1. Particle size – The size of various solid components making up sediment, as named in the applicable method reference (gravel, sand, silt, clay, etc.).

3.2. True particle size – The particle size determined when organic material is removed prior to analysis.

3.3. Apparent particle size – The particle size determined when organic material is not removed prior to analysis.

3.4. 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.

3.5. Laboratory Triplicates – Triplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative standard deviation (RSD) between the sample and its duplicates are calculated and used to assess analytical precision.

4. INTERFERENCES

Depending on the required particle size distribution, organic material can be an interference.

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 CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Samples can be collected in glass or plastic containers. A minimum sample size of 100-150g is recommended. If unrepresentative material is to be removed from the sample, it should be removed in the field under the supervision of the chief scientist and noted on the field log sheet.

6.2. Samples should be stored at 4 ± 2 °C, and can be held for up to 6 months before analysis. Samples must not be frozen or dried prior to analysis, as either process may change the particle size distribution.

7. APPARATUS AND EQUIPMENT

7.1. Sieve shaker - Ro-Tap or equivalent

7.2. Drying oven

7.3. Constant temperature bath

7.4. Analytical balance - 0.1mg accuracy

7.5. Desiccator

7.6. Clock - with second hand

7.7. Standard sieves - Appropriate mesh sizes, sieve pan and top, sieve brush.

7.8. Funnel

7.9. Graduated cylinders

7.10. 250-mL beakers

7.11. 20-mL pipettes

7.12. Water pique or squirt bottle

7.13. Glossy paper

7.14. 1000 mL Polycarbonate Centrifuge Bottles

7.15. Centrifuge - With buckets appropriate for 1000 mL bottles

7.16. 1000 mL Glass Beakers

7.17. Thermometer capable of reading to ± 0.5ºC, Verification performed internally per the SOP *Support Equipment Monitoring and Calibration (*ADM-SEMC).

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. 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.

8.2. Dispersant - 1 percent sodium hexamethaphosphate = 1 percent commercially available Calgon. To prepare, weigh 10.0g sodium hexamethaphosphate and dilute to 1.0L in DI Water.

8.3. Distilled water

8.4. Reagent grade Hydrogen Peroxide, 30 percent.

8.5. Ten percent hydrogen peroxide; One part H_2O_2 to two parts DI Water.

9. PREVENTIVE MAINTENANCE

9.1. No specific maintenance steps are needed for sieves other than normal cleaning and inspection.

9.2. Balance calibration checks are performed daily.

9.3. Color-indicating desiccant is recommended so that spent desiccant can be detected easily. The desiccant needs to be changed every 3 weeks to ensure its effectiveness. Also, the seal on the desiccator should be checked periodically, and, if necessary, the ground glass rims should be greased or the "0" rings should be replaced.

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 for Documentation of Training (ADM-TRANDOC).

11. PROCEDURE (Particle Size Fractionation)

11.1. Sample Preparation

11.1.1. Unless specifically asked for, organic oxidation is not performed and the apparent particle size distribution is determined.

11.1.2. It is critical that each sample be homogenized thoroughly in the laboratory before a subsample is taken for analysis. Laboratory homogenization should be conducted even if samples were homogenized in the field.

11.1.3. The total amount of sample used for analysis should be 25-100g. Refer to section 12.1 for a discussion of use of alternate sample sizes.

11.1.4. If True Particle size analysis is requested, place sample aliquot into a large beaker (1 to 2 Liter) and add 20 milliliters of ten percent hydrogen peroxide. Let the sample stand until frothing ceases and then add an additional 10 ml of hydrogen peroxide. Continue the incremental addition of hydrogen peroxide until no frothing occurs on addition.

11.1.5. Boil the sample to remove any excess hydrogen peroxide. This should be done in a large beaker to prevent sample loss due to boiling over or frothing.

11.2. Analysis

11.2.1. Particle size determination is determined by four similar methods using this SOP. They include Puget Sound Estuary Protocols; condensed version and expanded version, and ASTM D422 Modified; condensed version and expanded version. The differences between these methods are explained below:

11.2.1.1. Puget Sound Estuary Protocol (Condensed Version): Course particle size fractions are determined by using the following standard sieves: 10, 18, 35, 60, 120, and 230. The silt/clay portion of the sample is determined by pipette extraction using the withdrawal times given in Table 1.

11.2.1.2. Puget Sound Estuary Protocol (Expanded Version): Course particle size fractions are determined by using the following standard sieves: 10, 18, 35, 60, 120, and 230. The silt/clay portions of the sample are broken down into subdivisions and are determined by pipette extraction using the withdrawal times given in Table 2.

11.2.1.3. ASTM D422 Modified (Condensed Version): Course particle size fractions are determined by using the following standard sieves: 4, 10, 20, 40, 60, 140, and 200. The silt/clay portion of the sample is determined by pipette extraction using the withdrawal times given in Table 1.

11.2.1.4. ASTM D422 Modified (Expanded Version): Course particle size fractions are determined by using the following standard sieves: 4, 10, 20, 40, 60, 140, and 200. The silt/clay portions of the sample are broken down into subdivisions and are determined by pipette extraction using the withdrawal times given in Table 2.

11.2.2. Weigh sample as received. Record the balance ID on the benchsheet.

11.2.3. Total solids using the procedure described in the SOP GEN-160.3 (Total Solids) are determined at the same time the sample is weighed out.

11.2.4. Wet sieve through the appropriate (200 or 230) sieve, washing what goes through into a 1000mL graduated cylinder.

11.2.5. Add 10mL of a 1% sodium hexametaphosphate solution to cylinder.

11.2.6. Retain what was left on the 200 (or 230) sieve (gravel/sand fraction). Wash into a preweighed 250-ml beaker, and dry in 105ºC oven to dryness. Dry sieve through the applicable sieves (see 11.2.1). After dry-sieving a sample, all material must be removed from the sieve. This can be accomplished by tapping the rim of the sieve evenly on a hard surface and by brushing the screen.

11.2.7. Silt-clay fraction:

Note: Before pipette extractions can be made, the sample must be homogenized thoroughly within the settling cylinder. Once the pipette analysis begins, the settling cylinders must not be disturbed, as this will alter particle settling velocities. Care must be taken to disturb the sample as little as possible when pipette extractions are made.

11.2.7.1. After sample is brought to 1L and mixed, it is left on the counter and the temperature is tracked with a thermometer in a graduated cylinder with DI water. The temperature does not usually vary by more than ± 2°C from the start to the completion of the pipette analysis.

11.2.7.2. Withdrawal times for pipette analysis as a function of particle size and water temperature are given in Tables 1 and 2. Shake for 1 minute and take a 20mL aliquot at 20cm deep at 20 seconds.

11.2.7.3. Take 20mL aliquots at 10cm at differing times according to temperature of the suspension (see the attached sheets for specific times).

11.2.7.4. If the condensed analysis is wanted (silt & clay) only use 4 and 8 phi/times (Table 1). If the expanded analysis is wanted, refer to Table 2 for phi sizes and times.

11.2.7.5. After a pipette extract has been transferred to a drying beaker, any sample adhering to the inside of the pipette must be removed. This can be accomplished by drawing 20mL of distilled water into the pipette and adding this rinse water to the drying beaker.

11.2.8. Dried samples should be cooled in a desiccator and held there until they are weighed. If a desiccator is not used, the sediment will accumulate ambient moisture and the sample weight will be overestimated. A color-indicating desiccant is recommended so that spent desiccant can be detected easily.

12. PROCEDURE (Preparation for trace metals analysis)

12.1. Special Considerations

12.1.1. Metal sieves must not be used when preparing samples for trace metals analysis. Polymer mesh and pans are to be utilized.

12.1.2. Site water related to the samples being prepared is recommended for the wet sieving procedure. However, if site water is not available laboratory dionized water can be used.

12.1.3. Decontamination of all equipment that comes in contact with the sample must be performed prior to initiating the sieving. Rinse with 25% hydrochloric acid, followed by a minimum of 3 DI water rinses.

12.2. Analysis (Dry Sieve for Fractions >63 um)

12.2.1. Follow protocol described in Section 11, but include considerations listed in Section 12.1.

12.3. Analysis (Wet Sieve for ≤ 63 um Fraction)

12.3.1. Place an aliquot of sample onto the appropriate size sieve (sieve sized to be determined on a project specific basis).

12.3.2. Using a squirt bottle filled with the specified rinse solution (i.e. site or DI water) wash the sample through the sieve. Use a plastic funnel to capture the target sample fraction in a 1000 mL polycarbonate centrifuge bottle.

12.3.3. When sufficient sample has been captured, centrifuge the polycarbonate bottle then pour off and discard the supernatant. Transfer the remaining sample to an appropriate sized glass jar (i.e. 8 oz., 16 oz., etc.) clearly labeled with the sample I.D. and particle size fraction information. Store at 4±2°C.

12.3.4. The remaining sample is now ready for trace metals determination. (Note: The variety and combinations of trace metals analyses that can be performed vary widely, so subsequent analytical procedures will be defined on a project specific basis.) If further particle size reduction in needed an aliquot is retained for analysis. The remaining sample is then processed once more as described above using the next smaller sieve size as designated in the project plan.

12.3.5. So the final results can be reported on a dry weight basis perform a total solids determination on each fraction being analyzed for trace metals.

13. QUALITY CONTROL

13.1. The total amount of fine-grained material used for pipette analysis should be 5-25g. If more material is used, particles may interfere with each other during settling and the possibility of flocculation may be enhanced. If less material is used, the experimental error in weighing becomes large relative to the sample size.

13.2. It is recommended for Puget Sound Protocols that triplicate analyses be conducted on one of every 20 samples, or one sample per batch if less than 20 samples are analyzed. For ASTM Modified, it is recommended that duplicate analyses be conducted on one of every 20 samples, or one sample per batch is less than 20 samples are analyzed.

13.2.1. Calculate Relative Percent Difference (RPD) as:

$$\%\,RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1= Higher Result
R2= Lower Result

13.2.2. Calculate Relative Standard Deviation (RSD) as:

$$\%RSD = \frac{stddev}{mean} \times 100$$

13.2.3. The acceptance range for %RPD or %RSD is ≤ 20%. If the RPD is within the acceptance range, the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.

14. DATA REDUCTION, REVIEW, AND REPORTING

14.1. Calculations

14.1.1. The total weight of a phi-size interval in the 1-L graduated cylinder is determined as follows:

Phi weight (g dry weight) = 50[(A-C)-(B-C)]

Where: A = weight (g) of residue in a 20-mL aliquot for a given phi-size boundary
B = weight (g) residue in a 20-mL aliquot for the next larger phi-size boundary
C = mean weight (g) of dispersant in a 20-mL aliquot.

14.2. The data is entered into a spreadsheet and results determined using the appropriate equations.

14.3. Reporting and review

14.3.1. The weight of each sediment fraction should be reported to the nearest 0.0001g dry weight. The laboratory should report the results of all samples analyzed (including QA replicates) and should note any problems that may have influenced data quality.

14.3.2. 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 for samples (above). These results are then used to calculate QC determinations

14.3.3. The results are entered directly onto the appropriate Reporting/EDD forms located in the CAS network directory R:\WET\ANALYSES\GRAINSIZE\TEMPLATE. Once the results are transferred, the data and report are reviewed.

14.4. Data Review and Assessment

14.4.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

15. CORRECTIVE ACTION

15.1. Refer to the SOP for Corrective Action (ADM-CA) 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.

15.2. Handling out-of-control or unacceptable data

15.3. 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.

15.4. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

16. TRAINING

16.1. Training outline

16.1.1. 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.

16.1.2. 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.

16.1.3. Independently perform the analyses. For Initial Demonstration of Capability the data must be reviewed by a supervisor and the supervisor must document that the analyst is trained.

16.2. Training is documented following the *SOP for Documentation of Training.*

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. There are no known modifications in this laboratory standard operating procedure from the reference method described in the PSEP based upon Plumb 1981.

17.2. ASTM D422 does not use pipettes to determine the fractions but rather uses hydrometers. This SOP allows the use of the same sieve sizes as used in ASTM D422 but uses the pipette procedure from Plumb to determine the fractions.

18. REFERENCES

18.1. Conventional Sediment Variables - Particle Size, March 1986, *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, January, 1996.

18.2. *Procedures for Handling and Chemical Analysis of Sediment and Water Samples*, R.H. Plumb, prepared for USEPA and Army Corps of Engineers, May, 1981.

18.3. ASTM Procedure D422.

18.4. Related Documents – These documents are used in the laboratory to support this procedure and are reviewed at the same time this SOP is reviewed each year.

FILE NAME

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM CB special form.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM CB.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\ASTM EB.XLS

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\HYDEDD-PSEP.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB apparent.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB Teck.xlt

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB True.xls

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP CB.xlt

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB Clark County.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB10-230.XLT

R:\WET\ANALYSES\GRAINSIZE\TEMPLATE\PSEP EB4-230.xlt

19. CHANGES SINCE THE LAST REVISION

19.1. Sec 1.1 – added modified to ASTM D422

19.2. Sec 3.4 and 3.5 are new
19.3. Sec 7.16 and 7.17 added to list
19.4. Sec 8.1, 8.4 and 8.5 are new
19.5. Sec 9.3 – second sentence is new
19.6. Sec 11.1.4 and 11.1.5 are new
19.7. Sec 11.2.2 – added the requirement to record balance ID
19.8. Sec 11.2.7.1 –edited last sentence for clarity
19.9. Sec 11.2.3 is new
19.10. Sec 12.1.3 –added 3 DI rinses
19.11. Sec 13.2.1 – 13.2.3 are new
19.12. Sec 14.4 is new
19.13. Sec 13 renamed
19.14. Sec 15 on Corrective Action added
19.15. Sec 17 is new

Table 1

Withdrawal Times for Pipette Analysis as a Function of Particle Size and Water Temperature
Silt & Clay Fraction – Condensed Analysis

Micron μm	Diameter finer than (phi)	Diameter finer than (μm)	Withdrawal depth (cm)	Elapsed time for withdrawal of sample in hours (h), minutes (m), and seconds(s).						
				18°C	19°C	20°C	21°C	22°C	23°C	24°C
62.5	4.0	62.5 - 3.9	20	20s	20s	20s	20s	20s	20s	20s
3.9	8.0[a]	3.9	10	2h8m	2h5m	2h2m	1h59m	1h56m	1h53m	1h51m

Table 2

Withdrawal Times for Pipette Analysis as a Function of Particle Size and Water Temperature
Silt & Clay Fraction – Expanded Analysis

Micron μm	Diameter finer than (phi)	Diameter finer than (μm)	Withdrawal depth (cm)	Elapsed time for withdrawal of sample in hours (h), minutes (m), and seconds(s).						
				18°C	19°C	20°C	21°C	22°C	23°C	24°C
62.5	4.0	62.5	20	20s	20s	20s	20s	20s	20s	20s
31.2	5.0	31.2	10	2m0s	1m57s	1m54s	1m51s	1m49s	1m46s	1m44s
15.6	6.0	15.6	10	8m0s	7m48s	7m36s	7m25s	7m15s	7m5s	6m55s
7.8	7.0	7.8	10	31m59s	31m11s	30m26s	29m41s	28m59s	28m18s	27m39s
3.9	8.0[a]	3.9	10	2h8m	2h5m	2h2m	1h59m	1h56m	1h53m	1h51m
1.95	9.0	1.95	10	8h32m	8h18m	8h6m	7h56m	7h44m	7h32m	7h22m
0.98	10.0	0.98	10	34h6m	33h16m	32h28m	31h40m	30h56m	30h12m	29h30m

a) Breakpoint between silt and clay.

METALS DIGESTION METHOD 3050B

MET-3050B

ALS-KELSO

SOP ID: MET-3020a Rev. Number: 13 Effective Date: 12/1/2012

Approved By: _____ Date: 11/28/12
Department Supervisor - Jeff Coronado

Approved By: _____ Date: 11/28/12
QA Manager - Suzanne LeMay

Approved By: _____ Date: 11/29/12
Laboratory Director - Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

Standard Operating Procedure

For

METALS DIGESTION – 3050B

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 (HNO_3) and hydrogen peroxide (H_2O_2). 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

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, 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. APPARATUS AND EQUIPMENT

7.1. 125 mL plastic cup beaker cup, calibrated at 50mL and 100mL

7.2. Borosilicate watch glasses

7.3. Block Digester, calibrated to maintain 95°C ± 2°C

7.4. Hot Plates: "Thermolyne Cimerac 3", calibrated to maintain 95°C ± 2°C

7.5. Laboratory balance, top-loader capable of reading 0.01g

7.6. Evergreen disposable tubes 50 ml: 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.

7.7. USS # 10 sieve.

8. STANDARDS AND REAGENTS

8.1. 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.

8.2. Reagent water: ASTM Type I water (resistivity ≥18 MΩ-cm, conductivity ≤0.056 uS/cm).

8.3. Concentrated Nitric Acid: J.T. Baker "Instra-analyzed", Trace Metals Grade

8.4. Concentrated Hydrochloric Acid: EMD GR ACS

8.5. Hydrogen Peroxide (30%): EMD GR ACS

8.6. Standards

8.6.1. 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.

8.6.2. Metals spiking solutions: Five spiking solutions are needed to prepare the matrix spike sample; SS1, SS2, SS3, SS4, and SS5.

8.6.3. Follow the formulations laid out on the "Metals Spike Form" (see Attachments for example). 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.

8.6.4. 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.

8.6.5. 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.

8.6.6. SS3 (As, Se, and Tl): 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. 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.

8.6.7. 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.

8.6.8. 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.

8.7. Metals reference material (ERA Priority PollutnT/CLP Inorganic Soil) for use as the laboratory control sample. The expiration date is assigned by the manufacturer.

8.8. Teflon beads, Teflon boiling chips, or other suitable blank material.

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.

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.

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 ≥18 M□-cm, conductivity ≤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 sludge's 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 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.

For ICP and ICP-MS digestions 1.0 mL of SS1 and 0.50 mL of SS3 and SS4 are added to the sample aliquot designated as the matrix spike sample. The matrix spike sample is then digested as per the procedure.
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. 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).

14. CORRECTIVE ACTION

14.1. Refer to the SOP for *Corrective Action* 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. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when: a) corrective action is not taken or not possible b) corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis c) reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15. METHOD PERFORMANCE

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.

16. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. 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 solvent and reagents used in this method can be minimized when recycled or disposed of properly.

17. WASTE MANAGEMENT

17.1. 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.

17.2. 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.

18. TRAINING

18.1. Training outline

18.1.1. 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.

18.1.2. 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.

18.1.3. 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.

18.2. 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.

19. METHOD MODIFICATIONS

19.1. The method uses 2 mL of water and 3 mL of H_2O_2 in step 11.6. The lab does not add the 2 mL of water. 3.0 mL aliquots of 30% H_2O_2 in lieu of 1.0 mL aliquots are added subsequently.

20. REFERENCES

20.1. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA SW-846, 3rd Edition, Final Update III, Method 3050B, December 1996.

20.2. Table A - METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

21. CHANGES SINCE THE LAST REVISION

21.1. Reformatted to ALS style.
21.2. Sec. 11.5: Changed wording to reflect hotplate temperature monitoring per batch

Table A

METALS SPIKING SOLUTIONS CONCENTRATIONS FORM

Solution Name	Element	mLs of 1000ppm Solution	Final Volume	Solution Conc. mg/L	Concentration in the digest mg/L
SS1	HNO3	50.0	1000ml	-	
	Al	100*	1000ml	200	2
	Ag	100*	1000ml	5	0.05
	Ba	100*	1000ml	200	2
	Be	100*	1000ml	5	0.05
	Cd	100*	1000ml	5	0.05
	Co	100*	1000ml	50	0.5
	Cr	100*	1000ml	20	0.2
	Cu	100*	1000ml	25	0.25
	Fe	100*	1000ml	100	1
	Pb	100*	1000ml	50	0.5
	Mn	100*	1000ml	50	0.5
	Ni	100*	1000ml	50	0.5
	Sb	50	1000ml	50	0.5
	V	100*	1000ml	50	0.5
	Zn	100*	1000ml	50	0.5
SS2	HNO3	25.0	500ml	-	
GFAA SPIKE	As	2.0	500ml	4	0.04
	Cd	2.0	500ml	4	0.04
	Pb	2.0	500ml	4	0.04
	Se	2.0	500ml	4	0.04
	Tl	2.0	500ml	4	0.04
	Cu	2.0	500ml	4	0.04
SS3	HNO3	25.0	500ml	-	
	As	50.0	500ml	100	1
	Se	50.0	500ml	100	1
	Tl	50.0	500ml	100	1
SS4	HNO3	25	500ml	-	
	B	50	500ml	100	1
	Mo	50	500ml	100	1

* Denotes volume of mixed stock standard.
** Denotes 10,000 ppm individual stock standards.

DETERMIMATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUOPLED PLASMA-MASS SPECTROMETRY (ICP-MS)

MET-6020

ALS-KELSO

SOP ID:	MET-6020	Rev. Number:	15	Effective Date:	07/31/2013

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Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

For

DETERMIMATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP-MS) 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. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL) and Practical Quantitation Limit (PQL). Therefore, MRL=EQL=PQL. 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 SUMMARY OF METHOD

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.

3.2 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.

3.3 **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.

