UPPER COLUMBIA RIVER

FINAL
Work Plan for the
Soil Amendment Technology Evaluation Study
Phase I: Test Plot Characterization and Initial Amendment Alternatives Evaluation

Prepared for

Teck American Incorporated
P.O. Box 3087
Spokane, WA 99220-3087

Prepared by

Ramboll Environ

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TITLE AND APPROVAL SHEET

WORK PLAN FOR THE SOIL AMENDMENT TECHNOLOGY EVALUATION STUDY PHASE I: TEST PLOT CHARACTERIZATION AND INITIAL AMENDMENT ALTERNATIVES EVALUATION

Management Team

EPA UCR Project Coordinator	Laura Buelow	Date 7-31-17
EPA SATES Project Coordinator	Kira Lynch Kira Lynch	Date 7/31/17
TAI UCR Project Coordinator	Kris McCaig Kris McCaig	Date 07/31/17
TAI SATES Project Coordinator	Dave Enos	Date 07/28/17
TAI Technical Team Coordinator	Mike Arnold	Date 7/28/17
	Amy Kephart Kephart for A.K.	Date 7/28/17
Senior Technical Advisor	Rosalind Schoof Rosalind Schoof	Date 7/28/17
Task Quality Assurance Coordinator	Amy Kephart Kephart for A.K.	Date 7/28/17
Analytical Chemistry Laboratory Coordinator	Cristy Kessel Cristy Kessel	Date 7/28/17
Analytical Laboratory Project Managers	Nick Basta	Date 7/21/17
	Jeff Coronado	Date 7/28/17
Analytical Laboratory Quality Assurance Managers	Shane Whitacre Shane Whitacre by NB	Date 8/1/17
	Carl Degner	Date 7/28/17
Data Manager	Randy O'Boyle	Date 7/31/2017

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ACRONYMS AND ABBREVIATIONS

Agreement	June 2, 2006, Settlement Agreement
bgs	below ground surface
CEC	cation exchange capacity
CLP	Contract Laboratory Program
COC	chain-of-custody
CV	coefficient of variation
DOT	Department of Transportation
DQO	data quality objective
DMP	data management plan
DU	decision unit
EDD	electronic data deliverable
GIS	geographic information system
GPS	Global Positioning System
GSD	geometric standard deviation
IATA	International Air Transport Association
IC	incremental composite
IDW	investigation-derived wastes
ITRC	Interstate Technology and Regulatory Council
LCS	laboratory control sample
MAP	monoammonium phosphate
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
NIST	National Institute of Standards and Technology
OSHA	U.S. Occupational Safety and Health
QA	quality assurance
QA/QC	quality assurance and quality control
QC	quality control
RI	remedial investigation
RI/FS	remedial investigation and feasibility study
SATES	Soil Amendment Technology Evaluation Study
SHSP	Site Health and Safety Plan

SOP	standard operating procedure
TAI	Teck American Incorporated
TAL	Target Analyte List
TCRA	time-critical removal action
UCR	Upper Columbia River
USEPA	U.S. Environmental Protection Agency
USNRCS	U.S. Natural Resources Conservation Service
σ	standard deviation

UNITS OF MEASURE

mg	milligrams
m	meter(s)
mg/kg	milligram(s) per kilogram

DISTRIBUTION LIST

USEPA UCR Project Coordinator	Laura Buelow
USEPA SATES Project Coordinator	Kira Lynch
USEPA QA Manager	Donald Brown
TAI UCR Project Coordinator	Kris McCaig
TAI SATES Project Coordinator	Dave Enos
Technical Team Coordinator	Mike Arnold (Ramboll Environ) Amy Kephart (Ramboll Environ)
Task QA Coordinator	Amy Kephart (Ramboll Environ)
Senior Technical Advisor	Rosalind Schoof (Ramboll Environ)
Data Manager	Randy O'Boyle (Exponent)
Analytical Chemistry Laboratory Coordinator	Cristy Kessel (TAI)
Field Team Manager	Rebecca Andresen (Arcadis)
Analytical Laboratory Project Manager	Jeff Coronado (ALS); Nick Basta (Ohio State University)
Analytical Laboratory QA Manager	Carl Degner (ALS); Shane Whitacre (Ohio State University)
USEPA Subject Matter Expert	Sally Brown (Univ. of Washington)
TAI Subject Matter Expert	Nick Basta (Ohio State Univ.)
USEPA Subject Matter Expert	Kirk Scheckel
USEPA Subject Matter Expert	Todd Luxton
USEPA Subject Matter Expert and Risk Assessor	Marc Stifelman
USEPA Subject Matter Expert	Mark Johnson
CCT Consultant	Whitney Fraser (Lodestone)
CCT CERCLA Coordinator	Cindy J. Marchand