3.4.4 Nonaqueous Liquid – Any organic liquid with <15% settleable solids.

3.4.5 Animal tissue – Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.4.6 Solids – Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.4.7 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.

3.4.8 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.

3.5 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 mid point of the calibration range or at levels specified by a project analysis plan.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

3.10 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

3.11 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.

3.12 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.

3.13 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 isoptope.

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 APPARATUS & EQUIPMENT

7.1 Instruments: Thermo Elemental ExCell (K-ICP-MS-02) Serial # EX191, Thermo Elemental X-Series (K-ICP-MS-03) Serial # X0193, and NexION 300D (K-ICP-MS-04).

7.2 Thermo Meinhard type (Part # 1201318)

7.3 Thermo Impact Bead Quartz Spray Chamber (Part # 3600170)

7.4 Thermo X7 Nickel Sample Cone (1.0 mm orifice) (Part # 3004661), or Xi sample cone (part # 3600812)

7.5 Thermo X7 Nickel Skimmer Cone (0.75 mm orifice) (Part # 3200860) or Xi skimmer cone(part # 3600811)

8 STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1 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.

8.1.1 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.

8.1.2 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.

8.1.3 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.

8.2 Standards Preparation

8.2.1 Expiration of all standard solutions defaults to the earliest expiration date of an individual component unless otherwise specified.

8.2.2 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).

8.2.3 Initial Calibration Verification (ICV)

8.2.3.1 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.

8.2.3.2 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.

8.2.4 Interference Check Solutions (ICSA and ICSAB)

8.2.4.1 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.

8.2.4.2 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.

8.2.5 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.

8.2.6 Refer to the appropriate digestion SOP for details of LCSW and matrix spike solution composition and preparation.

8.2.7 Tuning / Mass Calibration Solution

8.2.7.1 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.

8.2.7.2 The working solution is prepared in three ways:

- For the ExCell (K-ICP-MS-02) 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.

8.3 Internal Standards Stock Solution – Prepare a 10 µg/mL solution containing ^{71}Ga, ^{115}In, ^{6}Li, ^{175}Lu, ^{103}Rh ^{45}Sc, and ^{89}Y by adding 10.0 mL 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 ration 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.

8.4 Additional Reagents

8.4.1 Reagent water, ASTM Type II

8.4.2 "OmniTrace Ultra" Concentrated Nitric Acid (EM Science # NX0408-2)

8.4.3 Argon (Airgas Industrial Grade – 99.999% pure, bulk delivered)

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

11.4.1.1Allow 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 8.2.7.2 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 10% 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 1. 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% to 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. See the Attachments for a listing of control 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. The matrix spike recovery and relative percent difference will be calculated while analysis is in progress. See the Attachments for a listing of control limits. 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 and are listed in Table 2. 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, REPORTING, AND REVIEW

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:

$$\mu g / L\ (Sample) = C^{*} \text{ x Digestion Dilution Factor x Post Digestion Dilution Factor}$$

C*= Concentration of analyte as measured at the instrument in ug/L (in digestate).

Solid samples are reported in mg/Kg:

$$mg/Kg\ (Sample) = C^{*} \text{ x Post Digestion Dilution Factor } x \frac{Digestion\ Vol.(ml)}{Sample\ wt.(g)} x \frac{1mg}{1000ug} x \frac{1L}{1000ml} x \frac{1000g}{1Kg}$$

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 *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 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.

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 TRAINING

16.1 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.

16.2 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.

16.3 Training outline

16.3.1 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.

16.3.2 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.

16.3.3 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.

16.4 Training and proficiency is documented in accordance with the SOP ADM-TRANDOC.

17 POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1 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.

17.2 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.

18 METHOD MODIFICATIONS

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

19 CHANGES SINCE THE LAST REVISION

19.1 Reformatted to ALS branding.
19.2 Replaced "CAS" references with "ALS".
19.3 Updated SOP references.
19.4 Sec. 1.1: Removed reference to annual studies, replaced with "new".
19.5 Sec. 7.1: Added NexION 300D.
19.6 Sec 8.2.7.1: Removed Ba and Tl from the intermediate solution; added Ce.
19.7 Sec 8.2.7.2: Added NexION working solution prep.
19.8 Sec. 8.3.2.1: Revised ICV int. stock sol. prep instructions.
19.9 Sec. 8.2.7.1/2: Updated solution prep instructions.
19.10 Sec. 12.8: Added description of NexION IS correction.
19.11 Sec. 18: New.

20 REFERENCES

20.1 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III Method 6020, Revision 0, September 1994.

20.2 USEPA, Test Methods for Evaluating Solid Waste, SW-846, Update IV, Method 6020A, Revision 1, February 2007.

20.3 VG and Thermo Elemental Instrument Manuals

TABLE 1
Method Reporting Limits and Method Detection Limits – Water Matrix

	Water (ug/L)			Water (ug/L)			Seawater (ug/L)		
	CLP Digestion			3020 Digestion			Reductive Precipitation		
Analyte	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**
Aluminum	2	**2**	**0.3**	2.4	**2**	**0.8**	–	**–**	**–**
Antimony	0.09	**0.05**	**0.03**	0.09	**0.05**	**0.03**	–	**–**	**–**
Arsenic	0.5	**0.5**	**0.08**	0.5	**0.5**	**0.07**	0.5	**0.5**	**0.02**
Barium	0.06	**0.05**	**0.02**	0.12	**0.05**	**0.04**			
Beryllium	0.02	**0.02**	**0.008**	0.02	**0.02**	**0.006**	0.02	**0.02**	**0.0007**
Bismuth	0.1	**0.1**	**0.02**	–	**–**	**–**	–	**–**	**–**
Boron	0.9	**0.5**	**0.3**	–	**–**	**–**	–	**–**	**–**
Cadmium	0.02	**0.02**	**0.008**	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.006**
Chromium	0.2	**0.2**	**0.07**	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Cobalt	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.001**
Copper	0.1	**0.1**	**0.02**	0.21	**0.1**	**0.07**	0.1	**0.1**	**0.03**
Lead	0.03	**0.02**	**0.009**	0.06	**0.05**	**0.02**	0.02	**0.02**	**0.003**
Manganese	0.06	**0.05**	**0.02**	0.05	**0.05**	**0.01**	–	**–**	**–**
Molybdenum	0.09	**0.05**	**0.03**	0.09	**0.05**	**0.03**	–	**–**	**–**
Nickel	0.2	**0.2**	**0.07**	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Selenium	1.2	**1**	**0.4**	1	**1**	**0.2**	–	**–**	**–**
Silver	0.03	**0.02**	**0.009**	0.03	**0.02**	**0.009**	0.02	**0.02**	**0.004**
Thallium	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.004**	0.02	**0.02**	**0.0009**
Tin	0.1	**0.1**	**0.04**	–	**–**	**–**	–	**–**	**–**
Uranium	0.02	**0.02**	**0.005**	0.02	**0.02**	**0.004**	–	**–**	**–**
Vanadium	0.2	**0.2**	**0.08**	0.2	**0.2**	**0.05**	–	**–**	**–**
Zinc	0.5	**0.5**	**0.1**	0.6	**0.5**	**0.2**	0.5	**0.5**	**0.04**

TABLE 1 (continued)
Method Reporting Limits and Method Detection Limits – Solid Matrix

	Soil/Sediment (mg/kg)			Tissue (mg/kg, dry basis)		
	3050 Digestion			PSEP		
Analyte	MRL (DoD)	**MRL**	**MDL**	MRL (DoD)	**MRL**	**MDL**
Aluminum	2	**2**	**0.5**	2	**2**	**0.4**
Antimony	0.09	**0.05**	**0.03**	0.06	**0.05**	**0.02**
Arsenic	0.5	**0.5**	**0.1**	0.5	**0.5**	**0.05**
Barium	0.09	**0.05**	**0.03**	0.15	**0.05**	**0.05**
Beryllium	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.005**
Bismuth	0.1	**0.1**	**0.02**	–	–	–
Cadmium	0.02	**0.02**	**0.008**	0.03	**0.02**	**0.01**
Chromium	0.2	**0.2**	**0.04**	–	–	–
Cobalt	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.006**
Copper	0.3	**0.1**	**0.1**	0.1	**0.1**	**0.03**
Lead	0.06	**0.05**	**0.02**	0.02	**0.02**	**0.006**
Manganese	0.12	**0.05**	**0.04**	0.06	**0.05**	**0.02**
Molybdenum	0.15	**0.05**	**0.05**	0.06	**0.05**	**0.02**
Nickel	0.2	**0.2**	**0.05**	0.2	**0.2**	**0.03**
Selenium	2	**1**	**0.4**	–	–	–
Silver	0.06	**0.02**	**0.02**	0.02	**0.02**	**0.006**
Thallium	0.02	**0.02**	**0.003**	0.02	**0.02**	**0.005**
Tin	0.2	**0.1**	**0.06**	–	–	–
Uranium	0.02	**0.02**	**0.004**	0.02	**0.02**	**0.007**
Vanadium	0.2	**0.2**	**0.04**	0.2	**0.2**	**0.04**
Zinc	0.6	**0.5**	**0.2**	1.2	**0.5**	**0.4**

ATTACHMENTS

List of Target Element Masses

Example Standard Sheet

QC Acceptance Criteria

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

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

SOLUTION: ICP-MS, 200.8 INTERMEDIATE STOCK
MATRIX: 5% HNO3
VOLUME: 1000 ml.

	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
	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
VOLUME: 1000 ml.

	ELEMENT			ALIQUOT OF 1000 ppm Std./1000ml	CHECK OFF	CONCENTRATION (µg/L)
	HNO3			50.0		5%
	Ag			1.0		1000

SOLUTION: ICP-MS 25ppb Calibration Standard and CCV
MATRIX: 1% HNO3
VOLUME: 100 ml.

SOURCE	ALIQUOT PER 100 ml.		CONCENTRATION (µg/L)
HNO3 (Ultrex)	1.0		1%
INTERMEDIATE STOCK	2.5		25.0
SILVER INTERMEDIATE STOCK	2.5		25.0

METALS ANALYSES						
Method	Prep Method	Matrix	Analyte	LCS Accuracy (% Rec.)	Matrix Spike (% Rec.)	Precision (RPD)
6020	3050B	Soil	Aluminum	41-158	75-125*	20
6020	3050B	Soil	Antimony	50-150	10-103	20
6020	3050B	Soil	Arsenic	78-122	57-133	20
6020	3050B	Soil	Barium	81-119	54-173	20
6020	3050B	Soil	Beryllium	83-117	64-133	20
6020	3050B	Soil	Boron	67-133	75-125*	20
6020	3050B	Soil	Cadmium	81-119	68-137	20
6020	3050B	Soil	Chromium	80-119	34-175	20
6020	3050B	Soil	Cobalt	82-118	74-118	20
6020	3050B	Soil	Copper	83-116	22-181	20
6020	3050B	Soil	Lead	79-121	27-178	20
6020	3050B	Soil	Manganese	81-119	75-125*	20
6020	3050B	Soil	Molybdenum	75-125	53-143	20
6020	3050B	Soil	Nickel	81-118	59-132	20
6020	3050B	Soil	Selenium	80-120	65-125	20
6020	3050B	Soil	Silver	66-134	62-131	20
6020	3050B	Soil	Thallium	79-120	70-128	20
6020	3050B	Soil	Uranium	80-120*	75-125*	20
6020	3050B	Soil	Vanadium	79-121	59-142	20
6020	3050B	Soil	Zinc	73-121	37-162	20
6020	CLP/3020A	Water	Aluminum	85-120	56-143	20
6020	CLP/3020A	Water	Antimony	91-112	66-133	20
6020	CLP/3020A	Water	Arsenic	89-112	72-129	20
6020	CLP/3020A	Water	Barium	92-111	86-117	20
6020	CLP/3020A	Water	Beryllium	81-122	73-125	20
6020	CLP/3020A	Water	Cadmium	92-111	87-113	20
6020	CLP/3020A	Water	Chromium	88-113	60-136	20
6020	CLP/3020A	Water	Cobalt	87-114	84-115	20
6020	CLP/3020A	Water	Copper	89-113	62-130	20
6020	CLP/3020A	Water	Lead	90-112	76-117	20
6020	CLP/3020A	Water	Manganese	89-115	25-180	20
6020	CLP/3020A	Water	Molybdenum	66-135	67-138	20
6020	CLP/3020A	Water	Nickel	89-113	78-117	20
6020	CLP/3020A	Water	Selenium	87-115	47-150	20
6020	CLP/3020A	Water	Silver	64-134	55-136	20
6020	CLP/3020A	Water	Thallium	78-123	75-121	20
6020	CLP/3020A	Water	Vanadium	87-113	82-119	20
6020	CLP/3020A	Water	Zinc	86-119	65-126	20

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
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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)
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SRM = NIST 2711, Montana Soil Spike Solution = _____

Analyst:_____ Date:_____

Reviewer:_____ Date:_____

DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

MET-ICP

ALS-KELSO

SOP ID:	MET-ICP	Rev. Number:	24	Effective Date:	12/1/2012

Approved By: _____ Date: 11/26/12
Department Manager – Jeff Coronado

Approved By: _____ Date: 11/26/12
QA Manager – Suzanne LeMay

Approved By: _____ Date: 11/27/12
Laboratory Director – Jeff Grindstaff

Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

Standard Operating Procedure

For

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 QAPPs 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 **Analysis Sequence** - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration followed by sample digestates interspersed with calibration standards.

3.2 **Independent Calibration Verification** (ICV) - ICV solutions are made from stock solutions different from the stock used to prepare calibration standards and are used to verify the validity of the standardization.

3.3 **Laboratory Control Sample** (LCS): A laboratory blank that has been fortified with target analyte and used to determine that the analysis is in control. For solids, a reference material may be used unless prohibited by project protocols.

3.4 **Matrix Spike** (MS) - In the matrix spike analysis, predetermined quantities of standard solutions of certain analytes are added to a sample matrix prior to sample digestion and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. Percent recoveries are calculated for each of the analytes detected.

3.5 **Matrix Spike Duplicate** (MSD) - In the matrix spike duplicate analysis, predetermined quantities of standard solutions of certain analytes are added to a sample matrix prior to sample digestion and analysis. The purpose of the matrix spike duplicate is to evaluate the effects of the sample matrix on the methods used for the analyses. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the matrix spikes is calculated and used to assess analytical precision.

3.6 **Duplicate Sample** (DUP) - A laboratory duplicate 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.

3.7 **Method Blank** - The method blank is an artificial sample designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

3.8 **Continuing Calibration Verification Standard (CCV)** - A standard analyzed at specified intervals and used to verify the ongoing validity of the instrument calibration.

3.9 **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.

3.10 **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.

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. A face shield is required when working with Hydrofluoric Acids.

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 APPARATUS & EQUIPMENT

7.1 Inductively Coupled Plasma Atomic Emission Spectrometer

7.1.1 Thermo Scientific ICAP 6500 (AES-03).
7.1.2 Thermo Scientific ICAP 6500 (AES-04).

7.2 Concentric nebulizers.

7.3 Microflow nebulizer for ICAP 6500.

7.4 Torches and injector tips for each ICP.

7.5 Cyclonic spray chambers for each instrument.

7.6 Water coolers for each ICP.

7.7 Argon Humidifiers for the ICAP 6500.

7.8 ESI SC4 DX Autosampler with Fast System for ICAP 6500.

7.9 Peristaltic Pumps for each Spectrometer.

7.10 RF Generators for each ICP (internal on the ICAP 6500).

8 STANDARDS, REAGENTS, & CONSUMABLE MATERIALS

8.1 Standards Preparation

8.1.1 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.

8.1.2 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 autopipettors. 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.

8.1.3 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.

8.1.4 Initial Calibration Verification (ICV) Standards

The ICV working standards are produced by direct dilution of three certified mixed stock solutions (QCP-CICV1, QCP-CICV2, 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.

8.1.5 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.

8.1.6 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.

8.1.7 The solutions and materials used for the LCS and matrix spikes are described in the applicable digestion SOP.

8.1.8 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.

8.2 High Purity Argon.

8.3 Capillary, rinse and peristaltic pump tubing.

8.4 17 x 100mm polypropylene test tubes.

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 with fused silica.

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 or CRI, CCV, CCB, ICSA, ICSAB, routine samples.

11.3.2 Evaluate the initial QC using the following criteria:

11.3.2.1For 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: $StdDev_{ccv}$ = Standard deviation of the replicate integrations
$Average_{ccv}$ = 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 and results must verify within 20% 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. The LLICV is used for Method 6010C.

- 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 ALS SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL.)*

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 1-4X 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 should be verified quarterly 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 method 200.7, the LCS recovery criterion is 85-115% for water samples. For method 6010B/C, the control limits are 80-120% or in-house calculated limits. 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. In all cases, project-specific QC limits may be required. 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. The default criteria may be used if statistically generated criteria are broader or insufficient points are available for accurate statistical limits. Currently, statistically generated criteria are broader and the default is used for all elements but Manganese, for which the limit is 17% RPD. The RPD criteria are <30% for soil samples and <20% for water samples for methods 200.7 and 6010B. The RPD criteria is <20% for both soils and waters for method 6010C. Criteria are subject to change as statistical data are generated. 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. Matrix spike recovery criteria for method 200.7 is 70-130% for both water and soil samples. For 6010B, the control limits are derived from lab data and are listed in Table 2. For 6010C, the control limits are 75-125% or in-house calculated limits. For CLP, use the prescribed limits for the SOW in use. In all cases, project-specific QC limits may be required. If the recovery is outside acceptance limits, either re-digest 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 A post spike shall be performed for 6010C - Tier III and Tier IV.

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%.

12.9 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 ICAP6500.

Aqueous samples are reported in µg/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:

$$mg/Kg(Sample) = C^{*} \; x \; PostDigestionDilutionFactor \; x \; \frac{DigestionVol(ml)}{Samplewt(g)} \; x \; \frac{1L}{1000ml} \; x \; \frac{1000g}{1Kg}$$

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.

$$Hardness, mg\ equivalent CaCO_3/L = 2.497[Ca, mg/L] + 4.118[Mg, mg/L]$$

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 CORRECTIVE ACTION

14.1 Refer to the SOP for *Non Conformity and Corrective Action* 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 Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15 METHOD PERFORMANCE

This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.

15.1 The method detection limit (MDL) is established using the procedure described in the SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL).* 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 Refer to ADM-TRAIN for standard procedures.

17.2 Training outline

17.2.1 Review literature (see references section). Review 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.

17.2.2 The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of 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.

17.2.3 Perform initial precision and recovery (IPR) study as described in Section 12.1 for water samples. Summaries of the IPR are reviewed and signed by the supervisor.

17.3 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 CHANGES SINCE THE LAST REVISION

19.1 Sec 6.2: Changed hold time after preservation to minimum 24 hours.
19.2 Sec 7.1.1: Removed reference to IRIS.
19.3 Sec 7.1.2: Added Thermo Scientific ICAP 6500 (AES-04).
19.4 Sec 7.6: Removed reference to IRIS.
19.5 Sec 7.7: Removed reference to IRIS.
19.6 Sec 7.10: Removed section.
19.7 Sec 7.11: Removed section.
19.8 Sec. 8.1.2: Removed reference to IRIS.
19.9 Sec 9.3: Removed section.
19.10 Sec 11.1.1: Removed section.
19.11 Sec 11.1.2: Changed reference to include new ICAP 6500.
19.12 Sec 11.2.1: Removed section.
19.13 Sec 11.2.2.5: Removed section.
19.14 Sec 11.2.4: Removed LLICV text.
19.15 Sec 11.3.1.2: Revised QC list.
19.16 Sec 11.3.2.1: Added LLICV test.
19.17 Sec 11.3.4: Removed “or ICS”.
19.18 Sec 12: Added “Internal Standard” section.
19.19 Sec 12.6: Added manual/auto correction using iTEVA software.
19.20 Sec 12.8.2: Added 6010C default limits.
19.21 Sec 12.8.5: Added 6010C default limits.
19.22 Sec 12.8.6: Revised section; changed order in which post spikes and serial dilutions are performed.
19.23 Table 3: Removed.
19.24 Table 5: Revised boron prep instruction.
19.25 Table 7: Removed.

20 REFERENCES/ATTACHMENTS

20.1 USEPA, Contract Laboratory Program, SOW #ILM04.0
20.2 Thermo Jarrell Ash ICAP61 Manual
20.3 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010B, Revision 2, December 1996.
20.4 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update III, Method 6010C, Revision 3, February 2007.
20.5 USEPA, Methods for Determination of Metals in Environmental Samples, Supplement I, EPA/600/R-94/111, Method 200.7, Revision 4.4, May 1994.
20.6 *Hardness by Calculation, Method 2340B,* Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.
20.7 Table 1.1, ALS Kelso Data Quality Objectives, 200.7, soil.
20.8 Table 1.2, ALS Kelso Data Quality Objectives, 200.7, water.
20.9 Table 1.3, ALS Kelso Data Quality Objectives, 6010C, water.
20.10 Table 1.4, ALS Kelso Data Quality Objectives, 6010C, soil.
20.11 Table 1.5, ALS Kelso Data Quality Objectives, 6010C LL, soil.

20.12 Table 1.6, ALS Kelso Data Quality Objectives, 6010C LL, water.
20.13 Table 1.7, ALS Kelso Data Quality Objectives, 6010C/PSEP, tissue
20.14 Table 2, Standard A for ICAP 6500 ICP-OES.
20.15 Table 3, ICP ICV Standards.
20.16 Table 4, ICP Interference Check Solutions.
20.17 Table 5, ICAP 6500 Analytical Wavelengths.

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.1

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
200.7	Aluminum	7429-90-5	Soil	6	10	mg/kg	41-158	70-130	30
200.7	Antimony	7440-36-0	Soil	3	10	mg/kg	50-150	70-130	30
200.7	Arsenic	7440-38-2	Soil	4	20	mg/kg	75-125	70-130	30
200.7	Barium	7440-39-3	Soil	0.3	2	mg/kg	81-119	70-130	30
200.7	Beryllium	7440-41-7	Soil	0.03	1	mg/kg	83-117	70-130	30
200.7	Boron	7440-42-8	Soil	0.4	10	mg/kg	67-133	70-130	30
200.7	Cadmium	7440-43-9	Soil	0.2	1	mg/kg	81-119	70-130	30
200.7	Calcium	7440-70-2	Soil	2	10	mg/kg	79-121	70-130	30
200.7	Chromium	7440-47-3	Soil	0.4	2	mg/kg	80-119	70-130	30
200.7	Cobalt	7440-48-4	Soil	0.3	2	mg/kg	82-118	70-130	30
200.7	Copper	7440-50-8	Soil	0.6	2	mg/kg	83-116	70-130	30
200.7	Iron	7439-89-6	Soil	0.7	4	mg/kg	50-149	70-130	30
200.7	Lead	7439-92-1	Soil	3	20	mg/kg	79-121	70-130	30
200.7	Lithium	7439-93-2	Soil	0.5	2	mg/kg	75-125	70-130	30
200.7	Magnesium	7439-95-4	Soil	0.3	4	mg/kg	73-127	70-130	30
200.7	Manganese	7439-96-5	Soil	0.04	2	mg/kg	81-119	70-130	30
200.7	Molybdenum	7439-98-7	Soil	0.5	2	mg/kg	75-125	70-130	30
200.7	Nickel	7440-02-0	Soil	0.5	4	mg/kg	81-118	70-130	30
200.7	Phosphorus	7723-14-0	Soil	3	40	mg/kg	75-125	70-130	30
200.7	Potassium	7440-09-7	Soil	20	80	mg/kg	73-126	70-130	30
200.7	Selenium	7782-49-2	Soil	4	20	mg/kg	75-125	70-130	30
200.7	Silver	7440-22-4	Soil	0.4	2	mg/kg	66-134	70-130	30
200.7	Sodium	7440-23-5	Soil	4	40	mg/kg	74-126	70-130	30
200.7	Strontium	7440-24-6	Soil	0.02	2	mg/kg	79-121	70-130	30
200.7	Thallium	7440-28-0	Soil	3	20	mg/kg	75-125	70-130	30
200.7	Tin	7440-31-5	Soil	2	10	mg/kg	75-124	70-130	30

200.7	Titanium	7440-32-6	Soil	0.5	2			mg/kg	75-125	70-130	30
200.7	Vanadium	7440-62-2	Soil	0.4	2			mg/kg	79-121	70-130	30
200.7	Zinc	7440-66-6	Soil	0.3	2			mg/kg	73-121	70-130	30

a Method Detection Limits are subject to change as new MDL studies are completed.

ALS/KELSO DATA QUALITY OBJECTIVES — Table 1.2

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
200.7	Aluminum	7429-90-5	Water	30	50	28	50	ug/L	85-115	70-130	20
200.7	Antimony	7440-36-0	Water	20	50	30	50	ug/L	85-115	70-130	20
200.7	Arsenic	7440-38-2	Water	20	100	30	100	ug/L	85-115	70-130	20
200.7	Barium	7440-39-3	Water	1	5	1.5	5	ug/L	85-115	70-130	20
200.7	Beryllium	7440-41-7	Water	0.2	5	0.3	5	ug/L	85-115	70-130	20
200.7	Boron	7440-42-8	Water	3	50		50	ug/L	85-115	70-130	20
200.7	Cadmium	7440-43-9	Water	0.8	5	2	5	ug/L	85-115	70-130	20
200.7	Calcium	7440-70-2	Water	10	50	25	50	ug/L	85-115	70-130	20
200.7	Chromium	7440-47-3	Water	3	5	2.5	5	ug/L	85-115	70-130	20
200.7	Cobalt	7440-48-4	Water	2	10	2.5	10	ug/L	85-115	70-130	20
200.7	Copper	7440-50-8	Water	5	10	4.5	10	ug/L	85-115	70-130	20
200.7	Iron	7439-89-6	Water	2	20	4	20	ug/L	85-115	70-130	20
200.7	Lead	7439-92-1	Water	8	50	30	50	ug/L	85-115	70-130	20
200.7	Lithium	7439-93-2	Water	2	10	3.5	10	ug/L	85-115	70-130	20
200.7	Magnesium	7439-95-4	Water	0.7	20	0.5	20	ug/L	85-115	70-130	20
200.7	Manganese	7439-96-5	Water	0.4	5	0.5	5	ug/L	85-115	70-130	20
200.7	Molybdenum	7439-98-7	Water	3	10	5	10	ug/L	85-115	70-130	20
200.7	Nickel	7440-02-0	Water	2	20	4	20	ug/L	85-115	70-130	20
200.7	Phosphorus	7723-14-0	Water	30	200	40	200	ug/L	85-115	70-130	20
200.7	Potassium	7440-09-7	Water	50	400	80	400	ug/L	85-115	70-130	20
200.7	Selenium	7782-49-2	Water	30	100	40	100	ug/L	85-115	70-130	20
200.7	Silicon	7440-21-3	Water	10	400		400	ug/L	85-115	70-130	20

200.7	Silver	7440-22-4	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Sodium	7440-23-5	Water	30	200	20	200	ug/L	85-115	70-130	20
200.7	Strontium	7440-24-6	Water	0.06	10			ug/L	85-115	70-130	20
200.7	Thallium	7440-28-0	Water	30	100	60	100	ug/L	85-115	70-130	20
200.7	Tin	7440-31-5	Water	20	50	30	50	ug/L	85-115	70-130	20
200.7	Titanium	7440-32-6	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Vanadium	7440-62-2	Water	5	10	5	10	ug/L	85-115	70-130	20
200.7	Zinc	7440-66-6	Water	2	10	2.5	10	ug/L	85-115	70-130	20

Table 1.3

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C	Aluminum	7429-90-5	Water	40	50	40	50	ug/L	92-112	75-125	20
6010C	Antimony	7440-36-0	Water	10	50	30	50	ug/L	90-113	75-125	20
6010C	Arsenic	7440-38-2	Water	20	100	30	100	ug/L	90-112	75-125	20
6010C	Barium	7440-39-3	Water	0.5	5	1.5	5	ug/L	91-113	75-125	20
6010C	Beryllium	7440-41-7	Water	0.2	5	0.3	5	ug/L	91-113	75-125	20
6010C	Boron	7440-42-8	Water	2	50	4	50	ug/L	91-112	75-125	20
6010C	Cadmium	7440-43-9	Water	0.9	5	2	5	ug/L	93-113	75-125	20
6010C	Calcium	7440-70-2	Water	9	50	25	50	ug/L	85-116	75-125	20
6010C	Chromium	7440-47-3	Water	2	5	5	5	ug/L	93-114	75-125	20
6010C	Cobalt	7440-48-4	Water	2	10	2.5	10	ug/L	93-114	75-125	20
6010C	Copper	7440-50-8	Water	5	10	9	10	ug/L	91-111	75-125	20
6010C	Iron	7439-89-6	Water	3	20	4	20	ug/L	92-111	75-125	20
6010C	Lead	7439-92-1	Water	8	50	30	50	ug/L	92-113	75-125	20
6010C	Lithium	7439-93-2	Water	2	10	3.5	10	ug/L	80-120	75-125	20
6010C	Magnesium	7439-95-4	Water	0.4	20	0.5	20	ug/L	86-115	75-125	20
6010C	Manganese	7439-96-5	Water	0.7	5	0.5	5	ug/L	92-112	75-125	20
6010C	Molybdenum	7439-98-7	Water	2	10	5	10	ug/L	92-113	75-125	20
6010C	Nickel	7440-02-0	Water	3	20	4	20	ug/L	91-118	75-125	20
6010C	Phosphorus	7723-14-0	Water	60	200	40	200	ug/L	80-120	75-125	20
6010C	Potassium	7440-09-7	Water	40	400	80	400	ug/L	89-114	75-125	20
6010C	Selenium	7782-49-2	Water	20	100	40	100	ug/L	88-113	75-125	20
6010C	Silicon	7440-21-3	Water	6	400	8	400	ug/L	80-120	75-125	20
6010C	Silver	7440-22-4	Water	5	10	10	10	ug/L	93-110	75-125	20
6010C	Sodium	7440-23-5	Water	20	200	20	200	ug/L	80-120	75-125	20
6010C	Strontium	7440-24-6	Water	0.9	10	0.25	10	ug/L	80-120	75-125	20
6010C	Thallium	7440-28-0	Water	30	100	60	100	ug/L	80-120	75-125	20
6010C	Tin	7440-31-5	Water	9	50	30	50	ug/L	80-120	75-125	20
6010C	Titanium	7440-32-6	Water	4	10	10	10	ug/L	80-120	75-125	20

6010C	Vanadium	7440-62-2	Water	6	10	6.25	10	ug/L	92-111	75-125	20
6010C	Zinc	7440-66-6	Water	2	10	2.5	10	ug/L	92-112	75-125	20

Table 1.4

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C	Aluminum	7429-90-5	Soil	6	10	10	10	mg/kg	41-158	75-125	20
6010C	Antimony	7440-36-0	Soil	3	10	6	10	mg/kg	50-150	75-125	20
6010C	Arsenic	7440-38-2	Soil	4	20	8	20	mg/kg	78-122	75-125	20
6010C	Barium	7440-39-3	Soil	0.08	2	0.16	2	mg/kg	81-119	75-125	20
6010C	Beryllium	7440-41-7	Soil	0.02	1	0.04	1	mg/kg	83-117	75-125	20
6010C	Boron	7440-42-8	Soil	0.4	10	0.8	10	mg/kg	67-133	75-125	20
6010C	Cadmium	7440-43-9	Soil	0.3	1	0.6	1	mg/kg	81-119	75-125	20
6010C	Calcium	7440-70-2	Soil	2	10	4	10	mg/kg	79-121	75-125	20
6010C	Chromium	7440-47-3	Soil	0.5	2	1	2	mg/kg	80-119	75-125	20
6010C	Cobalt	7440-48-4	Soil	0.4	2	0.8	2	mg/kg	82-118	75-125	20
6010C	Copper	7440-50-8	Soil	0.7	2	1.4	2	mg/kg	83-116	75-125	20
6010C	Iron	7439-89-6	Soil	0.7	4	1.4	4	mg/kg	50-149	75-125	20
6010C	Lead	7439-92-1	Soil	3	20	6	20	mg/kg	79-121	75-125	20
6010C	Lithium	7439-93-2	Soil	0.5	2	0.8	2	mg/kg	75-125	75-125	20
6010C	Magnesium	7439-95-4	Soil	0.08	4	0.16	4	mg/kg	73-127	75-125	20
6010C	Manganese	7439-96-5	Soil	0.04	2	0.08	2	mg/kg	81-119	75-125	20
6010C	Molybdenum	7439-98-7	Soil	0.7	2	1.4	4.5	mg/kg	75-125	75-125	20
6010C	Nickel	7440-02-0	Soil	0.6	4	1.2	4	mg/kg	81-118	75-125	20
6010C	Phosphorus	7723-14-0	Soil	4	40	8	40	mg/kg	75-125	75-125	20
6010C	Potassium	7440-09-7	Soil	20	80	40	80	mg/kg	73-126	75-125	20
6010C	Selenium	7782-49-2	Soil	5	20	10	20	mg/kg	80-120	75-125	20
6010C	Silver	7440-22-4	Soil	2	2	4	4	mg/kg	66-134	75-125	20
6010C	Sodium	7440-23-5	Soil	4	40	8	40	mg/kg	74-126	75-125	20
6010C	Strontium	7440-24-6	Soil	0.02	2	0.04	2	mg/kg	79-121	75-125	20
6010C	Thallium	7440-28-0	Soil	7	20	14	20	mg/kg	79-120	75-125	20
6010C	Tin	7440-31-5	Soil	4	10	8	10	mg/kg	75-124	75-125	20
6010C	Titanium	7440-32-6	Soil	0.8	2	1.6	2	mg/kg	75-125	75-125	20

6010C	Vanadium	7440-62-2	Soil	2	2	2	2	mg/kg	79-121	75-125	20
6010C	Zinc	7440-66-6	Soil	0.3	2	0.6	2	mg/kg	73-121	75-125	20

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.5

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C LL	Aluminum	7429-90-5	Soil	0.4	1	0.8	2	mg/kg	41-158	75-125	20
6010C LL	Antimony	7440-36-0	Soil	0.5	2	1	3	mg/kg	50-150	75-125	20
6010C LL	Arsenic	7440-38-2	Soil	0.9	2	1.8	5	mg/kg	78-122	75-125	20
6010C LL	Barium	7440-39-3	Soil	0.06	0.5	0.12	0.5	mg/kg	81-119	75-125	20
6010C LL	Beryllium	7440-41-7	Soil	0.03	0.1	0.06	0.2	mg/kg	83-117	75-125	20
6010C LL	Boron	7440-42-8	Soil	0.4	2	1.6	10	mg/kg	67-133	75-125	20
6010C LL	Cadmium	7440-43-9	Soil	0.03	0.1	0.06	0.18	mg/kg	81-119	75-125	20
6010C LL	Calcium	7440-70-2	Soil	0.6	2	1.2	3.6	mg/kg	79-121	75-125	20
6010C LL	Chromium	7440-47-3	Soil	0.2	0.5	0.4	1.2	mg/kg	80-119	75-125	20
6010C LL	Cobalt	7440-48-4	Soil	0.2	0.5	0.4	1.2	mg/kg	82-118	75-125	20
6010C LL	Copper	7440-50-8	Soil	0.3	0.6	0.6	1.8	mg/kg	83-116	75-125	20
6010C LL	Iron	7439-89-6	Soil	0.7	2	1.4	4.2	mg/kg	50-149	75-125	20
6010C LL	Lead	7439-92-1	Soil	0.4	2	0.8	2	mg/kg	79-121	75-125	20
6010C LL	Lithium	7439-93-2	Soil	0.5	2	1	3	mg/kg	80-120	75-125	20
6010C LL	Magnesium	7439-95-4	Soil	0.06	0.5	0.12	0.5	mg/kg	73-127	75-125	20
6010C LL	Manganese	7439-96-5	Soil	0.02	0.2	0.04	0.2	mg/kg	81-119	75-125	20
6010C LL	Molybdenum	7439-98-7	Soil	0.08	0.4	0.06	0.4	mg/kg	75-125	75-125	20
6010C LL	Nickel	7440-02-0	Soil	0.07	0.4	0.14	0.4	mg/kg	81-118	75-125	20
6010C LL	Phosphorus	7723-14-0	Soil	3	6	6	40	mg/kg	80-120	75-125	20
6010C LL	Potassium	7440-09-7	Soil	20	60	40	120	mg/kg	73-126	75-125	20
6010C LL	Selenium	7782-49-2	Soil	0.7	4	1.4	4.2	mg/kg	80-120	75-125	20
6010C LL	Silver	7440-22-4	Soil	0.2	0.5	0.4	1.2	mg/kg	66-134	75-125	20
6010C LL	Sodium	7440-23-5	Soil	4	40	8	40	mg/kg	74-126	75-125	20
6010C LL	Strontium	7440-24-6	Soil	0.02	2	0.06	2	mg/kg	80-120	75-125	20
6010C LL	Thallium	7440-28-0	Soil	0.4	2	0.4	20	mg/kg	79-120	75-125	20
6010C LL	Tin	7440-31-5	Soil	0.7	10	1.6	10	mg/kg	75-124	75-125	20
6010C LL	Titanium	7440-32-6	Soil	0.05	0.2	0.16	2	mg/kg	80-120	75-125	20

6010C LL	Vanadium	7440-62-2	Soil	0.3	1	0.6	2	mg/kg	79-121	75-125	20
6010C LL	Zinc	7440-66-6	Soil	0.3	1	0.6	2	mg/kg	73-121	75-125	20

Table 1.6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C LL	Aluminum	7429-90-5	Water	0.5	2	6	18	ug/L	92-112	75-125	20
6010C LL	Antimony	7440-36-0	Water	3	10	6	18	ug/L	90-113	75-125	20
6010C LL	Arsenic	7440-38-2	Water	4	10	8	24	ug/L	90-112	75-125	20
6010C LL	Barium	7440-39-3	Water	0.4	2	0.8	2.4	ug/L	91-113	75-125	20
6010C LL	Beryllium	7440-41-7	Water	0.09	0.2	0.18	0.6	ug/L	91-113	75-125	20
6010C LL	Boron	7440-42-8	Water	2	10	8	50	ug/L	91-112	75-125	20
6010C LL	Cadmium	7440-43-9	Water	0.3	0.5	0.6	1.8	ug/L	93-113	75-125	20
6010C LL	Calcium	7440-70-2	Water	2	4	20	50	ug/L	85-116	75-125	20
6010C LL	Chromium	7440-47-3	Water	0.4	2	0.8	2.4	ug/L	93-114	75-125	20
6010C LL	Cobalt	7440-48-4	Water	0.4	1	0.8	2.4	ug/L	93-114	75-125	20
6010C LL	Copper	7440-50-8	Water	2	2	4	12	ug/L	91-111	75-125	20
6010C LL	Iron	7439-89-6	Water	3	10	6	18	ug/L	92-111	75-125	20
6010C LL	Lead	7439-92-1	Water	4	10	8	24	ug/L	92-113	75-125	20
6010C LL	Lithium	7439-93-2	Water	2	10	4	12	ug/L	80-120	75-125	20
6010C LL	Magnesium	7439-95-4	Water	0.4	2	6	20	ug/L	86-115	75-125	20
6010C LL	Manganese	7439-96-5	Water	0.2	0.6	0.4	2.4	ug/L	92-112	75-125	20
6010C LL	Molybdenum	7439-98-7	Water	0.6	2	1.2	3.6	ug/L	92-113	75-125	20
6010C LL	Nickel	7440-02-0	Water	0.7	2	1.4	4.2	ug/L	91-118	75-125	20
6010C LL	Phosphorus	7723-14-0	Water	7	20	7	400	ug/L	80-120	75-125	20
6010C LL	Potassium	7440-09-7	Water	50	100	100	300	ug/L	89-114	75-125	20
6010C LL	Selenium	7782-49-2	Water	5	20	10	30	ug/L	88-113	75-125	20
6010C LL	Silicon	7440-21-3	Water	10	50	10	400	ug/L	80-120	75-125	20
6010C LL	Silver	7440-22-4	Water	0.7	2	1.4	4.2	ug/L	93-110	75-125	20
6010C LL	Sodium	7440-23-5	Water	70	200	140	420	ug/L	80-120	75-125	20

6010C LL	Strontium	7440-24-6	Water	0.07	0.2	0.07	10	ug/L	80-120	75-125	20
6010C LL	Thallium	7440-28-0	Water	2	10	6	18	ug/L	80-120	75-125	20
6010C LL	Tin	7440-31-5	Water	2	10	2	10	ug/L	80-120	75-125	20
6010C LL	Titanium	7440-32-6	Water	0.2	1	0.8	10	ug/L	80-120	75-125	20
6010C LL	Vanadium	7440-62-2	Water	1	2	2	6	ug/L	92-111	75-125	20
6010C LL	Zinc	7440-66-6	Water	0.7	2	1.4	4.2	ug/L	92-112	75-125	20

ALS/KELSO DATA QUALITY OBJECTIVES

Table 1.7

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
6010C/PSEP	Aluminum	7429-90-5	Tissue	0.07	1	mg/kg	75-125	70-130	30
6010C/PSEP	Antimony	7440-36-0	Tissue	0.4	5	mg/kg	75-125	70-130	30
6010C/PSEP	Arsenic		Tissue	0.6	10	mg/kg	75-125	70-130	30
6010C/PSEP	Barium	7440-39-3	Tissue	0.04	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Beryllium		Tissue	0.02	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Boron	7440-42-8	Tissue	0.2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Cadmium	7440-43-9	Tissue	3	5	mg/kg	75-125	70-130	30
6010C/PSEP	Calcium	7440-70-2	Tissue	2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Chromium	7440-47-3	Tissue	0.08	0.2	mg/kg	75-125	70-130	30
6010C/PSEP	Cobalt		Tissue	0.05	1	mg/kg	75-125	70-130	30
6010C/PSEP	Copper	7440-50-8	Tissue	0.2	1	mg/kg	75-125	70-130	30
6010C/PSEP	Iron	7439-89-6	Tissue	0.4	2	mg/kg	75-125	70-130	30
6010C/PSEP	Lead		Tissue	0.2	5	mg/kg	75-125	70-130	30
6010C/PSEP	Lithium	7439-93-2	Tissue	0.3	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Magnesium	7439-95-4	Tissue	0.4	2	mg/kg	75-125	70-130	30
6010C/PSEP	Manganese	7439-96-5	Tissue	0.03	0.5	mg/kg	75-125	70-130	30
6010C/PSEP	Molybdenum	7439-98-7	Tissue	0.05	1	mg/kg	75-125	70-130	30
6010C/PSEP	Nickel	7440-02-0	Tissue	0.06	2	mg/kg	75-125	70-130	30
6010C/PSEP	Phosphorus	7723-14-0	Tissue	2	20	mg/kg	75-125	70-130	30
6010C/PSEP	Potassium	7440-09-7	Tissue	6	40	mg/kg	75-125	70-130	30
6010C/PSEP	Selenium	7782-49-2	Tissue	0.7	10	mg/kg	75-125	70-130	30
6010C/PSEP	Silver	7440-22-4	Tissue	0.1	1	mg/kg	75-125	70-130	30
6010C/PSEP	Sodium	7440-23-5	Tissue	4	20	mg/kg	75-125	70-130	30
6010C/PSEP	Strontium	7440-24-6	Tissue	0.02	1	mg/kg	75-125	70-130	30
6010C/PSEP	Thallium	7440-28-0	Tissue	0.3	10	mg/kg	75-125	70-130	30