Washington Department of Ecology	John Roland
Spokane Tribe of Indians	Randy Connolly
US National Park Service	Dan Audet
Citizens for a Clean Columbia	Joe Wichmann
Citizens for a Clean Columbia	Mindy Smith

1. INTRODUCTION

This document presents the work plan for the Soil Amendment Technology Evaluation Study (SATES) Test Plot Characterization and Initial Amendment Alternatives Evaluation (herein the 'study') within the Upper Columbia River (UCR) project area. This work is being completed as part of the ongoing UCR remedial investigation and feasibility study (RI/FS) conducted by Teck American Incorporated (TAI) under U.S. Environmental Protection Agency (USEPA) oversight.

This work plan describes the project organization, field procedures and protocols that will be followed, data quality objectives (DQOs), study design, analytical procedures, and quality assurance and quality control (QA/QC) procedures upon which the study will be based. USEPA's DQO process (USEPA 2006a) and the DQO details developed by the USEPA team for the study were used to guide development of the requirements and design rationale for data collection activities presented in this work plan. A copy of the DQO document developed by the USEPA is included in Appendix A (USEPA 2016a).

2. PROJECT ORGANIZATION

This section presents the organizational structure for activities associated with the study, including task management and oversight, fieldwork, sample analysis, and data management.

2.1 USEPA ORGANIZATION AND RESPONSIBILITIES

USEPA 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 [CCT] and the Spokane Tribe of Indians) input with respect to review of technical documents submitted by TAI. In addition, USEPA, under Section 106 of the National Historic Preservation Act, has the primary responsibility for consulting with interested parties. USEPA's project coordinators, Dr. Laura Buelow, as the UCR project coordinator, and Kira Lynch, as the SATES program coordinator, will be responsible for ensuring that the work performed is consistent with all applicable USEPA guidance. USEPA's QA manager is Donald Brown, or designee.

The USEPA will also provide several subject matter experts to contribute technical information and provide technical review during the study. These subject matter experts include:

- Dr. Kirk Scheckel – USEPA Office of Research and Development (ORD);
- Dr. Todd Luxton - USEPA ORD;
- Marc Stifelman – USEPA (Region 10);
- Mark Johnson – USEPA ORD, and
- Dr. Sally Brown, University of Washington.

2.2 TAI ORGANIZATION AND RESPONSIBILITIES

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

TAI UCR Project Coordinator—Kris McCaig serves as TAI's overall project coordinator and has the primary responsibility for ensuring that TAI meets all requirements and associated deliverables specified within the June 2, 2006, Settlement Agreement (Agreement) (USEPA 2006b).

TAI SATES Project Coordinator—Dave Enos serves as TAI's SATES project coordinator and has responsibility for supporting Kris McCaig in ensuring that TAI meets all requirements and associated deliverables specified within the Agreement (USEPA 2006b), and has responsibility for ensuring that the SATES program is consistent with the USEPA expectations outlined in the SATES program request letter to TAI dated June 21, 2016 (USEPA 2016a).

Technical Team Coordinator—Mr. Mike Arnold (Ramboll Environ) will oversee task activities, review QA reports, and ensure that required activities are completed in sequence. Mr. Arnold will work closely with the TAI senior technical advisor, USEPA technical advisor, CCT technical staff, and task QA coordinator to ensure that all requirements are met and study objectives achieved. Mr. Arnold 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. Mr. Arnold will inform the technical team coordinator when problems occur and will communicate and document corrective actions taken.

Senior Technical Advisor—Dr. Rosalind Schoof (Ramboll Environ) 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.

Task QA Coordinator—Amy Kephart (Ramboll Environ) will be the Task QA Coordinator for the study and is responsible for providing overall QA support. The Task QA Coordinator will coordinate the validation of laboratory data; communicate data quality issues; and work with the Data Manager to address potential data limitations. The Task QA Coordinator will report directly to the analytical chemistry laboratory coordinator, the Data Manager, and the laboratories to ensure that data are of high quality.

Analytical Chemistry Laboratory Coordinator—Cristy Kessel (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. Ms. Kessel will report directly to the TAI UCR project coordinator and will work closely with the technical team coordinator and senior technical advisor.

Data Manager—Randy O'Boyle of Exponent will be the Data Manager and will have primary responsibility for data management and database maintenance and development. Mr. O'Boyle 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. Mr. O'Boyle will report directly to the analytical chemistry laboratory coordinator and will work closely with the task QA coordinator and laboratories.