6010C/PSEP	Tin	7440-31-5	Tissue	0.3	5		mg/kg	75-125	70-130	30
6010C/PSEP	Titanium	7440-32-6	Tissue	0.09	1		mg/kg	75-125	70-130	30
6010C/PSEP	Vanadium	7440-62-2	Tissue	0.07	1		mg/kg	75-125	70-130	30
6010C/PSEP	Zinc	7440-66-6	Tissue	0.06	1		mg/kg	75-125	70-130	30

TABLE 2
Standard A for ICAP 6500 ICP-OES

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (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	(1)	100	5	1000	0.5
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

Standard B for ICAP 6500 ICP-OES

Analyte	Source	Source Concentration (ppm)	Aliquot (mL)	Final Volume (mL)	Final Concentration (ppm)
Aluminum	Elemental Stock	10000	2	1000	20
Arsenic	Elemental Stock	1000	2	1000	2
Barium	Elemental Stock	10000	2	1000	20
Calcium	Elemental Stock	10000	2	1000	20
Iron	Elemental Stock	10000	2	1000	20
Lithium	Elemental Stock	1000	2	1000	2
Manganese	Elemental Stock	1000	2	1000	2
Magnesium	Elemental Stock	10000	2	1000	20
Phosphorus	Elemental Stock	10000	2	1000	20
Potassium	Elemental Stock	10000	2	1000	20
Silicon	Elemental Stock	10000	2	1000	20
Sodium	Elemental Stock	10000	2	1000	20
Strontium	Elemental Stock	1000	2	1000	2
HCl	-	-	50	1000	5%
HNO3	-	-	10	1000	1%

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-2	500	2.5	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%

ICVB Solution

Analyte	Source	Source Concentration	Aliquot	Final Volume	Final Concentration

		(ppm)	(mL)	(mL)	(ppm)
Aluminum	Elemental Stock	1000	0.5	500	1
Boron	Elemental Stock	1000	1	500	2
Calcium	Elemental Stock	1000	2.5	500	5
Iron	Elemental Stock	1000	5	500	10
Lithium	Elemental Stock	1000	1	500	2
Magnesium	Elemental Stock	1000	2.5	500	5
Manganese	Elemental Stock	1000	5	500	10
Phosphorus	Elemental Stock	1000	2.5	500	5
Silicon	Elemental Stock	1000	2.5	500	5
Strontium	Elemental Stock	1000	1	500	2
Tin	Elemental Stock	1000	2.5	500	5
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

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 5
ICAP 6500 Analytical Wavelengths, continued

Strontium	407.7	
Thallium	190.8	
Tin	189.9	
Titanium	336.1	
Vanadium	292.4	
Zinc	206.2	
Zinc	213.8	Alternate

APPENDIX G

List of Laboratory Certifications and Accreditations

Federal and National Programs

- The TNI (The NELAC Institute) National Environmental Laboratory Accreditation Program (NELAP) Accredited Drinking Water, Non-Potable Water, Solid & Hazardous Waste, and Biological Tissue Laboratory
- ANSI-ASQ National Accreditation Board/ACLASS ISO 17025:2005
- DoD- ELAP Environmental Laboratory Accreditation Program
- U.S. EPA Region 8
  Approved Drinking Water Laboratory

State and Local Programs

- State of Alaska, Department of Environmental Conservation
  UST Laboratory, Lab I.D. UST040
- State of Arizona, Department of Health Services
  License No. AZ0339
- State of Arkansas, Department of Environmental Quality
  Certified Environmental Laboratory, Lab I.D. 88-0637
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program, Certification No. 2286
- State of Florida, Department of Health
  Accredited Environmental Laboratory No. E87412
- State of Georgia, Department of Natural Resources
  Certified Drinking Water Laboratory
- State of Hawaii, Department of Health
  Certified Drinking Water Laboratory
- State of Idaho, Department of Health and Welfare
  Certified Drinking Water Laboratory
- State of Indiana, Department of Health
  Certified Drinking Water Laboratory, Lab I.D. C-WA-01
- State of Louisiana, Department of Environmental Quality
  Accredited Environmental Laboratory, Lab I.D. 3016
- State of Maine, Department of Human Services
  Certified Environmental Laboratory, Lab I.D. WA0035
- State of Michigan, Department of Environmental Quality
  Certified Drinking Water Laboratory, Lab I.D. 9949

State and Local Programs (continued)

- State of Minnesota, Department of Health
  Certified Environmental Laboratory, Lab I.D. 053-999-368
- State of Montana, Department of Health and Environmental Sciences
  Certified Drinking Water Laboratory, Lab I.D. 0047
- State of Nebraska, Division of Public Health
  Certified Drinking Water Laboratory, Lab I.D. NE-OS-23-13
- State of Nevada, Division of Environmental Protection
  Certified Drinking Water Laboratory, Lab I.D. WA35
- State of New Jersey, Department of Environmental Protection
  Accredited Environmental Laboratory, Lab I.D. WA005
- State of North Carolina, Department of Environment and Natural Resources
  Certified Environmental Laboratory, Lab I.D. 605
- State of Oklahoma, Department of Environmental Quality
  General Water Quality/Sludge Testing, Lab I.D. 9801
- State of Oregon, ORELAP Laboratory Accreditation Program
  Accredited Environmental Laboratory, Lab I.D. WA200001
- State of South Carolina, Department of Health and Environmental Control
  Certified Environmental Laboratory, Lab I.D. 61002
- State of Texas, Commission on Environmental Quality
  Certified Environmental Laboratory, Lab I.D. T104704427-12-4
- State of Utah, Department of Health
  Accredited Environmental Laboratory, Lab I.D. WA000352013-2
- State of Washington, Department of Ecology
  Accreditation Program Lab I.D. C1203
- State of Wisconsin, Department of Natural Resources
  Accredited Environmental Laboratory, Lab I.D. 998386840

A complete listing of and certifications and accreditations can be found at:

http://alsnetnew/divisions/env_northamerica/Lists/USA%20Certifications1/AllItems.aspx

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Columbia Analytical Services, Inc. Kelso

WA100010

1317 South 13th Ave.

Kelso,WA 98626

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

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

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

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

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

Gary K. Ward

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 02/11/2013

EXPIRATION DATE: 02/10/2014

Certificate No: WA100010 - 005

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: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2013 ***Expiration Date:*** 02/10/2014

As of 02/11/2013 ***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
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	Arsenic (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

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

Analyte Code	*Analyte*
8031	Extraction/Preparation

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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2013 ***Expiration Date:*** 02/10/2014

As of 02/11/2013 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

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

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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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Columbia Analytical Services, Inc. Kelso

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Analyte Code	*Analyte*
1150	Silver
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

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
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
4835	Hexachlorobutadiene
7725	Isodrin

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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
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',5,6-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)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
8915	2-Chlorobiphenyl (BZ-1)
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)

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
9105	Decachlorobiphenyl (BZ-209)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
6380	1-Methylnaphthalene
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
5670	Butyl benzyl phthalate
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
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
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)
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)

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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 200.9 2.2	**10015404**	**Metals by Graphite Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
1010	Arsenic
1055	Copper
1075	Lead
1140	Selenium
1165	Thallium

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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
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 **10082007** **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
7250	Chlordane (tech.)
7470	Dieldrin
7540	Endrin
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor

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Analyte Code	*Analyte*
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
8505	Acifluorfen
8555	Dalapon
8570	DCPA di-acid degradate
8595	Dicamba
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
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
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4835	Hexachlorobutadiene
4900	Isopropylbenzene
4950	Methyl bromide (Bromomethane)

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Analyte Code	*Analyte*
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
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 (s-ethyl-n,n-dipropyl thio carbamate)
6275	Hexachlorobenzene
6285	Hexachlorocyclopentadiene
6320	Isophorone
7835	Metolachlor
7845	Metribuzin
7875	Molinate
8045	Propachlor (Ramrod)
8125	Simazine
8180	Terbacil

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

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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*
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

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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

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MATRIX : Non-Potable Water

Reference	Code	Description
ASTM D1426-98B	**30023406**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

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)
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
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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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	Soil 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*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 1650 **10124808** **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

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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
220	5,5-Diphenylhydantoin (Dilantin)
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
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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Analyte Code	*Analyte*
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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
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*
1005	Antimony
1010	Arsenic
1055	Copper
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

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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*
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

ORELAP Fields of Accreditation

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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 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

ORELAP Fields of Accreditation

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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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium
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

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
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
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
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4680	cis-1,3-Dichloropropene
4765	Ethylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
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
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

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Analyte Code	*Analyte*
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
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 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
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

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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
9408	Gasoline range organics (GRO)

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

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

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
4835	Hexachlorobutadiene
7725	Isodrin

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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
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',5,6-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)
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)

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Analyte Code	*Analyte*
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
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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Analyte Code	*Analyte*
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
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
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
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
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)

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Analyte Code	*Analyte*
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
4440	sec-Butylbenzene
5100	Styrene
4370	t-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
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

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
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
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
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
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
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

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Analyte Code	*Analyte*
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6535	n-Nitrosodiphenylamine
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*
6380	1-Methylnaphthalene
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
5670	Butylbenzylphthalate
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
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
6665	Pyrene

EPA 8315A **10188008** **Determination of Carbonyl Compounds by HPLC/UV-VIS**

Analyte Code	*Analyte*
4815	Formaldehyde

ORELAP Fields of Accreditation

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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

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)

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

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

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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 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 F 20th ED **20051300** **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

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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

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⁻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

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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

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-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9230 B (PSE) 20th ED **20217203** **Multiple Tube Fermentation Quantitative: Fecal Streptococci**

Analyte Code	*Analyte*
2540	Fecal streptococci

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MATRIX : Solids

Reference	Code	Description
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
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
7910	trans-Nonachlor

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

ORELAP Fields of Accreditation

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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*
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

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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

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

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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
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156406** **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
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium

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Analyte Code	*Analyte*
1185	Vanadium
1190	Zinc

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 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 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 8021B **10174803** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

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

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Analyte Code	*Analyte*
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
4835	Hexachlorobutadiene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
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)
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)

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Analyte Code	*Analyte*
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)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

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

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

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

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
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
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
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethylenoxide)
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
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane

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Analyte Code	*Analyte*
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
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
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
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

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Analyte Code	*Analyte*
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
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
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
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2013 ***Expiration Date:*** 02/10/2014

As of 02/11/2013 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

Analyte Code	*Analyte*
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
6535	n-Nitrosodiphenylamine
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*
6380	1-Methylnaphthalene
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
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran

ORELAP Fields of Accreditation

ORELAP ID: WA100010
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Analyte Code	*Analyte*
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
6615	Phenanthrene
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)
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

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. 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)

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

The State of Washington Department of Ecology

ALS Environmental - Kelso
Kelso, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective July 9, 2013 and shall expire July 8, 2014.

Witnessed under my hand on July 26, 2013

Alan D. Rue
Lab Accreditation Unit Supervisor

Laboratory ID
C544

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

ALS Environmental - Kelso

Kelso, WA

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

Matrix/Analyte	Method	Notes
Drinking Water		
Turbidity	EPA 180.1_2_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate	EPA 300.0_2.1_1993	
Nitrite	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Bromate	EPA 300.1_1_1997	
Bromide	EPA 300.1_1_1997	
Chlorate	EPA 300.1_1_1997	
Chlorite	EPA 300.1_1_1997	
Perchlorate	EPA 314.0	
Total cyanide	EPA 335.4_1_1993	
Nitrate	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Color	SM 2120 B-01	
Alkalinity	SM 2320 B-97	
Conductivity	SM 2510 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Cyanide, Total	SM 4500-CN^- E-99	
Fluoride	SM 4500-F C-97	
Orthophosphate as P	SM 4500-P E-99	
Total organic carbon	SM 5310 C-00	

Matrix/Analyte	Method	Notes
Aluminum	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Silica as SiO2	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Total hardness as CaCO3	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	
Chromium	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Arsenic	EPA 200.9 Rev 2.2 (1994)	
Copper	EPA 200.9 Rev 2.2 (1994)	4

Matrix/Analyte	Method	Notes
Lead	EPA 200.9 Rev 2.2 (1994)	
Selenium	EPA 200.9 Rev 2.2 (1994)	
Thallium	EPA 200.9 Rev 2.2 (1994)	
Mercury	EPA 245.1_3_1994	
1,2,3-Trichloropropane	EPA 504.1_1.1_1995	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1_1.1_1995	
Dibromochloropropane	EPA 504.1_1.1_1995	
4,4'-DDD	EPA 508.1_2_1995	
4,4'-DDE	EPA 508.1_2_1995	
4,4'-DDT	EPA 508.1_2_1995	
Aldrin	EPA 508.1_2_1995	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Aroclor-1016 (PCB-1016)	EPA 508.1_2_1995	
Aroclor-1221 (PCB-1221)	EPA 508.1_2_1995	
Aroclor-1232 (PCB-1232)	EPA 508.1_2_1995	
Aroclor-1242 (PCB-1242)	EPA 508.1_2_1995	
Aroclor-1248 (PCB-1248)	EPA 508.1_2_1995	
Aroclor-1254 (PCB-1254)	EPA 508.1_2_1995	
Aroclor-1260 (PCB-1260)	EPA 508.1_2_1995	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Chlordane (tech.)	EPA 508.1_2_1995	
delta-BHC	EPA 508.1_2_1995	
Dieldrin	EPA 508.1_2_1995	
Endosulfan I	EPA 508.1_2_1995	
Endosulfan II	EPA 508.1_2_1995	
Endosulfan sulfate	EPA 508.1_2_1995	
Endrin	EPA 508.1_2_1995	
Endrin aldehyde	EPA 508.1_2_1995	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 508.1_2_1995	
Heptachlor	EPA 508.1_2_1995	
Heptachlor epoxide	EPA 508.1_2_1995	
Methoxychlor	EPA 508.1_2_1995	
PCBs	EPA 508.1_2_1995	

Matrix/Analyte	Method	Notes
Toxaphene (Chlorinated camphene)	EPA 508.1_2_1995	
2,4,5-T	EPA 515.4_1_2000	
2,4-D	EPA 515.4_1_2000	
2,4-DB	EPA 515.4_1_2000	
3,5-Dichlorobenzoic acid	EPA 515.4_1_2000	
Acifluorfen	EPA 515.4_1_2000	
Bentazon	EPA 515.4_1_2000	
Chloramben	EPA 515.4_1_2000	
Dalapon	EPA 515.4_1_2000	
DCPA di acid degradate	EPA 515.4_1_2000	
DCPA mono acid degradate	EPA 515.4_1_2000	
Dicamba	EPA 515.4_1_2000	
Dichlorprop	EPA 515.4_1_2000	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 515.4_1_2000	
Pentachlorophenol	EPA 515.4_1_2000	
Picloram	EPA 515.4_1_2000	
Silvex (2,4,5-TP)	EPA 515.4_1_2000	
Diquat	EPA 549.2_1_1997	
Paraquat	EPA 549.2_1_1997	
Bromoacetic acid	EPA 552.2_1_1995	
Bromochloroacetic acid	EPA 552.2_1_1995	
Chloroacetic acid	EPA 552.2_1_1995	
Dibromoacetic acid	EPA 552.2_1_1995	
Dichloroacetic acid	EPA 552.2_1_1995	
Total haloacetic acids	EPA 552.2_1_1995	
Trichloroacetic acid	EPA 552.2_1_1995	
1,1,1,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,1-Trichloroethane	EPA 524.2_4.1_1995	
1,1,2,2-Tetrachloroethane	EPA 524.2_4.1_1995	
1,1,2-Trichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethane	EPA 524.2_4.1_1995	
1,1-Dichloroethylene	EPA 524.2_4.1_1995	
1,1-Dichloropropene	EPA 524.2_4.1_1995	
1,2,3-Trichlorobenzene	EPA 524.2_4.1_1995	
1,2,3-Trichloropropane	EPA 524.2_4.1_1995	
1,2,4-Trichlorobenzene	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
1,2,4-Trimethylbenzene	EPA 524.2_4.1_1995	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 524.2_4.1_1995	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 524.2_4.1_1995	
1,2-Dichlorobenzene	EPA 524.2_4.1_1995	
1,2-Dichloroethane	EPA 524.2_4.1_1995	
1,2-Dichloropropane	EPA 524.2_4.1_1995	
1,3,5-Trimethylbenzene	EPA 524.2_4.1_1995	
1,3-Dichlorobenzene	EPA 524.2_4.1_1995	
1,3-Dichloropropane	EPA 524.2_4.1_1995	
1,4-Dichlorobenzene	EPA 524.2_4.1_1995	
2,2-Dichloropropane	EPA 524.2_4.1_1995	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 524.2_4.1_1995	
2-Chlorotoluene	EPA 524.2_4.1_1995	
2-Hexanone	EPA 524.2_4.1_1995	
4-Chlorotoluene	EPA 524.2_4.1_1995	
4-Methyl-2-pentanone (MIBK)	EPA 524.2_4.1_1995	
Acetone	EPA 524.2_4.1_1995	
Benzene	EPA 524.2_4.1_1995	
Bromobenzene	EPA 524.2_4.1_1995	
Bromochloromethane	EPA 524.2_4.1_1995	
Bromodichloromethane	EPA 524.2_4.1_1995	
Bromoform	EPA 524.2_4.1_1995	
Carbon disulfide	EPA 524.2_4.1_1995	
Carbon tetrachloride	EPA 524.2_4.1_1995	
Chlorobenzene	EPA 524.2_4.1_1995	
Chloroethane	EPA 524.2_4.1_1995	
Chloroform	EPA 524.2_4.1_1995	
cis-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
cis-1,3-Dichloropropene	EPA 524.2_4.1_1995	
Dibromochloromethane	EPA 524.2_4.1_1995	
Dibromomethane	EPA 524.2_4.1_1995	
Dichlorodifluoromethane	EPA 524.2_4.1_1995	
Dichloromethane (DCM, Methylene chloride)	EPA 524.2_4.1_1995	
Ethylbenzene	EPA 524.2_4.1_1995	
Hexachlorobutadiene	EPA 524.2_4.1_1995	
Isopropylbenzene	EPA 524.2_4.1_1995	

Matrix/Analyte	Method	Notes
Methyl bromide (Bromomethane)	EPA 524.2_4.1_1995	
Methyl chloride (Chloromethane)	EPA 524.2_4.1_1995	
Methyl tert-butyl ether (MTBE)	EPA 524.2_4.1_1995	
m-Xylene	EPA 524.2_4.1_1995	
Naphthalene	EPA 524.2_4.1_1995	
n-Butylbenzene	EPA 524.2_4.1_1995	
n-Propylbenzene	EPA 524.2_4.1_1995	
o-Xylene	EPA 524.2_4.1_1995	
p-Isopropyltoluene	EPA 524.2_4.1_1995	
p-Xylene	EPA 524.2_4.1_1995	
sec-Butylbenzene	EPA 524.2_4.1_1995	
Styrene	EPA 524.2_4.1_1995	
tert-Butylbenzene	EPA 524.2_4.1_1995	
Tetrachloroethylene (Perchloroethylene)	EPA 524.2_4.1_1995	
Toluene	EPA 524.2_4.1_1995	
Total trihalomethanes	EPA 524.2_4.1_1995	
trans-1,2-Dichloroethylene	EPA 524.2_4.1_1995	
trans-1,3-Dichloropropylene	EPA 524.2_4.1_1995	
Trichloroethene (Trichloroethylene)	EPA 524.2_4.1_1995	
Trichlorofluoromethane	EPA 524.2_4.1_1995	
Trihalomethanes	EPA 524.2_4.1_1995	
Vinyl chloride	EPA 524.2_4.1_1995	
Xylenes (total)	EPA 524.2_4.1_1995	
2,4-Dinitrotoluene (2,4-DNT)	EPA 525.2_2_1995	
2,6-Dinitrotoluene (2,6-DNT)	EPA 525.2_2_1995	
2-Chlorobiphenyl	EPA 525.2_2_1995	
Acenaphthylene	EPA 525.2_2_1995	
Alachlor	EPA 525.2_2_1995	
Ametryn	EPA 525.2_2_1995	
Anthracene	EPA 525.2_2_1995	
Atraton	EPA 525.2_2_1995	
Atrazine	EPA 525.2_2_1995	
Benzo(a)anthracene	EPA 525.2_2_1995	
Benzo(a)pyrene	EPA 525.2_2_1995	
Benzo(g,h,i)perylene	EPA 525.2_2_1995	
Benzo(k)fluoranthene	EPA 525.2_2_1995	

Matrix/Analyte	Method	Notes
Benzo[b]fluoranthene	EPA 525.2_2_1995	
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 525.2_2_1995	
Bromacil	EPA 525.2_2_1995	
Butachlor	EPA 525.2_2_1995	
Butyl benzyl phthalate	EPA 525.2_2_1995	
Butylate	EPA 525.2_2_1995	
Carboxin	EPA 525.2_2_1995	
Chlorobenzilate	EPA 525.2_2_1995	
Chloroneb	EPA 525.2_2_1995	
Chloropropham	EPA 525.2_2_1995	
Chlorothalonil	EPA 525.2_2_1995	
Chrysene	EPA 525.2_2_1995	
cis-Permethrin	EPA 525.2_2_1995	
Cyanazine	EPA 525.2_2_1995	
Cycloate	EPA 525.2_2_1995	
Dacthal (DCPA)	EPA 525.2_2_1995	
Di(2-ethylhexyl)adipate	EPA 525.2_2_1995	
Di(2-ethylhexyl)phthalate	EPA 525.2_2_1995	
Diazinon	EPA 525.2_2_1995	
Dibenz(a,h) anthracene	EPA 525.2_2_1995	
Diethyl phthalate	EPA 525.2_2_1995	
Dimethyl phthalate	EPA 525.2_2_1995	
Di-n-butyl phthalate	EPA 525.2_2_1995	
Diphenamid	EPA 525.2_2_1995	
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 525.2_2_1995	
Ethoprop	EPA 525.2_2_1995	
Etridiazole	EPA 525.2_2_1995	
Fenamiphos	EPA 525.2_2_1995	
Fenarimol	EPA 525.2_2_1995	
Fluorene	EPA 525.2_2_1995	
Hexachlorobenzene	EPA 525.2_2_1995	
Hexachlorocyclohexane	EPA 525.2_2_1995	
Hexazinone	EPA 525.2_2_1995	
Indeno(1,2,3-cd) pyrene	EPA 525.2_2_1995	
Isophorone	EPA 525.2_2_1995	
Merphos	EPA 525.2_2_1995	

Matrix/Analyte	Method	Notes
Metolachlor	EPA 525.2_2_1995	
Metribuzin	EPA 525.2_2_1995	
Mevinphos	EPA 525.2_2_1995	
MGK-264	EPA 525.2_2_1995	
Molinate	EPA 525.2_2_1995	
Napropamide	EPA 525.2_2_1995	
Norflurazon	EPA 525.2_2_1995	
Pebulate	EPA 525.2_2_1995	
Phenanthrene	EPA 525.2_2_1995	
Prometon	EPA 525.2_2_1995	
Prometryn	EPA 525.2_2_1995	
Pronamide (Kerb)	EPA 525.2_2_1995	
Propachlor (Ramrod)	EPA 525.2_2_1995	
Propazine	EPA 525.2_2_1995	
Pyrene	EPA 525.2_2_1995	
Simazine	EPA 525.2_2_1995	
Simetryn	EPA 525.2_2_1995	
Tebuthiuron	EPA 525.2_2_1995	
Terbacil	EPA 525.2_2_1995	
Terbufos	EPA 525.2_2_1995	
Terbutryn	EPA 525.2_2_1995	
trans Permethrin	EPA 525.2_2_1995	
Triademefon	EPA 525.2_2_1995	
Tricyclazole	EPA 525.2_2_1995	
Trifluralin (Treflan)	EPA 525.2_2_1995	
Vernolate	EPA 525.2_2_1995	
Endothall	EPA 548.1_1_1992	
Heterotrophic plate count	SM 9215 B (PCA)	
Total & Fecal Coli - count	SM 9221 B (LTB) + E1 (EC) + C MPN	
Total Coli/Ecoli - count	SM 9221 B (LTB) + F (EC Mug) + C	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Total Coli/Ecoli - detect	SM 9223 B Colilert	6
Non-Potable Water		
Formaldehyde	ASTM D 19	

Matrix/Analyte	Method	Notes
Kjeldahl nitrogen - total	ASTM D1426-93B	
Conductivity	EPA 120.1_1982	
Solids, Total Volatile	EPA 160.4_1971	
Adsorbable Organic Halides (AOX)	EPA 1650_C_1997	
n-Hexane Extractable Material (O&G)	EPA 1664A (SGT-HEM)	
Turbidity	EPA 180.1_2_1993	
Bromide	EPA 300.0_2.1_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate	EPA 300.0_2.1_1993	
Nitrite	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Perchlorate	EPA 314.0	
Total cyanide	EPA 335.4_1_1993	
Nitrate	EPA 353.2_2_1993	
Nitrate-nitrite	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Orthophosphate as P	EPA 365.3_1978	
Phosphorus, total	EPA 365.3_1978	
Phenolics, Total	EPA 420.1_1978	
Chromium, Hexavalent	EPA 7196A_1_1992	
Color	SM 2120 B-01	
Acidity, as CaCO3	SM 2310 B-97	
Alkalinity as CaCO3	SM 2320 B-97	
Total hardness as CaCO3	SM 2340 C-97	
Solids, Total	SM 2540 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Solids, Total Suspended	SM 2540 D-97	
Solids, Settleable	SM 2540 F-97	
Chromium, Hexavalent	SM 3500-Cr B-09	
Chloride	SM 4500-Cl C-93	
Amenable cyanide	SM 4500-CN G-97	
Cyanides, Amenable to Chlorination	SM 4500-CN G-97	
Cyanide, Total	SM 4500-CN^- E-99	
Fluoride	SM 4500-F C-97	
pH	SM 4500-H+ B-00	1

Matrix/Analyte	Method	Notes
Ammonia as N	SM 4500-NH3 E-97	
Sulfide	SM 4500-$S2^{-}$ F-00	
Biochemical oxygen demand	SM 5210 B-01	
Chemical oxygen demand	SM 5220 C-97	
Total organic carbon	SM 5310 C-00	
Surfactants - MBAS	SM 5540 C-00	
Tannin & Lignin	SM 5550	
Methyl Mercury	EPA 1630	
Mercury	EPA 1631 E-02	
Antimony	EPA 1638_1996	2
Cadmium	EPA 1638_1996	2
Copper	EPA 1638_1996	2
Lead	EPA 1638_1996	2
Nickel	EPA 1638_1996	2
Selenium	EPA 1638_1996	2
Silver	EPA 1638_1996	2
Thallium	EPA 1638_1996	2
Zinc	EPA 1638_1996	2
Aluminum	EPA 200.7_4.4_1994	
Antimony	EPA 200.7_4.4_1994	
Arsenic	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Cobalt	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Lead	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Molybdenum	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Potassium	EPA 200.7_4.4_1994	

Matrix/Analyte	Method	Notes
Selenium	EPA 200.7_4.4_1994	
Silica as SiO2	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Strontium	EPA 200.7_4.4_1994	
Thallium	EPA 200.7_4.4_1994	
Tin	EPA 200.7_4.4_1994	
Titanium	EPA 200.7_4.4_1994	
Total hardness as CaCO3	EPA 200.7_4.4_1994	
Vanadium	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	
Chromium	EPA 200.8_5.4_1994	
Cobalt	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Molybdenum	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Vanadium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Arsenic	EPA 200.9 Rev 2.2 (1994)	
Lead	EPA 200.9 Rev 2.2 (1994)	
Selenium	EPA 200.9 Rev 2.2 (1994)	
Thallium	EPA 200.9 Rev 2.2 (1994)	

Matrix/Analyte	Method	Notes
Mercury	EPA 245.1_3_1994	
Acenaphthene	EPA 610	
Acenaphthylene	EPA 610	
Anthracene	EPA 610	
Benzo(a)anthracene	EPA 610	
Benzo(a)pyrene	EPA 610	
Benzo(g,h,i)perylene	EPA 610	
Benzo(k)fluoranthene	EPA 610	
Benzo[b]fluoranthene	EPA 610	
Chrysene	EPA 610	
Dibenz(a,h) anthracene	EPA 610	
Fluoranthene	EPA 610	
Fluorene	EPA 610	
Indeno(1,2,3-cd) pyrene	EPA 610	
Naphthalene	EPA 610	
Phenanthrene	EPA 610	
Pyrene	EPA 610	
Organo-tins	Krone 1988	
Methanol	NCASI 94.03	
2-Butanone (Methyl ethyl ketone, MEK)	NCASI DI/HAPS-99.01	
Acetaldehyde	NCASI DI/HAPS-99.01	
Methanol	NCASI DI/HAPS-99.01	
Propionaldehyde	NCASI DI/HAPS-99.01	
2,3,4,6-Tetrachlorophenol	EPA 1653_A_1997	
2,4,5-Trichlorophenol	EPA 1653_A_1997	
2,4,6-Trichlorophenol	EPA 1653_A_1997	
3,4,5-Trichlorocatechol	EPA 1653_A_1997	
3,4,5-Trichloroguaiacol	EPA 1653_A_1997	
3,4,6-Trichlorocatechol	EPA 1653_A_1997	
3,4,6-Trichloroguaiacol	EPA 1653_A_1997	
4,5,6-Trichloroguaiacol	EPA 1653_A_1997	
Pentachlorophenol	EPA 1653_A_1997	
Tetrachlorocatechol	EPA 1653_A_1997	
Tetrachloroguaiacol	EPA 1653_A_1997	
Trichlorosyringol	EPA 1653_A_1997	
Acetaminophen	EPA 1694	

Matrix/Analyte	Method	Notes
Caffeine	EPA 1694	
Fluoxetine	EPA 1694	
Gemfibrozil	EPA 1694	
Ibuprofen	EPA 1694	
Naproxen	EPA 1694	
Triclosan	EPA 1694	
Trimethoprim	EPA 1694	
1,1,1,2-Tetrachloroethane	EPA 624	
1,1,1-Trichloroethane	EPA 624	
1,1,2,2-Tetrachloroethane	EPA 624	
1,1,2-Trichloroethane	EPA 624	
1,1-Dichloroethane	EPA 624	
1,1-Dichloroethylene	EPA 624	
1,2-Dichlorobenzene	EPA 624	
1,2-Dichloroethane	EPA 624	
1,2-Dichloropropane	EPA 624	
1,3-Dichlorobenzene	EPA 624	
1,4-Dichlorobenzene	EPA 624	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 624	
2-Chloroethyl vinyl ether	EPA 624	
Acetone	EPA 624	
Acetonitrile	EPA 624	
Acrolein (Propenal)	EPA 624	
Acrylonitrile	EPA 624	
Benzene	EPA 624	
Bromodichloromethane	EPA 624	
Bromoform	EPA 624	
Carbon tetrachloride	EPA 624	
Chlorobenzene	EPA 624	
Chloroethane	EPA 624	
Chloroform	EPA 624	
cis-1,3-Dichloropropene	EPA 624	
Dibromochloromethane	EPA 624	
Dichlorodifluoromethane	EPA 624	
Dichloromethane (DCM, Methylene chloride)	EPA 624	
Ethylbenzene	EPA 624	

Matrix/Analyte	Method	Notes
Methyl bromide (Bromomethane)	EPA 624	
Methyl chloride (Chloromethane)	EPA 624	
Methyl tert-butyl ether (MTBE)	EPA 624	
Methylene chloride	EPA 624	
Styrene	EPA 624	
Tetrachloroethylene (Perchloroethylene)	EPA 624	
Toluene	EPA 624	
trans-1,2-Dichloroethylene	EPA 624	
trans-1,3-Dichloropropylene	EPA 624	
Trichloroethene (Trichloroethylene)	EPA 624	
Trichlorofluoromethane	EPA 624	
Vinyl chloride	EPA 624	
1,2,4-Trichlorobenzene	EPA 625	
1,2-Diphenylhydrazine	EPA 625	
2,4,5-Trichlorophenol	EPA 625	
2,4,6-Trichlorophenol	EPA 625	
2,4-Dichlorophenol	EPA 625	
2,4-Dimethylphenol	EPA 625	
2,4-Dinitrophenol	EPA 625	
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	
2-Chloronaphthalene	EPA 625	
2-Chlorophenol	EPA 625	
2-Nitrophenol	EPA 625	
3,3'-Dichlorobenzidine	EPA 625	
4,6-Dinitro-2-methylphenol	EPA 625	
4-Bromophenyl phenyl ether	EPA 625	
4-Chloro-3-methylphenol	EPA 625	
4-Chlorophenyl phenylether	EPA 625	
4-Nitrophenol	EPA 625	
Acenaphthene	EPA 625	
Acenaphthylene	EPA 625	
Anthracene	EPA 625	
Atrazine	EPA 625	
Benzidine	EPA 625	
Benzo(a)anthracene	EPA 625	

Matrix/Analyte	Method	Notes
Benzo(a)pyrene	EPA 625	
Benzo(g,h,i)perylene	EPA 625	
Benzo(k)fluoranthene	EPA 625	
Benzo[b]fluoranthene	EPA 625	
Benzoic acid	EPA 625	
Biphenyl	EPA 625	
bis(2-Chloroethoxy)methane	EPA 625	
bis(2-Chloroethyl) ether	EPA 625	
bis(2-Chloroisopropyl) ether	EPA 625	
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	
Butyl benzyl phthalate	EPA 625	
Carbazole	EPA 625	
Chrysene	EPA 625	
Dibenz(a,h) anthracene	EPA 625	
Dibenzofuran	EPA 625	
Diethyl phthalate	EPA 625	
Dimethyl phthalate	EPA 625	
Di-n-butyl phthalate	EPA 625	
Di-n-octyl phthalate	EPA 625	
Fluoranthene	EPA 625	
Fluorene	EPA 625	
Hexachlorobenzene	EPA 625	
Hexachlorobutadiene	EPA 625	
Hexachlorocyclopentadiene	EPA 625	
Hexachloroethane	EPA 625	
Indeno(1,2,3-cd) pyrene	EPA 625	
Isophorone	EPA 625	
Naphthalene	EPA 625	
Nitrobenzene	EPA 625	
N-Nitrosodimethylamine	EPA 625	
N-Nitroso-di-n-propylamine	EPA 625	
N-Nitrosodiphenylamine	EPA 625	
Pentachlorophenol	EPA 625	
Phenanthrene	EPA 625	
Phenol	EPA 625	
Pyrene	EPA 625	

Matrix/Analyte	Method	Notes
Pyridine	EPA 625	
Enterococci	Enterolert	
Heterotrophic plate count	SM 9215 B (PCA)	
Total & Fecal Coli - count	SM 9221 B (LTB) + E1 (EC) + C MPN	
Total Coli/Ecoli - count	SM 9221 B (LTB) + F (EC Mug) + C	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Total Coli/Ecoli - count	SM 9223 B (Colilert® QTray)	6
Fecal streptococci	SM 9230 B (PSE)	
Solid and Chemical Materials		
Nitrogen, Total Kjeldahl	ASTM D1426-93B	
Total Organic Carbon	ASTM D4129-05	
Solids, Total Volatile	EPA 160.4_1971	
Ammonia as N	EPA 350.1_2_1993	
Nitrate	EPA 353.2_2_1993	
Nitrite	EPA 353.2_2_1993	
Orthophosphate	EPA 365.3_1978	
Phosphorus, total	EPA 365.3_1978	
Chromium VI	EPA 7196A_1_1992	
Total cyanide	EPA 9012A_1_1996	
Total organic halides (TOX)	EPA 9020B_2_1994	
Sulfide	EPA 9030B_2_1996	
Sulfide	EPA 9034_1996	3
pH	EPA 9040C_2002	
pH (non-aqueous)	EPA 9045C_3_1995	
Chloride	EPA 9056A_(11/00)	
Fluoride	EPA 9056A_(11/00)	
Nitrate	EPA 9056A_(11/00)	
Nitrite	EPA 9056A_(11/00)	
Sulfate	EPA 9056A_(11/00)	
Total organic carbon	EPA 9060	
Oil & Grease	EPA 9071 B_2_1999	
Sulfide	PSEP 1986 Color	
Solids, Total	SM 2540 B-97	

Matrix/Analyte	Method	Notes
Chemical Oxygen Demand (COD)	SM 5220 C-97	
Methyl Mercury	EPA 1630	
Aluminum	EPA 200.7_4.4_1994	
Antimony	EPA 200.7_4.4_1994	
Arsenic	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Boron	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Cobalt	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Lead	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Molybdenum	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Potassium	EPA 200.7_4.4_1994	
Selenium	EPA 200.7_4.4_1994	
Silica	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Strontium	EPA 200.7_4.4_1994	
Thallium	EPA 200.7_4.4_1994	
Tin	EPA 200.7_4.4_1994	
Titanium	EPA 200.7_4.4_1994	
Vanadium	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	

Matrix/Analyte	Method	Notes
Chromium	EPA 200.8_5.4_1994	
Cobalt	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Molybdenum	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	
Uranium	EPA 200.8_5.4_1994	4
Vanadium	EPA 200.8_5.4_1994	
Zinc	EPA 200.8_5.4_1994	
Aluminum	EPA 6010C_(2/07)	
Antimony	EPA 6010C_(2/07)	
Arsenic	EPA 6010C_(2/07)	
Barium	EPA 6010C_(2/07)	
Beryllium	EPA 6010C_(2/07)	
Boron	EPA 6010C_(2/07)	
Cadmium	EPA 6010C_(2/07)	
Calcium	EPA 6010C_(2/07)	
Chromium	EPA 6010C_(2/07)	
Cobalt	EPA 6010C_(2/07)	
Copper	EPA 6010C_(2/07)	
Iron	EPA 6010C_(2/07)	
Lead	EPA 6010C_(2/07)	
Magnesium	EPA 6010C_(2/07)	
Manganese	EPA 6010C_(2/07)	
Molybdenum	EPA 6010C_(2/07)	
Nickel	EPA 6010C_(2/07)	
Potassium	EPA 6010C_(2/07)	
Selenium	EPA 6010C_(2/07)	
Silver	EPA 6010C_(2/07)	
Sodium	EPA 6010C_(2/07)	
Thallium	EPA 6010C_(2/07)	
Vanadium	EPA 6010C_(2/07)	

Matrix/Analyte	Method	Notes
Zinc	EPA 6010C_(2/07)	
Aluminum	EPA 6020A_(2/07)	
Antimony	EPA 6020A_(2/07)	
Arsenic	EPA 6020A_(2/07)	
Barium	EPA 6020A_(2/07)	
Beryllium	EPA 6020A_(2/07)	
Cadmium	EPA 6020A_(2/07)	
Chromium	EPA 6020A_(2/07)	
Cobalt	EPA 6020A_(2/07)	
Copper	EPA 6020A_(2/07)	
Lead	EPA 6020A_(2/07)	
Manganese	EPA 6020A_(2/07)	
Molybdenum	EPA 6020A_(2/07)	
Nickel	EPA 6020A_(2/07)	
Selenium	EPA 6020A_(2/07)	
Silver	EPA 6020A_(2/07)	
Thallium	EPA 6020A_(2/07)	
Vanadium	EPA 6020A_(2/07)	
Zinc	EPA 6020A_(2/07)	
Antimony	EPA 7010 (2007)	
Arsenic	EPA 7010 (2007)	
Chromium	EPA 7010 (2007)	
Lead	EPA 7010 (2007)	
Selenium	EPA 7010 (2007)	
Thallium	EPA 7010 (2007)	
Arsenic	EPA 7062	
Chromium VI	EPA 7195	
Mercury, Liquid Waste	EPA 7470A_1_1994	3
Mercury, Solid Waste	EPA 7471B_(1/98)	
Selenium	EPA 7742	
Glycols	EPA 8015B_2_1996	
Benzene	EPA 8021B_2_1996	
Ethylbenzene	EPA 8021B_2_1996	
m+p-xylene	EPA 8021B_2_1996	
o-Xylene	EPA 8021B_2_1996	
Toluene	EPA 8021B_2_1996	