2.2.1 Analytical Laboratory

The analytical laboratories for this study include ALS and Ohio State University. Laboratory Project and QA managers from each of the selected laboratories will have the following responsibilities.

Analytical Laboratory Project Manager—The Analytical Laboratory Project Manager 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 QA Manager—The Analytical Laboratory QA Manager 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.

3. PROJECT BACKGROUND

Arsenic and lead concentrations greater than the respective project action levels were identified in shallow soil at decision units (DUs) on several tribal allotment and residential properties during sampling activities associated with the Residential Soil Study completed in 2014 (CH2MHill 2016). In 2015, TAI implemented time-critical removal actions (TCRA) in which shallow soils were excavated from select DUs with elevated arsenic and lead concentrations (Arcadis 2016). At three tribal allotment DUs eligible for TCRA because of elevated lead concentrations in surficial soils, actions were deferred due to expected damage to vegetation and habitat that excavation activities would likely cause at these DUs. The expectation was that benefits of alternative removal or remedial techniques would be further evaluated for potential future cleanup actions by completing a treatability study at these DUs (USEPA 2016a). These DUs include DU-258, DU -401, and DU-441 (Figure 1).

This study seeks to identify soil amendment technology options that will be effective at reducing potential human exposure to lead in soil and that can be applied directly to the land surface or that will require only minimal reworking of soils targeted for treatment. This study will also evaluate other treatment effects that may affect human exposure to metals in the soils, such as changes in lead and arsenic bioaccessibility, soil structure, and vegetation changes. This study will evaluate conditions on DU-258, DU -401, and DU-441, and will apply amendments at those locations identified as suitable for amendment performance evaluation.

3.1 PROGRAMMATIC CONSIDERATIONS AND SETTLEMENT AGREEMENT REQUIREMENTS

The USEPA requested proceeding with the study in a letter to TAI dated June 21, 2016 (USEPA 2016a, Appendix A) that stated that a soil amendment technologies evaluation was important because soil removal may not be a feasible or appropriate remedial approach at some affected properties. Although the UCR RI is not yet complete, TAI and the USEPA have agreed to proceed with the study as an interim measure using available characterization information.

With the characterization of several privately-held land parcels as part of the 2014 Residential Soil Study (CH2MHill 2016) and subsequent TCRA on a subset of those properties (Arcadis 2016), TAI and the USEPA have agreed that appropriate data are available to move forward with the study, and that the study will provide a head start to evaluating remedial alternatives to support the UCR feasibility study effort.

The study is subject to the terms of the Settlement Agreement for Implementation of RI/FS at the UCR Site between TAI and the USEPA dated June 2, 2006 (Settlement Agreement, USEPA 2006b). Section V.13.e of the Settlement Agreement provides a general outline of the process of conducting treatability studies. The treatability study process and schedule outlined in the Settlement Agreement will be followed to the extent practicable as part of this study, with modifications of some elements, such as work plan development, as necessary based on implementation as an interim study while the RI is ongoing.

3.2 PROJECT SITE LOCATION AND DESCRIPTION

The project site includes DUs 258, 401, and 441 on CCT allotment lands within the UCR area at the locations shown in Figure 1. The DUs are each located northwest side of the Columbia River in the vicinity of Northport, Washington, at an approximate distance of 0.5 mile (DU 441), 3 miles (DU 258) and 5 miles (DU 401) from the town at approximate elevations above mean sea level of 1,400 feet, 1,430 feet, and 1,380 feet, respectively. Distances of each DU form the Trail smelter are DU 258 - 10.1 miles, DU 401 - 9.3 miles, and DU 441 - 12.7 miles.

The DUs were established during the 2014 Residential Soil Study (CH2MHill 2016) and, based on the results of that effort, have each been selected for the test plot locations for this study. Each of the DUs consists of undeveloped land typically used for dispersed outdoor recreation activities. Camping, hunting, and plant gathering are common recreational activities on and near the DUs, and there is potential that they may be developed for future residential use.

The DUs are situated on the following tribal allotments:

Decision Unit	Allotment
DU 258	Tribal Allotment 151-H-193
DU 401	Tribal Allotment 151-H-196
DU 441	Tribal Allotment 151-H-197

Maps showing the location of each DU within the tribal allotment and relative to other DUs in the vicinity are included in Figure 2 (DU 258), Figure 3 (DU 401), and Figure 4 (DU 441).