Matrix/Analyte	Method	Notes
Xylenes (total)	EPA 8021B_2_1996	
4,4'-DDD	EPA 8081B_(2/07)	
4,4'-DDE	EPA 8081B_(2/07)	
4,4'-DDT	EPA 8081B_(2/07)	
Alachlor	EPA 8081B_(2/07)	
Aldrin	EPA 8081B_(2/07)	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
alpha-Chlordane	EPA 8081B_(2/07)	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
Chlordane (tech.)	EPA 8081B_(2/07)	
delta-BHC	EPA 8081B_(2/07)	
Dieldrin	EPA 8081B_(2/07)	
Endosulfan I	EPA 8081B_(2/07)	
Endosulfan II	EPA 8081B_(2/07)	
Endosulfan sulfate	EPA 8081B_(2/07)	
Endrin	EPA 8081B_(2/07)	
Endrin aldehyde	EPA 8081B_(2/07)	
Endrin ketone	EPA 8081B_(2/07)	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B_(2/07)	
gamma-Chlordane	EPA 8081B_(2/07)	
Heptachlor	EPA 8081B_(2/07)	
Heptachlor epoxide	EPA 8081B_(2/07)	
Hexachlorobenzene	EPA 8081B_(2/07)	
Isodrin	EPA 8081B_(2/07)	
Methoxychlor	EPA 8081B_(2/07)	
Mirex	EPA 8081B_(2/07)	
Permethrin (total)	EPA 8081B_(2/07)	
Toxaphene (Chlorinated camphene)	EPA 8081B_(2/07)	
trans-Nonachlor	EPA 8081B_(2/07)	
Aroclor-1016 (PCB-1016)	EPA 8082A_(2/07)	
Aroclor-1221 (PCB-1221)	EPA 8082A_(2/07)	
Aroclor-1232 (PCB-1232)	EPA 8082A_(2/07)	
Aroclor-1242 (PCB-1242)	EPA 8082A_(2/07)	
Aroclor-1248 (PCB-1248)	EPA 8082A_(2/07)	
Aroclor-1254 (PCB-1254)	EPA 8082A_(2/07)	
Aroclor-1260 (PCB-1260)	EPA 8082A_(2/07)	

Matrix/Analyte	Method	Notes
Azinphos-methyl (Guthion)	EPA 8141B_(11/00)	
Bolstar (Sulprofos)	EPA 8141B_(11/00)	
Chlorpyrifos	EPA 8141B_(11/00)	
Coumaphos	EPA 8141B_(11/00)	
Demeton	EPA 8141B_(11/00)	
Demeton-o	EPA 8141B_(11/00)	
Demeton-s	EPA 8141B_(11/00)	
Diazinon	EPA 8141B_(11/00)	
Dichlorovos (DDVP, Dichlorvos)	EPA 8141B_(11/00)	
Dimethoate	EPA 8141B_(11/00)	
Disulfoton	EPA 8141B_(11/00)	
EPN	EPA 8141B_(11/00)	
Ethoprop	EPA 8141B_(11/00)	
Fensulfothion	EPA 8141B_(11/00)	
Fenthion	EPA 8141B_(11/00)	
Malathion	EPA 8141B_(11/00)	
Merphos	EPA 8141B_(11/00)	
Methyl parathion (Parathion, methyl)	EPA 8141B_(11/00)	
Mevinphos	EPA 8141B_(11/00)	
Naled	EPA 8141B_(11/00)	
Parathion, ethyl	EPA 8141B_(11/00)	
Phorate	EPA 8141B_(11/00)	
Ronnel	EPA 8141B_(11/00)	
Sulfotepp	EPA 8141B_(11/00)	
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8141B_(11/00)	
Tokuthion (Prothiophos)	EPA 8141B_(11/00)	
Trichloronate	EPA 8141B_(11/00)	
2,4,5-T	EPA 8151A_(1/98)	
2,4-D	EPA 8151A_(1/98)	
2,4-DB	EPA 8151A_(1/98)	
Dalapon	EPA 8151A_(1/98)	
Dicamba	EPA 8151A_(1/98)	
Dichlorprop	EPA 8151A_(1/98)	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A_(1/98)	
MCPA	EPA 8151A_(1/98)	
MCPP	EPA 8151A_(1/98)	

Matrix/Analyte	Method	Notes
Pentachlorophenol	EPA 8151A_(1/98)	
Silvex (2,4,5-TP)	EPA 8151A_(1/98)	
Acetaldehyde	EPA 8315A_1_1996	
Formaldehyde	EPA 8315A_1_1996	
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330B_(10/06)	
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330B_(10/06)	
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330B_(10/06)	
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330B_(10/06)	
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330B_(10/06)	
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330B_(10/06)	
2-Nitrotoluene	EPA 8330B_(10/06)	
3-Nitrotoluene	EPA 8330B_(10/06)	
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330B_(10/06)	
4-Nitrotoluene	EPA 8330B_(10/06)	
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330B_(10/06)	
Nitrobenzene	EPA 8330B_(10/06)	
Nitroglycerin	EPA 8330B_(10/06)	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (	EPA 8330B_(10/06)	
Pentaerythritoltetranitrate (PETN)	EPA 8330B_(10/06)	
Picramic Acid	EPA 8330B_(10/06)	
Picric Acid	EPA 8330B_(10/06)	
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330B_(10/06)	
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330B_(10/06)	
Organo-tins	Krone 1988	
Nitroguanidine	LCP-NITG	
OTTO Fuel	SOC-OTTO	
Total Pet Hydrocarbons - Diesel	WDOE NWTPH-Dx_(1997)	
Total Pet Hydrocarbons - Gasoline	WDOE NWTPH-Gx_(1997)	
1,1,1,2-Tetrachloroethane	EPA 8260C_(8/06)	
1,1,1-Trichloro-2,2,2-trifluoroethane	EPA 8260C_(8/06)	
1,1,1-Trichloroethane	EPA 8260C_(8/06)	
1,1,2,2-Tetrachloroethane	EPA 8260C_(8/06)	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260C_(8/06)	
1,1,2-Trichloroethane	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
1,1-Dichloroethane	EPA 8260C_(8/06)	
1,1-Dichloroethylene	EPA 8260C_(8/06)	
1,1-Dichloropropene	EPA 8260C_(8/06)	
1,2,3-Trichlorobenzene	EPA 8260C_(8/06)	
1,2,3-Trichloropropane	EPA 8260C_(8/06)	
1,2,3-Trimethylbenzene	EPA 8260C_(8/06)	
1,2,4-Trichlorobenzene	EPA 8260C_(8/06)	
1,2,4-Trimethylbenzene	EPA 8260C_(8/06)	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260C_(8/06)	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260C_(8/06)	
1,2-Dichlorobenzene	EPA 8260C_(8/06)	
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260C_(8/06)	
1,2-Dichloropropane	EPA 8260C_(8/06)	
1,3,5-Trimethylbenzene	EPA 8260C_(8/06)	
1,3-Dichlorobenzene	EPA 8260C_(8/06)	
1,3-Dichloropropane	EPA 8260C_(8/06)	
1,3-Dichloropropene	EPA 8260C_(8/06)	
1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
1,4-Dichlorobenzene	EPA 8260C_(8/06)	
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260C_(8/06)	
1-Chlorohexane	EPA 8260C_(8/06)	
2,2-Dichloro-1,1,1-trifluoroethane (Freon 123)	EPA 8260C_(8/06)	
2,2-Dichloropropane	EPA 8260C_(8/06)	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260C_(8/06)	
2-Chloroethyl vinyl ether	EPA 8260C_(8/06)	
2-Chlorotoluene	EPA 8260C_(8/06)	
2-Hexanone	EPA 8260C_(8/06)	
2-Methylpentane (Isohexane)	EPA 8260C_(8/06)	
2-Nitropropane	EPA 8260C_(8/06)	
3-Methylpentane	EPA 8260C_(8/06)	
4-Bromofluorobenzene	EPA 8260C_(8/06)	
4-Chlorotoluene	EPA 8260C_(8/06)	
4-Isopropyltoluene (p-Cymene)	EPA 8260C_(8/06)	
4-Methyl-2-pentanone (MIBK)	EPA 8260C_(8/06)	
Acetone	EPA 8260C_(8/06)	
Acetonitrile	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
Acrolein (Propenal)	EPA 8260C_(8/06)	
Acrylonitrile	EPA 8260C_(8/06)	
Allyl chloride (3-Chloropropene)	EPA 8260C_(8/06)	
Benzene	EPA 8260C_(8/06)	
Bromobenzene	EPA 8260C_(8/06)	
Bromochloromethane	EPA 8260C_(8/06)	
Bromodichloromethane	EPA 8260C_(8/06)	
Bromoform	EPA 8260C_(8/06)	
Carbon disulfide	EPA 8260C_(8/06)	
Carbon tetrachloride	EPA 8260C_(8/06)	
Chlorobenzene	EPA 8260C_(8/06)	
Chlorodibromomethane	EPA 8260C_(8/06)	
Chloroethane (Ethyl chloride)	EPA 8260C_(8/06)	
Chloroform	EPA 8260C_(8/06)	
Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260C_(8/06)	
cis & trans-1,2-Dichloroethene	EPA 8260C_(8/06)	
cis-1,2-Dichloroethylene	EPA 8260C_(8/06)	
cis-1,3-Dichloropropene	EPA 8260C_(8/06)	
cis-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
Cyclohexane	EPA 8260C_(8/06)	
Dibromochloropropane	EPA 8260C_(8/06)	
Dibromofluoromethane	EPA 8260C_(8/06)	
Dibromomethane (Methylene bromide)	EPA 8260C_(8/06)	
Dichlorodifluoromethane (Freon-12)	EPA 8260C_(8/06)	
Dichlorofluoromethane (Freon 21)	EPA 8260C_(8/06)	
Diethyl ether	EPA 8260C_(8/06)	
Ethanol	EPA 8260C_(8/06)	
Ethyl acetate	EPA 8260C_(8/06)	
Ethyl acrylate	EPA 8260C_(8/06)	
Ethyl methacrylate	EPA 8260C_(8/06)	
Ethyl tert-Butyl alcohol	EPA 8260C_(8/06)	
Ethylbenzene	EPA 8260C_(8/06)	
Ethylene oxide	EPA 8260C_(8/06)	
Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropan	EPA 8260C_(8/06)	
Hexachlorobutadiene	EPA 8260C_(8/06)	
Iodomethane (Methyl iodide)	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260C_(8/06)	
Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260C_(8/06)	
Isopropylbenzene	EPA 8260C_(8/06)	
m+p-xylene	EPA 8260C_(8/06)	
Methacrylonitrile	EPA 8260C_(8/06)	
Methyl acetate	EPA 8260C_(8/06)	
Methyl acrylate	EPA 8260C_(8/06)	
Methyl bromide (Bromomethane)	EPA 8260C_(8/06)	
Methyl chloride (Chloromethane)	EPA 8260C_(8/06)	
Methyl methacrylate	EPA 8260C_(8/06)	
Methyl tert-butyl ether (MTBE)	EPA 8260C_(8/06)	
Methylcyclohexane	EPA 8260C_(8/06)	
Methylcyclopentane	EPA 8260C_(8/06)	
Methylene chloride (Dichloromethane)	EPA 8260C_(8/06)	
m-Xylene	EPA 8260C_(8/06)	
Naphthalene	EPA 8260C_(8/06)	
n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260C_(8/06)	
n-Butylbenzene	EPA 8260C_(8/06)	
n-Heptane	EPA 8260C_(8/06)	
n-Hexane	EPA 8260C_(8/06)	
n-Octane	EPA 8260C_(8/06)	
n-Propanol (1-Propanol)	EPA 8260C_(8/06)	
n-Propylbenzene	EPA 8260C_(8/06)	
o-Xylene	EPA 8260C_(8/06)	
Propionitrile (Ethyl cyanide)	EPA 8260C_(8/06)	
p-Xylene	EPA 8260C_(8/06)	
sec-Butylbenzene	EPA 8260C_(8/06)	
Styrene	EPA 8260C_(8/06)	
tert-amylmethylether (TAME)	EPA 8260C_(8/06)	
tert-Butyl alcohol	EPA 8260C_(8/06)	
tert-Butylbenzene	EPA 8260C_(8/06)	
Tetrachloroethylene (Perchloroethylene)	EPA 8260C_(8/06)	
Tetrahydrofuran (THF)	EPA 8260C_(8/06)	
Toluene	EPA 8260C_(8/06)	
trans-1,2-Dichloroethylene	EPA 8260C_(8/06)	
trans-1,3-Dichloropropylene	EPA 8260C_(8/06)	

Matrix/Analyte	Method	Notes
trans-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	
Trichloroethene (Trichloroethylene)	EPA 8260C_(8/06)	
Trichlorofluoromethane (Freon 11)	EPA 8260C_(8/06)	
Vinyl acetate	EPA 8260C_(8/06)	
Vinyl chloride	EPA 8260C_(8/06)	
Xylenes (total)	EPA 8260C_(8/06)	
1,2,4,5-Tetrachlorobenzene	EPA 8270D_(2/07)	
1,2,4-Trichlorobenzene	EPA 8270D_(2/07)	
1,2-Dichlorobenzene	EPA 8270D_(2/07)	
1,2-Diphenylhydrazine	EPA 8270D_(2/07)	
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D_(2/07)	
1,3-Dichlorobenzene	EPA 8270D_(2/07)	
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D_(2/07)	
1,4-Dichlorobenzene	EPA 8270D_(2/07)	
1,4-Naphthoquinone	EPA 8270D_(2/07)	
1,4-Phenylenediamine	EPA 8270D_(2/07)	
1-Chloronaphthalene	EPA 8270D_(2/07)	
1-Naphthylamine	EPA 8270D_(2/07)	
2,3,4,6-Tetrachlorophenol	EPA 8270D_(2/07)	
2,4,5-Trichlorophenol	EPA 8270D_(2/07)	
2,4,6-Trichlorophenol	EPA 8270D_(2/07)	
2,4-Dichlorophenol	EPA 8270D_(2/07)	
2,4-Dimethylphenol	EPA 8270D_(2/07)	
2,4-Dinitrophenol	EPA 8270D_(2/07)	
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D_(2/07)	
2,6-Dichlorophenol	EPA 8270D_(2/07)	
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D_(2/07)	
2-Acetylaminofluorene	EPA 8270D_(2/07)	
2-Chloronaphthalene	EPA 8270D_(2/07)	
2-Chlorophenol	EPA 8270D_(2/07)	
2-Methylnaphthalene	EPA 8270D_(2/07)	
2-Methylphenol (o-Cresol)	EPA 8270D_(2/07)	
2-Naphthylamine	EPA 8270D_(2/07)	
2-Nitroaniline	EPA 8270D_(2/07)	
2-Nitrophenol	EPA 8270D_(2/07)	
2-Picoline (2-Methylpyridine)	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
3,3'-Dichlorobenzidine	EPA 8270D_(2/07)	
3,3'-Dimethylbenzidine	EPA 8270D_(2/07)	
3-Methylcholanthrene	EPA 8270D_(2/07)	
3-Methylphenol (m-Cresol)	EPA 8270D_(2/07)	
3-Nitroaniline	EPA 8270D_(2/07)	
4,4'-Methylenebis(2-chloroaniline)	EPA 8270D_(2/07)	
4,6-Dinitro-2-methylphenol	EPA 8270D_(2/07)	
4-Aminobiphenyl	EPA 8270D_(2/07)	
4-Bromophenyl phenyl ether	EPA 8270D_(2/07)	
4-Chloro-3-methylphenol	EPA 8270D_(2/07)	
4-Chloroaniline	EPA 8270D_(2/07)	
4-Chlorophenyl phenylether	EPA 8270D_(2/07)	
4-Methylphenol (p-Cresol)	EPA 8270D_(2/07)	
4-Nitroaniline	EPA 8270D_(2/07)	
4-Nitrophenol	EPA 8270D_(2/07)	
5-Nitro-o-toluidine	EPA 8270D_(2/07)	
7,12-Dimethylbenz(a) anthracene	EPA 8270D_(2/07)	
a,a-Dimethylphenethylamine	EPA 8270D_(2/07)	
Acenaphthene	EPA 8270D_(2/07)	
Acenaphthylene	EPA 8270D_(2/07)	
Acetophenone	EPA 8270D_(2/07)	
Aniline	EPA 8270D_(2/07)	
Anthracene	EPA 8270D_(2/07)	
Aramite	EPA 8270D_(2/07)	
Atrazine	EPA 8270D_(2/07)	
Benzidine	EPA 8270D_(2/07)	
Benzo(a)anthracene	EPA 8270D_(2/07)	
Benzo(a)pyrene	EPA 8270D_(2/07)	
Benzo(g,h,i)perylene	EPA 8270D_(2/07)	
Benzo(k)fluoranthene	EPA 8270D_(2/07)	
Benzo[b]fluoranthene	EPA 8270D_(2/07)	
Benzoic acid	EPA 8270D_(2/07)	
Benzyl alcohol	EPA 8270D_(2/07)	
Biphenyl	EPA 8270D_(2/07)	
bis(2-Chloroethoxy)methane	EPA 8270D_(2/07)	
bis(2-Chloroethyl) ether	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
bis(2-Chloroisopropyl) ether	EPA 8270D_(2/07)	
Butyl benzyl phthalate	EPA 8270D_(2/07)	
Carbazole	EPA 8270D_(2/07)	
Chlorobenzilate	EPA 8270D_(2/07)	
Chrysene	EPA 8270D_(2/07)	
Di(2-ethylhexyl)phthalate	EPA 8270D_(2/07)	
Diallate	EPA 8270D_(2/07)	
Dibenzofuran	EPA 8270D_(2/07)	
Diethyl phthalate	EPA 8270D_(2/07)	
Dimethoate	EPA 8270D_(2/07)	
Dimethyl phthalate	EPA 8270D_(2/07)	
Di-n-butyl phthalate	EPA 8270D_(2/07)	
Di-n-octyl phthalate	EPA 8270D_(2/07)	
Diphenylamine	EPA 8270D_(2/07)	
Famphur	EPA 8270D_(2/07)	
Fluoranthene	EPA 8270D_(2/07)	
Fluorene	EPA 8270D_(2/07)	
Hexachlorobutadiene	EPA 8270D_(2/07)	
Hexachlorocyclopentadiene	EPA 8270D_(2/07)	
Hexachloroethane	EPA 8270D_(2/07)	
Hexachlorophene	EPA 8270D_(2/07)	
Hexachloropropene	EPA 8270D_(2/07)	
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07)	
Isodrin	EPA 8270D_(2/07)	
Isophorone	EPA 8270D_(2/07)	
Isosafrole	EPA 8270D_(2/07)	
Kepone	EPA 8270D_(2/07)	
Malathion	EPA 8270D_(2/07)	
Methapyrilene	EPA 8270D_(2/07)	
Methyl methanesulfonate	EPA 8270D_(2/07)	
Methyl parathion (Parathion, methyl)	EPA 8270D_(2/07)	
Naphthalene	EPA 8270D_(2/07)	
Nitrobenzene	EPA 8270D_(2/07)	
Nitroquinoline-1-oxide	EPA 8270D_(2/07)	
N-Nitrosodiethylamine	EPA 8270D_(2/07)	
N-Nitrosodimethylamine	EPA 8270D_(2/07)	

Matrix/Analyte	Method	Notes
N-Nitroso-di-n-butylamine	EPA 8270D_(2/07)	
N-Nitroso-di-n-propylamine	EPA 8270D_(2/07)	
N-Nitrosodiphenylamine	EPA 8270D_(2/07)	
N-Nitrosomethylethalamine	EPA 8270D_(2/07)	
N-Nitrosomorpholine	EPA 8270D_(2/07)	
N-Nitrosopiperidine	EPA 8270D_(2/07)	
N-Nitrosopyrrolidine	EPA 8270D_(2/07)	
o,o,o-Triethyl phosphorothioate	EPA 8270D_(2/07)	
o-Toluidine	EPA 8270D_(2/07)	
Parathion	EPA 8270D_(2/07)	
p-Benzoquinone	EPA 8270D_(2/07)	
Pentachlorobenzene	EPA 8270D_(2/07)	
Pentachloronitrobenzene	EPA 8270D_(2/07)	
Pentachlorophenol	EPA 8270D_(2/07)	
Phenacetin	EPA 8270D_(2/07)	
Phenanthrene	EPA 8270D_(2/07)	
Phenol	EPA 8270D_(2/07)	
Phorate	EPA 8270D_(2/07)	
Pronamide (Kerb)	EPA 8270D_(2/07)	
Pyrene	EPA 8270D_(2/07)	
Pyridine	EPA 8270D_(2/07)	
Safrole	EPA 8270D_(2/07)	
1-Methylnaphthalene	EPA 8270D_(2/07) SIM	
Acenaphthene	EPA 8270D_(2/07) SIM	
Acenaphthylene	EPA 8270D_(2/07) SIM	
Anthracene	EPA 8270D_(2/07) SIM	
Benzo(a)anthracene	EPA 8270D_(2/07) SIM	
Benzo(a)pyrene	EPA 8270D_(2/07) SIM	
Benzo(g,h,i)perylene	EPA 8270D_(2/07) SIM	
Benzo(k)fluoranthene	EPA 8270D_(2/07) SIM	
Benzo[b]fluoranthene	EPA 8270D_(2/07) SIM	
Chrysene	EPA 8270D_(2/07) SIM	
Dibenz(a,h) anthracene	EPA 8270D_(2/07) SIM	
Fluoranthene	EPA 8270D_(2/07) SIM	
Fluorene	EPA 8270D_(2/07) SIM	
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07) SIM	

Matrix/Analyte	Method	Notes
Naphthalene	EPA 8270D_(2/07) SIM	
Pentachlorophenol	EPA 8270D_(2/07) SIM	
Phenanthrene	EPA 8270D_(2/07) SIM	
Pyrene	EPA 8270D_(2/07) SIM	
3-Hydroxycarbofuran	EPA 8321B_(1/98)	
Aldicarb (Temik)	EPA 8321B_(1/98)	
Aldicarb sulfone	EPA 8321B_(1/98)	
Aldicarb sulfoxide	EPA 8321B_(1/98)	
Aminocarb	EPA 8321B_(1/98)	
Barban	EPA 8321B_(1/98)	
Benomyl	EPA 8321B_(1/98)	
Bromacil	EPA 8321B_(1/98)	
Carbaryl (Sevin)	EPA 8321B_(1/98)	
Carbofuran (Furaden)	EPA 8321B_(1/98)	
Chloropropham	EPA 8321B_(1/98)	
Chloroxuron	EPA 8321B_(1/98)	
Diuron	EPA 8321B_(1/98)	
Fenuron	EPA 8321B_(1/98)	
Fluometuron	EPA 8321B_(1/98)	
Linuron (Lorox)	EPA 8321B_(1/98)	
Methiocarb (Mesurol)	EPA 8321B_(1/98)	
Methomyl (Lannate)	EPA 8321B_(1/98)	
Mexacarbate	EPA 8321B_(1/98)	
Monuron	EPA 8321B_(1/98)	
Neburon	EPA 8321B_(1/98)	
Oxamyl	EPA 8321B_(1/98)	
Propham	EPA 8321B_(1/98)	
Propoxur (Baygon)	EPA 8321B_(1/98)	
Prosulfocarb	EPA 8321B_(1/98)	
Siduron	EPA 8321B_(1/98)	
Tebuthiuron	EPA 8321B_(1/98)	
Fecal coliform-count	SM 9221 B (LTB) + E1 (EC) + C MPN	5
Particle Size Distribution	ASTM D 422	
Ignitability	EPA 1020A_1_1992	
Corrosivity	EPA 1110A-02	

Matrix/Analyte	Method	Notes
Particle Size Distribution (Sed)	PSEP 1986 Wet Sieve	

Accredited Parameter Note Detail

(1) Accreditation does not apply to NPDES testing due to the sample holding time requirment for pH. (2) Method not approved for NPDES testing. (3) Accrediltation is limited to liquid matrix only. (4) Provisional accreditation pending submittal of additional, acceptable Proficiency Testing (PT) results (WAC 173-50-110). (5) Interim accreditation pending the successful completion of an on-site audit to verify method capabilities (WAC 173-50-100). (6) Colilert accreditation includes the use of both Colilert 24 and Colilert 18 formulations.

07/26/2013

Authentication Signature
Alan D. Rue, Lab Accreditation Unit Supervisor

Date

Parameters Not Accredited

ALS Environmental - Kelso

Kelso, WA

Analyte	Method	Notes	Matrix
2,4-Dichlorophenol	EPA 1653_A_1997	a	N
2,6-Dichlorophenol	EPA 1653_A_1997	a	N
2,6-Dichlorosyringaldehyde	EPA 1653_A_1997	a	N
2-Chlorosyringaldehyde	EPA 1653_A_1997	a	N
3,4-Dichlorocatechol	EPA 1653_A_1997	a	N
3,4-Dichloroguaiacol	EPA 1653_A_1997	a	N
3,6-Dichlorocatechol	EPA 1653_A_1997	a	N
4,5-Dichloro-2-methoxyphenol	EPA 1653_A_1997	a	N
4,5-Dichlorocatechol	EPA 1653_A_1997	a	N
4,6-Dichloroguaiacol	EPA 1653_A_1997	a	N
4-Chlorocatechol	EPA 1653_A_1997	a	N
4-Chloroguaiacol	EPA 1653_A_1997	a	N
4-Chlorophenol	EPA 1653_A_1997	a	N
5,6-Dichlorovanillin	EPA 1653_A_1997	a	N
5-Chlorovanillin	EPA 1653_A_1997	a	N
6-Chlorovanillin	EPA 1653_A_1997	a	N
1,7-Dimethylxanthine	EPA 1694	a	N
4-Epianhydrochlortetracycline (EACTC)	EPA 1694	a	N
4-Epianhydrotetracycline (EATC)	EPA 1694	a	N
4-Epichlortetracycline (ECTC)	EPA 1694	a	N
4-Epioxytetracycline (EOTC)	EPA 1694	a	N
4-Epitetracycline (ETC)	EPA 1694	a	N
Albuterol	EPA 1694	a	N
Ampicillin	EPA 1694	a	N
Anhydrochlortetracycline (ACTC)	EPA 1694	a	N
Anhydrotetracycline (ATC)	EPA 1694	a	N
Azithromycin	EPA 1694	a	N
Carbadox	EPA 1694	a	N
Carbamazepine	EPA 1694	a	N
Cefotaxime	EPA 1694	a	N
Chlortetracycline (CTC)	EPA 1694	a	N
Cimetidine	EPA 1694	a	N
Ciprofloxacin	EPA 1694	a	N
Clarithromycin	EPA 1694	a	N
Clinafloxacin	EPA 1694	a	N
Cloxacillin	EPA 1694	a	N
Codeine	EPA 1694	a	N
Cotinine	EPA 1694	a	N
Dehydronifedipine	EPA 1694	a	N
Demeclocycline	EPA 1694	a	N
Digoxigenin	EPA 1694	a	N

Analyte	Method	Notes	Matrix
Digoxin	EPA 1694	a	N
Diltiazem	EPA 1694	a	N
Diphenhydramine	EPA 1694	a	N
Doxycycline	EPA 1694	a	N
Enrofloxacin	EPA 1694	a	N
Erythromycin	EPA 1694	a	N
Erythromycin anhydrate	EPA 1694	a	N
Flumequine	EPA 1694	a	N
Isochlortetracycline (ICTC)	EPA 1694	a	N
Lincomycin	EPA 1694	a	N
Lomefloxacin	EPA 1694	a	N
Metformin	EPA 1694	a	N
Miconazole	EPA 1694	a	N
Minocycline	EPA 1694	a	N
Norfloxacin	EPA 1694	a	N
Norgestimate	EPA 1694	a	N
Ofloxacin	EPA 1694	a	N
Ormetoprim	EPA 1694	a	N
Oxacillin	EPA 1694	a	N
Oxolinic acid	EPA 1694	a	N
Oxytetracycline (OTC)	EPA 1694	a	N
Penicillin G	EPA 1694	a	N
Penicillin V	EPA 1694	a	N
Ranitidine	EPA 1694	a	N
Roxithromycin	EPA 1694	a	N
Sarafloxacin	EPA 1694	a	N
Sulfachloropyridazine	EPA 1694	a	N
Sulfadiazine	EPA 1694	a	N
Sulfadimethoxine	EPA 1694	a	N
Sulfamerazine	EPA 1694	a	N
Sulfamethazine	EPA 1694	a	N
Sulfamethizole	EPA 1694	a	N
Sulfamethoxazole	EPA 1694	a	N
Sulfanilamide	EPA 1694	a	N
Sulfathiazole	EPA 1694	a	N
Tetracycline (TC)	EPA 1694	a	N
Thiabendazole	EPA 1694	a	N
Triclocarban	EPA 1694	a	N
Tylosin	EPA 1694	a	N
Virginiamycin	EPA 1694	a	N
Warfarin	EPA 1694	a	N
Ammonia as N	EPA 350.1_2_1993	a	N
Surfactants - MBAS	EPA 425.1_1971	a	N
2,4'-DDD	EPA 508.1_2_1995	a	D
Alachlor	EPA 508.1_2_1995	a	D
Atrazine	EPA 508.1_2_1995	a	D
Butachlor	EPA 508.1_2_1995	a	D
Chlorobenzilate	EPA 508.1_2_1995	a	D

Analyte	Method	Notes	Matrix
Chloroneb	EPA 508.1_2_1995	a	D
Chlorothalonil	EPA 508.1_2_1995	a	D
cis-Permethrin	EPA 508.1_2_1995	a	D
Cyanazine	EPA 508.1_2_1995	a	D
Dacthal (DCPA)	EPA 508.1_2_1995	a	D
Decachlorobiphenyl	EPA 508.1_2_1995	a	D
Etridiazole	EPA 508.1_2_1995	a	D
Hexachlorobenzene	EPA 508.1_2_1995	a	D
Hexachlorocyclopentadiene	EPA 508.1_2_1995	a	D
Metolachlor	EPA 508.1_2_1995	a	D
Metribuzin	EPA 508.1_2_1995	a	D
Propachlor (Ramrod)	EPA 508.1_2_1995	a	D
Simazine	EPA 508.1_2_1995	a	D
trans Permethrin	EPA 508.1_2_1995	a	D
Trifluralin (Treflan)	EPA 508.1_2_1995	a	D
1-Chlorobutane	EPA 524.2_4.1_1995	a	D
2-Nitropropane	EPA 524.2_4.1_1995	a	D
Acrolein (Propenal)	EPA 524.2_4.1_1995	a	D
Acrylonitrile	EPA 524.2_4.1_1995	a	D
Allyl chloride (3-Chloropropene)	EPA 524.2_4.1_1995	a	D
Chloroacetonitrile	EPA 524.2_4.1_1995	a	D
Diethyl ether	EPA 524.2_4.1_1995	a	D
Ethyl methacrylate	EPA 524.2_4.1_1995	a	D
Hexachloroethane	EPA 524.2_4.1_1995	a	D
Methacrylonitrile	EPA 524.2_4.1_1995	a	D
Methyl methacrylate	EPA 524.2_4.1_1995	a	D
Nitrobenzene	EPA 524.2_4.1_1995	a	D
Pentachloroethane	EPA 524.2_4.1_1995	a	D
Propionitrile (Ethyl cyanide)	EPA 524.2_4.1_1995	a	D
Tetrahydrofuran (THF)	EPA 524.2_4.1_1995	a	D
trans-1,4-Dichloro-2-butene	EPA 524.2_4.1_1995	a	D
2,2', 3,3', 4,4', 5-Heptachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2', 3,3', 4,4'5,5'-Octachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2', 4,5'-Tetrachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2',3,4,4',5',6-Heptachlorobiphenyl	EPA 525.2_2_1995	a	D
2,2',3,4,5'-Pentachlorobiphenyl	EPA 525.2_2_1995	a	D
2,3-Dichlorobiphenyl	EPA 525.2_2_1995	a	D
2,4',5-Trichlorobiphenyl	EPA 525.2_2_1995	a	D
4,4'-DDD	EPA 525.2_2_1995	a	D
4,4'-DDE	EPA 525.2_2_1995	a	D
4,4'-DDT	EPA 525.2_2_1995	a	D
Aldrin	EPA 525.2_2_1995	a	D
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
alpha-Chlordane	EPA 525.2_2_1995	a	D
Aroclor-1016 (PCB-1016)	EPA 525.2_2_1995	a	D
Aroclor-1221 (PCB-1221)	EPA 525.2_2_1995	a	D
Aroclor-1232 (PCB-1232)	EPA 525.2_2_1995	a	D
Aroclor-1242 (PCB-1242)	EPA 525.2_2_1995	a	D

Analyte	Method	Notes	Matrix
Aroclor-1248 (PCB-1248)	EPA 525.2_2_1995	a	D
Aroclor-1254 (PCB-1254)	EPA 525.2_2_1995	a	D
Aroclor-1260 (PCB-1260)	EPA 525.2_2_1995	a	D
beta-BHC (beta-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
Chlordane (tech.)	EPA 525.2_2_1995	a	D
Chlorpyrifos	EPA 525.2_2_1995	a	D
Decachlorobiphenyl	EPA 525.2_2_1995	a	D
delta-BHC	EPA 525.2_2_1995	a	D
Dieldrin	EPA 525.2_2_1995	a	D
Disulfoton	EPA 525.2_2_1995	a	D
Endosulfan I	EPA 525.2_2_1995	a	D
Endosulfan II	EPA 525.2_2_1995	a	D
Endosulfan sulfate	EPA 525.2_2_1995	a	D
Endrin	EPA 525.2_2_1995	a	D
Endrin aldehyde	EPA 525.2_2_1995	a	D
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 525.2_2_1995	a	D
gamma-Chlordane	EPA 525.2_2_1995	a	D
Heptachlor	EPA 525.2_2_1995	a	D
Heptachlor epoxide	EPA 525.2_2_1995	a	D
Hexachlorocyclopentadiene	EPA 525.2_2_1995	a	D
Methoxychlor	EPA 525.2_2_1995	a	D
Methyl paraoxon	EPA 525.2_2_1995	a	D
Pentachlorophenol	EPA 525.2_2_1995	a	D
Stirolos	EPA 525.2_2_1995	a	D
Toxaphene (Chlorinated camphene)	EPA 525.2_2_1995	a	D
Aldicarb (Temik)	EPA 531.1_3.1_1995	a	D
Aldicarb sulfone	EPA 531.1_3.1_1995	a	D
Aldicarb sulfoxide	EPA 531.1_3.1_1995	a	D
Carbaryl (Sevin)	EPA 531.1_3.1_1995	a	D
Carbofuran (Furaden)	EPA 531.1_3.1_1995	a	D
Methiocarb (Mesurol)	EPA 531.1_3.1_1995	a	D
Methomyl (Lannate)	EPA 531.1_3.1_1995	a	D
n-Methylcarbamates	EPA 531.1_3.1_1995	a	D
Oxamyl	EPA 531.1_3.1_1995	a	D
Propoxur (Baygon)	EPA 531.1_3.1_1995	a	D
Glyphosate	EPA 547_1990	a	D
Dalapon	EPA 552.2_1_1995	a	D
1,2,3-Trichlorobenzene	EPA 624	a	N
1,2,4-Trichlorobenzene	EPA 624	a	N
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 624	a	N
2-Chloro-1,3-butadiene (Chloroprene)	EPA 624	a	N
2-Picoline (2-Methylpyridine)	EPA 624	a	N
Dibromochloropropane	EPA 624	a	N
Diethyl ether	EPA 624	a	N
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 624	a	N
Naphthalene	EPA 624	a	N
Nitrobenzene	EPA 624	a	N
p-Dioxane	EPA 624	a	N

Analyte	Method	Notes	Matrix
p-Isopropyltoluene	EPA 624	a	N
1,2-Dichlorobenzene	EPA 625	a	N
1,3-Dichlorobenzene	EPA 625	a	N
1,4-Dichlorobenzene	EPA 625	a	N
1,4-Naphthoquinone	EPA 625	a	N
1-Chloronaphthalene	EPA 625	a	N
1-Naphthylamine	EPA 625	a	N
2,3,6-Trichlorophenol (4C)	EPA 625	a	N
2-Naphthylamine	EPA 625	a	N
4,4'-DDD	EPA 625	a	N
4,4'-DDE	EPA 625	a	N
4,4'-DDT	EPA 625	a	N
4-Chlorophenol	EPA 625	a	N
Aldrin	EPA 625	a	N
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 625	a	N
alpha-Terpineol	EPA 625	a	N
beta-BHC (beta-Hexachlorocyclohexane)	EPA 625	a	N
Chlordane (tech.)	EPA 625	a	N
delta-BHC	EPA 625	a	N
Di(2-ethylhexyl)adipate	EPA 625	a	N
Dieldrin	EPA 625	a	N
Endosulfan I	EPA 625	a	N
Endosulfan II	EPA 625	a	N
Endosulfan sulfate	EPA 625	a	N
Endrin	EPA 625	a	N
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 625	a	N
Heptachlor	EPA 625	a	N
Heptachlor epoxide	EPA 625	a	N
Hexachloropropene	EPA 625	a	N
Methoxychlor	EPA 625	a	N
n-Decane	EPA 625	a	N
n-Docosane	EPA 625	a	N
n-Dodecane	EPA 625	a	N
n-Eicosane	EPA 625	a	N
n-Hexadecane	EPA 625	a	N
N-Nitrosodiethylamine	EPA 625	a	N
N-Nitroso-di-n-butylamine	EPA 625	a	N
n-Octadecane	EPA 625	a	N
n-Tetradecane	EPA 625	a	N
Pentachloroethane	EPA 625	a	N
Toxaphene (Chlorinated camphene)	EPA 625	a	N
Copper	EPA 7010 (2007)	b	S
Arsenic	EPA 7060A (1994)	a	S
Chromium VI	EPA 7191	a	S
Lead	EPA 7420	a	S
Lead	EPA 7421	a	S
Selenium	EPA 7740	a	S
Thallium	EPA 7841	a	S

Analyte	Method	Notes	Matrix
Captafol	EPA 8081B_(2/07)	a	S
Chlorobenzilate	EPA 8081B_(2/07)	a	S
Chloroneb	EPA 8081B_(2/07)	a	S
Chloropropylate	EPA 8081B_(2/07)	a	S
Chlorothalonil	EPA 8081B_(2/07)	a	S
Dacthal (DCPA)	EPA 8081B_(2/07)	a	S
Diallate	EPA 8081B_(2/07)	a	S
Dichlone	EPA 8081B_(2/07)	a	S
Dicofol	EPA 8081B_(2/07)	a	S
Etridiazole	EPA 8081B_(2/07)	a	S
Halowax-1000	EPA 8081B_(2/07)	a	S
Halowax-1001	EPA 8081B_(2/07)	a	S
Halowax-1013	EPA 8081B_(2/07)	a	S
Halowax-1014	EPA 8081B_(2/07)	a	S
Halowax-1051	EPA 8081B_(2/07)	a	S
Halowax-1099	EPA 8081B_(2/07)	a	S
Hexachlorocyclopentadiene	EPA 8081B_(2/07)	a	S
Nitrofen	EPA 8081B_(2/07)	a	S
Perthane	EPA 8081B_(2/07)	a	S
Propachlor (Ramrod)	EPA 8081B_(2/07)	a	S
Strobane	EPA 8081B_(2/07)	a	S
Trifluralin (Treflan)	EPA 8081B_(2/07)	a	S
1,2-Phenylenediamine (o-Phenylenediamine)	EPA 8141B_(11/00)	a	S
Aspon	EPA 8141B_(11/00)	a	S
Atrazine	EPA 8141B_(11/00)	a	S
Azinphos-ethyl (Ethyl guthion)	EPA 8141B_(11/00)	a	S
Bendiocarb	EPA 8141B_(11/00)	a	S
Butylate	EPA 8141B_(11/00)	a	S
Carbophenothion	EPA 8141B_(11/00)	a	S
Chlorfenvinphos	EPA 8141B_(11/00)	a	S
Chlorpyrifos methyl	EPA 8141B_(11/00)	a	S
Crotoxyphos	EPA 8141B_(11/00)	a	S
Dichlorofenthion	EPA 8141B_(11/00)	a	S
Dicrotophos	EPA 8141B_(11/00)	a	S
Dioxathion	EPA 8141B_(11/00)	a	S
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 8141B_(11/00)	a	S
Ethion	EPA 8141B_(11/00)	a	S
Famphur	EPA 8141B_(11/00)	a	S
Fenitrothion	EPA 8141B_(11/00)	a	S
Fonophos	EPA 8141B_(11/00)	a	S
Hexamethylphosphoramide (HMPA)	EPA 8141B_(11/00)	a	S
Leptophos	EPA 8141B_(11/00)	a	S
Methiocarb (Mesurol)	EPA 8141B_(11/00)	a	S
Molinate	EPA 8141B_(11/00)	a	S
Monocrotophos	EPA 8141B_(11/00)	a	S
Pebulate	EPA 8141B_(11/00)	a	S
Phosmet (Imidan)	EPA 8141B_(11/00)	a	S
Phosphamidon	EPA 8141B_(11/00)	a	S

Analyte	Method	Notes	Matrix
Propham	EPA 8141B_(11/00)	a	S
Prosulfocarb	EPA 8141B_(11/00)	a	S
Simazine	EPA 8141B_(11/00)	a	S
Terbufos	EPA 8141B_(11/00)	a	S
Tetraethyl pyrophosphate (TEPP)	EPA 8141B_(11/00)	a	S
Thionazin (Zinophos)	EPA 8141B_(11/00)	a	S
Triallate	EPA 8141B_(11/00)	a	S
Trichlorfon	EPA 8141B_(11/00)	a	S
Tri-o-cresylphosphate (TOCP)	EPA 8141B_(11/00)	a	S
3,5-Dichlorobenzoic acid	EPA 8151A_(1/98)	a	S
4-Nitrophenol	EPA 8151A_(1/98)	a	S
5-Hydroxydicamba	EPA 8151A_(1/98)	a	S
Acifluorfen	EPA 8151A_(1/98)	a	S
Bentazon	EPA 8151A_(1/98)	a	S
Chloramben	EPA 8151A_(1/98)	a	S
Dacthal (DCPA)	EPA 8151A_(1/98)	a	S
DCPA di acid degradate	EPA 8151A_(1/98)	a	S
Picloram	EPA 8151A_(1/98)	a	S
1,1,1-Trichloro-2-propanone	EPA 8260C_(8/06)	a	S
1,1,2-Trichlorofluoroethane	EPA 8260C_(8/06)	a	S
1,1-Dichloro-1-fluoroethane	EPA 8260C_(8/06)	a	S
1,2,3,4-Diepoxybutane	EPA 8260C_(8/06)	a	S
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	EPA 8260C_(8/06)	a	S
1,2-Dichloro-1,1,2-trifluoroethane	EPA 8260C_(8/06)	a	S
1,2-Dimethoxyethane	EPA 8260C_(8/06)	a	S
1,3-Butanediol	EPA 8260C_(8/06)	a	S
1,3-Dichloro-2-propanol	EPA 8260C_(8/06)	a	S
1,4-Butanediol	EPA 8260C_(8/06)	a	S
1,4-Difluorobenzene	EPA 8260C_(8/06)	a	S
1-Butene	EPA 8260C_(8/06)	a	S
1-Chloro-1,2,2-trifluoroethane (Freon 133)	EPA 8260C_(8/06)	a	S
1-Chlorobutane	EPA 8260C_(8/06)	a	S
1-Heptene	EPA 8260C_(8/06)	a	S
1-Hexene	EPA 8260C_(8/06)	a	S
1-Methyl-2-n-propylbenzene	EPA 8260C_(8/06)	a	S
1-Propene	EPA 8260C_(8/06)	a	S
2,2,4-Trimethylpentane	EPA 8260C_(8/06)	a	S
2,2-Dimethylbutane	EPA 8260C_(8/06)	a	S
2,2'-Oxybis(1-chloropropane)	EPA 8260C_(8/06)	a	S
2,3,4-Trimethylpentane	EPA 8260C_(8/06)	a	S
2,3-Dichloropropene	EPA 8260C_(8/06)	a	S
2,3-Dimethylbutane	EPA 8260C_(8/06)	a	S
2,3-Dimethylpentane	EPA 8260C_(8/06)	a	S
2,4-Dimethylpentane	EPA 8260C_(8/06)	a	S
2-Bromofluorobenzene	EPA 8260C_(8/06)	a	S
2-Chloro-2-methybutane (tert-Amyl chloride)	EPA 8260C_(8/06)	a	S
2-Chloroethanol	EPA 8260C_(8/06)	a	S
2-Ethylhexanol (2-Ethyl-1-hexanol)	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
2-Ethyltoluene	EPA 8260C_(8/06)	a	S
2-Hexene	EPA 8260C_(8/06)	a	S
2-Hydroxypropionitrile	EPA 8260C_(8/06)	a	S
2-Methoxyethanol (Methyl cellosolve)	EPA 8260C_(8/06)	a	S
2-Methyl-1,3-dioxolane	EPA 8260C_(8/06)	a	S
2-Methyl-2-Butene	EPA 8260C_(8/06)	a	S
2-Methylaniline (o-Toluidine)	EPA 8260C_(8/06)	a	S
2-Methylbutadiene (Isoprene)	EPA 8260C_(8/06)	a	S
2-Methylbutane (Isopentane)	EPA 8260C_(8/06)	a	S
2-Methylheptane	EPA 8260C_(8/06)	a	S
2-Methylhexane	EPA 8260C_(8/06)	a	S
2-methylpropane (Isobutane)	EPA 8260C_(8/06)	a	S
2-Pentanone	EPA 8260C_(8/06)	a	S
2-Picoline (2-Methylpyridine)	EPA 8260C_(8/06)	a	S
3-Bromofluorobenzene	EPA 8260C_(8/06)	a	S
3-Butene-1-ol	EPA 8260C_(8/06)	a	S
3-Chloropropionitrile	EPA 8260C_(8/06)	a	S
3-Ethyltoluene	EPA 8260C_(8/06)	a	S
3-Methyl-1-Butene	EPA 8260C_(8/06)	a	S
3-Methylheptane	EPA 8260C_(8/06)	a	S
3-Methylhexane	EPA 8260C_(8/06)	a	S
4-Ethyltoluene	EPA 8260C_(8/06)	a	S
4-Methyl-1-Pentene	EPA 8260C_(8/06)	a	S
4-Methylaniline (p-Toluidine)	EPA 8260C_(8/06)	a	S
Acetamide	EPA 8260C_(8/06)	a	S
Acetylene	EPA 8260C_(8/06)	a	S
Acrylamide	EPA 8260C_(8/06)	a	S
Acrylic acid	EPA 8260C_(8/06)	a	S
Adsorbable Organic Halides (AOX)	EPA 8260C_(8/06)	a	S
Allyl alcohol	EPA 8260C_(8/06)	a	S
alpha-Methylstyrene	EPA 8260C_(8/06)	a	S
beta-Propiolactone	EPA 8260C_(8/06)	a	S
bis(2-Chloroethyl) sulfide	EPA 8260C_(8/06)	a	S
bis(Chloromethyl)ether	EPA 8260C_(8/06)	a	S
Bromoacetone	EPA 8260C_(8/06)	a	S
Bromoethane (Ethyl Bromide)	EPA 8260C_(8/06)	a	S
Bromoethene	EPA 8260C_(8/06)	a	S
Butyl acetate	EPA 8260C_(8/06)	a	S
Chloral hydrate	EPA 8260C_(8/06)	a	S
Chloroacetonitrile	EPA 8260C_(8/06)	a	S
Chlorodifluoromethane (Freon-22)	EPA 8260C_(8/06)	a	S
Chloromethyl methyl ether	EPA 8260C_(8/06)	a	S
cis-2-Butene	EPA 8260C_(8/06)	a	S
cis-2-Hexene	EPA 8260C_(8/06)	a	S
cis-2-pentene	EPA 8260C_(8/06)	a	S
Cycloate	EPA 8260C_(8/06)	a	S
Cyclohexanol	EPA 8260C_(8/06)	a	S
Cyclohexanone	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
Cyclopentane	EPA 8260C_(8/06)	a	S
Cyclopentene	EPA 8260C_(8/06)	a	S
Decanal	EPA 8260C_(8/06)	a	S
Dichlorotetrafluoroethane	EPA 8260C_(8/06)	a	S
Dicyclopentadiene	EPA 8260C_(8/06)	a	S
Diethylamine	EPA 8260C_(8/06)	a	S
Diethylene glycol	EPA 8260C_(8/06)	a	S
Dimethyl disulfide	EPA 8260C_(8/06)	a	S
Dimethyl sulfoxide	EPA 8260C_(8/06)	a	S
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260C_(8/06)	a	S
Ethane	EPA 8260C_(8/06)	a	S
Ethene	EPA 8260C_(8/06)	a	S
Ethylene glycol	EPA 8260C_(8/06)	a	S
Ethylene thiourea	EPA 8260C_(8/06)	a	S
Ethyleneimine	EPA 8260C_(8/06)	a	S
Fluorobenzene	EPA 8260C_(8/06)	a	S
Fluoromethane (Freon 41)	EPA 8260C_(8/06)	a	S
Heptanal	EPA 8260C_(8/06)	a	S
Hexachloroethane	EPA 8260C_(8/06)	a	S
Isopropyl acetate	EPA 8260C_(8/06)	a	S
Malononitrile	EPA 8260C_(8/06)	a	S
Methane	EPA 8260C_(8/06)	a	S
Methanol	EPA 8260C_(8/06)	a	S
Methyl formate	EPA 8260C_(8/06)	a	S
n, n-Dimethylformamide	EPA 8260C_(8/06)	a	S
n-Amyl acetate	EPA 8260C_(8/06)	a	S
n-Amyl alcohol	EPA 8260C_(8/06)	a	S
n-Butane	EPA 8260C_(8/06)	a	S
n-Butylcyclopentane	EPA 8260C_(8/06)	a	S
Nitrobenzene	EPA 8260C_(8/06)	a	S
N-Nitroso-di-n-butylamine	EPA 8260C_(8/06)	a	S
n-Nonane	EPA 8260C_(8/06)	a	S
n-Pentane	EPA 8260C_(8/06)	a	S
n-Propane	EPA 8260C_(8/06)	a	S
n-Propylamine	EPA 8260C_(8/06)	a	S
p-Diethylbenzene	EPA 8260C_(8/06)	a	S
Pentachloroethane	EPA 8260C_(8/06)	a	S
Pentafluorobenzene	EPA 8260C_(8/06)	a	S
Propargyl alcohol	EPA 8260C_(8/06)	a	S
Propyne	EPA 8260C_(8/06)	a	S
Purgeable Organic Halides	EPA 8260C_(8/06)	a	S
Pyridine	EPA 8260C_(8/06)	a	S
Sec-Amyl Alcohol (2-Pentanol)	EPA 8260C_(8/06)	a	S
S-Methyl thioacetate (S-Methyl etanethioate)	EPA 8260C_(8/06)	a	S
tert-Amyl alcohol (TAA)	EPA 8260C_(8/06)	a	S
tert-Amyl ethyl ether (TAEE)	EPA 8260C_(8/06)	a	S
trans-2-Butene	EPA 8260C_(8/06)	a	S
trans-2-Hexene	EPA 8260C_(8/06)	a	S

Analyte	Method	Notes	Matrix
trans-2-pentene	EPA 8260C_(8/06)	a	S
Triethylamine	EPA 8260C_(8/06)	a	S
Trifluoromethane (Freon 23)	EPA 8260C_(8/06)	a	S
Vinyl bromide	EPA 8260C_(8/06)	a	S
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8270D_(2/07)	a	S
1,2-Dinitrobenzene	EPA 8270D_(2/07)	a	S
1,4-Dinitrobenzene	EPA 8270D_(2/07)	a	S
1-Acetyl-2-thiourea	EPA 8270D_(2/07)	a	S
1-Methylnaphthalene	EPA 8270D_(2/07)	a	S
2,4,5-Trimethylaniline	EPA 8270D_(2/07)	a	S
2,4-Diaminotoluene	EPA 8270D_(2/07)	a	S
2-Aminoanthraquinone	EPA 8270D_(2/07)	a	S
2-Cyclohexyl-4,6-dinitrophenol	EPA 8270D_(2/07)	a	S
3-(Chloromethyl) pyridine hydrochloride	EPA 8270D_(2/07)	a	S
3,3'-Dimethoxybenzidine	EPA 8270D_(2/07)	a	S
3-Amino-9-ethylcarbazole	EPA 8270D_(2/07)	a	S
4,4'-DDD	EPA 8270D_(2/07)	a	S
4,4'-DDE	EPA 8270D_(2/07)	a	S
4,4'-DDT	EPA 8270D_(2/07)	a	S
4,4'-Methylenebis(n, n-dimethylaniline)	EPA 8270D_(2/07)	a	S
4,4'-Oxydianiline	EPA 8270D_(2/07)	a	S
4-Chloro-1,2-phenylenediamine	EPA 8270D_(2/07)	a	S
4-Chloro-1,3-phenylenediamine	EPA 8270D_(2/07)	a	S
4-Chlorophenol	EPA 8270D_(2/07)	a	S
4-Dimethyl aminoazobenzene	EPA 8270D_(2/07)	a	S
4-Nitrobiphenyl	EPA 8270D_(2/07)	a	S
5,5-Diphenylhydantoin	EPA 8270D_(2/07)	a	S
5-Chloro-2-methylaniline	EPA 8270D_(2/07)	a	S
5-Nitroacenaphthene	EPA 8270D_(2/07)	a	S
5-Nitro-o-anisidine	EPA 8270D_(2/07)	a	S
Aldrin	EPA 8270D_(2/07)	a	S
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
alpha-Terpineol	EPA 8270D_(2/07)	a	S
Aminoazobenzene	EPA 8270D_(2/07)	a	S
Anilazine	EPA 8270D_(2/07)	a	S
Aroclor-1016 (PCB-1016)	EPA 8270D_(2/07)	a	S
Aroclor-1221 (PCB-1221)	EPA 8270D_(2/07)	a	S
Aroclor-1232 (PCB-1232)	EPA 8270D_(2/07)	a	S
Aroclor-1242 (PCB-1242)	EPA 8270D_(2/07)	a	S
Aroclor-1248 (PCB-1248)	EPA 8270D_(2/07)	a	S
Aroclor-1254 (PCB-1254)	EPA 8270D_(2/07)	a	S
Aroclor-1260 (PCB-1260)	EPA 8270D_(2/07)	a	S
Azinphos-methyl (Guthion)	EPA 8270D_(2/07)	a	S
Barban	EPA 8270D_(2/07)	a	S
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
Bromoxynil octanate	EPA 8270D_(2/07)	a	S
Captafol	EPA 8270D_(2/07)	a	S
Captan	EPA 8270D_(2/07)	a	S

Analyte	Method	Notes	Matrix
Carbaryl (Sevin)	EPA 8270D_(2/07)	a	S
Carbofuran (Furaden)	EPA 8270D_(2/07)	a	S
Carbophenothion	EPA 8270D_(2/07)	a	S
Chlordane (tech.)	EPA 8270D_(2/07)	a	S
Chlorfenvinphos	EPA 8270D_(2/07)	a	S
Chlorpyrifos	EPA 8270D_(2/07)	a	S
Coumaphos	EPA 8270D_(2/07)	a	S
Crotoxyphos	EPA 8270D_(2/07)	a	S
delta-BHC	EPA 8270D_(2/07)	a	S
Demeton	EPA 8270D_(2/07)	a	S
Demeton-o	EPA 8270D_(2/07)	a	S
Demeton-s	EPA 8270D_(2/07)	a	S
Di(2-ethylhexyl)adipate	EPA 8270D_(2/07)	a	S
Dibenz(a,h) acridine	EPA 8270D_(2/07)	a	S
Dibenz(a,h) anthracene	EPA 8270D_(2/07)	a	S
Dibenz(a,j) acridine	EPA 8270D_(2/07)	a	S
Dibenzo(a,e) pyrene	EPA 8270D_(2/07)	a	S
Dibenzothiophene	EPA 8270D_(2/07)	a	S
Dichlone	EPA 8270D_(2/07)	a	S
Dichlorovos (DDVP, Dichlorvos)	EPA 8270D_(2/07)	a	S
Dicrotophos	EPA 8270D_(2/07)	a	S
Dieldrin	EPA 8270D_(2/07)	a	S
Diethyl sulfate	EPA 8270D_(2/07)	a	S
Diethylstilbestrol	EPA 8270D_(2/07)	a	S
Dihydrosafrole	EPA 8270D_(2/07)	a	S
Dinocap	EPA 8270D_(2/07)	a	S
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D_(2/07)	a	S
Disulfoton	EPA 8270D_(2/07)	a	S
Endosulfan I	EPA 8270D_(2/07)	a	S
Endosulfan II	EPA 8270D_(2/07)	a	S
Endosulfan sulfate	EPA 8270D_(2/07)	a	S
Endrin	EPA 8270D_(2/07)	a	S
Endrin aldehyde	EPA 8270D_(2/07)	a	S
Endrin ketone	EPA 8270D_(2/07)	a	S
EPN	EPA 8270D_(2/07)	a	S
Ethion	EPA 8270D_(2/07)	a	S
Ethyl carbamate (Urethane)	EPA 8270D_(2/07)	a	S
Ethyl methanesulfonate	EPA 8270D_(2/07)	a	S
Fensulfothion	EPA 8270D_(2/07)	a	S
Fenthion	EPA 8270D_(2/07)	a	S
Fluchloralin	EPA 8270D_(2/07)	a	S
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8270D_(2/07)	a	S
Heptachlor	EPA 8270D_(2/07)	a	S
Heptachlor epoxide	EPA 8270D_(2/07)	a	S
Hexachlorobenzene	EPA 8270D_(2/07)	a	S
Hexamethylphosphoramide (HMPA)	EPA 8270D_(2/07)	a	S
Hydroquinone	EPA 8270D_(2/07)	a	S
Leptophos	EPA 8270D_(2/07)	a	S

Analyte	Method	Notes	Matrix
Maleic anhydride	EPA 8270D_(2/07)	a	S
Mestranol	EPA 8270D_(2/07)	a	S
Methoxychlor	EPA 8270D_(2/07)	a	S
Mevinphos	EPA 8270D_(2/07)	a	S
Mexacarbate	EPA 8270D_(2/07)	a	S
Mirex	EPA 8270D_(2/07)	a	S
Monocrotophos	EPA 8270D_(2/07)	a	S
Naled	EPA 8270D_(2/07)	a	S
n-Hexadecane	EPA 8270D_(2/07)	a	S
Nicotine	EPA 8270D_(2/07)	a	S
Nitrofen	EPA 8270D_(2/07)	a	S
n-Tetradecane	EPA 8270D_(2/07)	a	S
o-Anisidine	EPA 8270D_(2/07)	a	S
Octamethyl pyrophosphoramide	EPA 8270D_(2/07)	a	S
p-Cresidine	EPA 8270D_(2/07)	a	S
Phenobarbital	EPA 8270D_(2/07)	a	S
Phosalone	EPA 8270D_(2/07)	a	S
Phosmet (Imidan)	EPA 8270D_(2/07)	a	S
Phosphamidon	EPA 8270D_(2/07)	a	S
Phthalic anhydride	EPA 8270D_(2/07)	a	S
Piperonyl sulfoxide	EPA 8270D_(2/07)	a	S
Propylthiouracil	EPA 8270D_(2/07)	a	S
Resorcinol	EPA 8270D_(2/07)	a	S
Strychnine	EPA 8270D_(2/07)	a	S
Sulfallate	EPA 8270D_(2/07)	a	S
Terbufos	EPA 8270D_(2/07)	a	S
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270D_(2/07)	a	S
Tetraethyl dithiopyrophosphate	EPA 8270D_(2/07)	a	S
Tetraethyl pyrophosphate (TEPP)	EPA 8270D_(2/07)	a	S
Thionazin (Zinophos)	EPA 8270D_(2/07)	a	S
Thiophenol (Benzenethiol)	EPA 8270D_(2/07)	a	S
Toluene diisocyanate	EPA 8270D_(2/07)	a	S
Toxaphene (Chlorinated camphene)	EPA 8270D_(2/07)	a	S
Trifluralin (Treflan)	EPA 8270D_(2/07)	a	S
Trimethyl phosphate	EPA 8270D_(2/07)	a	S
Tri-p-tolyl phosphate	EPA 8270D_(2/07)	a	S
tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D_(2/07)	a	S
1,2-Phenylenediamine (o-Phenylenediamine)	EPA 8321B_(1/98)	a	S
2,4,5-T	EPA 8321B_(1/98)	a	S
2,4-D	EPA 8321B_(1/98)	a	S
2,4-DB	EPA 8321B_(1/98)	a	S
Asulam	EPA 8321B_(1/98)	a	S
Butylate	EPA 8321B_(1/98)	a	S
Carbendazim	EPA 8321B_(1/98)	a	S
Carbosulfan	EPA 8321B_(1/98)	a	S
Dalapon	EPA 8321B_(1/98)	a	S
Dicamba	EPA 8321B_(1/98)	a	S
Dichlorovos (DDVP, Dichlorvos)	EPA 8321B_(1/98)	a	S

Analyte	Method	Notes	Matrix
Dichlorprop	EPA 8321B_(1/98)	a	S
Dimethoate	EPA 8321B_(1/98)	a	S
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8321B_(1/98)	a	S
Disperse blue 14	EPA 8321B_(1/98)	a	S
Disperse blue 3	EPA 8321B_(1/98)	a	S
Disperse brown 1	EPA 8321B_(1/98)	a	S
Disperse orange 3	EPA 8321B_(1/98)	a	S
Disperse orange 30	EPA 8321B_(1/98)	a	S
Disperse red 1	EPA 8321B_(1/98)	a	S
Disperse red 13	EPA 8321B_(1/98)	a	S
Disperse red 5	EPA 8321B_(1/98)	a	S
Disperse red 60	EPA 8321B_(1/98)	a	S
Disperse yellow 5	EPA 8321B_(1/98)	a	S
Disulfoton	EPA 8321B_(1/98)	a	S
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 8321B_(1/98)	a	S
Famphur	EPA 8321B_(1/98)	a	S
Fensulfothion	EPA 8321B_(1/98)	a	S
Formetanate hydrochloride	EPA 8321B_(1/98)	a	S
MCPA	EPA 8321B_(1/98)	a	S
MCPP	EPA 8321B_(1/98)	a	S
m-Cumenyl methylcarbamate	EPA 8321B_(1/98)	a	S
Merphos	EPA 8321B_(1/98)	a	S
Methyl parathion (Parathion, methyl)	EPA 8321B_(1/98)	a	S
Metolcarb	EPA 8321B_(1/98)	a	S
Molinate	EPA 8321B_(1/98)	a	S
Monocrotophos	EPA 8321B_(1/98)	a	S
Naled	EPA 8321B_(1/98)	a	S
Pebulate	EPA 8321B_(1/98)	a	S
Phorate	EPA 8321B_(1/98)	a	S
Physostigmine	EPA 8321B_(1/98)	a	S
Physostigmine salicylate	EPA 8321B_(1/98)	a	S
Promecarb	EPA 8321B_(1/98)	a	S
Silvex (2,4,5-TP)	EPA 8321B_(1/98)	a	S
Solvent red 23	EPA 8321B_(1/98)	a	S
Solvent red 3	EPA 8321B_(1/98)	a	S
Thiodicarb	EPA 8321B_(1/98)	a	S
Thiofanox	EPA 8321B_(1/98)	a	S
Thiophanate-methyl	EPA 8321B_(1/98)	a	S
Triallate	EPA 8321B_(1/98)	a	S
Trichlorfon	EPA 8321B_(1/98)	a	S
tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8321B_(1/98)	a	S
Vernolate	EPA 8321B_(1/98)	a	S
2,4,6-Trinitrobenzene	EPA 8330B_(10/06)	a	S

Analyte	Method	Notes	Matrix

Denied Parameter Accreditation Footnotes

(a) Withdrawn at laboratory request. (b) Denied pending receipt of acceptable PT results (WAC 173-50-140).

Matrix Definitions - D = Drinking Water; N = Non-potable Water; S = Solid and Chemical Material; A = Air and Emissions.