3.2.1 Study Area Soil Conditions

The three DUs that comprise the study area were previously sampled during the 2014 Residential Soil Study. Incremental composite samples were collected from shallow soils on residential properties from 0 to 1 inch in depth and on each of the tribal allotments in

the study area (DU 258, DU 401, and DU 441) from 0 to 3 inches in depth. Additionally, five discrete soil samples were each collected from a depth of 1 to 6 inches below ground surface at DU 258. The arsenic and lead concentrations detected in the soil samples from the DUs are summarized in Table 1. Table 1 includes total arsenic and lead concentrations and in vitro bioaccessibility testing results in each sample or sample composite.

Shallow soils at DU 258 were described in CH2MHill (2016) as dark brown silty sand with trace fine gravel and roots. The DU 401 soils are described as medium brown silt and very fine sand with trace organics. DU 441 soils were reported as dark brown silt with fine sand and trace occurrence of gravel, medium to coarse sand, and organic material.

Shallow soil conditions at the target DUs as reported by the U.S. Natural Resources Conservation Service (USNRCS) are summarized on Table 2 (USNRCS 2017). Soils types reported at the DUs include Bisbee loamy fine sand, Garrison gravelly loam, Peone silt loam, and Springdale sandy loam. Surface water infiltration rates into the soils are estimated to range from 0.57 to 7.09 in. per hour.

Other than metal concentrations and brief soil descriptions, no detailed site-specific data are available that indicate grain size distribution, porosity/permeability, organic content, nutrient balance, and other key physical and chemical parameters for shallow soils in the study area.

4. PROJECT DESCRIPTION

4.1 SATES PROJECT PHASES

The study is subdivided into four primary phases, with the detailed scope of work for each phase dependent on the outcomes of the preceding phases. This work plan has been developed to address the process requirements for completing both sub-phases under the first project phase. The four phases of the project are:

- Phase I – Test plot characterization and amendment alternatives screening
  - Phase IA – Test plot selection and characterization
  - Phase IB – Soil amendment technology screening and design
- Phase II – Bench-scale treatability studies
- Phase III - Test plot field implementation
- Phase IV – Test plot monitoring

4.1.1 Phase I

Phase I addresses selection of the appropriate field test plots for pilot testing of the selected soil amendment technology options, characterization of those plots, and screening of the available options to confirm which will be evaluated as part of bench-scale testing (Phase II) and field pilot testing (Phase III). The two subphases are integrated and concurrent, with information from each informing the progress of the other.

4.1.1.1 Phase IA

Phase IA will focus on pilot study test plot selection and establishing substantive soil and vegetation baseline conditions to monitor the effects of the soil amendment options once the amendments are applied to the test plots.

4.1.1.2 Phase IB

Phase IB includes development of an initial comprehensive list of amendment technology options and specific approaches and design of additional site-specific amendment technologies (if warranted), followed by screening to eliminate those options that have clear drawbacks to their potential for meeting study objectives. Design of additional site-specific amendment technologies will consider site-specific conditions such as mineralogy, porosity, and soil type. Screening will be through review of available information, and/or through comparison of remedial performance expectations to site characterization data developed as part of Phase IA.

4.1.2 Phase II

Phase II will include completion of laboratory bench-scale testing of the amendment options remaining once initial screening has been completed as part of Phase I. The bench-scale testing results will be used to confirm which options will be advanced to pilot-scale application on the test plots during Phase III.

4.1.3 Phase III

Phase III will consist of constructing the field test plots to evaluate the effectiveness of the application of the various options in the range of environments expected to require treatment in the vicinity of the study area.

4.1.4 Phase IV

Phase IV includes the field monitoring program that will be completed to confirm the effects of the various options applied on the test plots in the study area, and a report summarizing the results of the pilot testing program along with recommendations for options to remediate lead in soil in the UCR area.

4.2 SATES PROGRAM OBJECTIVES

The objective of the study is to identify an appropriate soil amendment technology or technologies that could be applied to appropriately and cost-effectively reduce the long-term potential for human exposure to lead in shallow soils in the UCR area by one or more of the following:

- Reducing bioaccessibility of lead in soil by chemical sequestration;
- Reducing lead mobility and leachability in soil by increasing soil pH;
- Increasing vegetative cover in a manner that reduces the potential for direct human exposure and reduces erosion and transport of affected soil;
- Increasing the thickness of the humus barrier over the lead-bearing soil; and
- Improving soil structure in a manner that reduces the potential for erosion and transport of affected soils.

Additionally, application of the selected remedy or remedies should minimize acute and long-term negative impacts to the ecology and land use of the treated parcels. In this study, maintenance of natural plant populations is desired. This is a key distinction of this study compared with soil amendment programs that aim to increase agricultural productivity or ground cover by non-native plants such as lawn grasses. Thus, changes in

soil pH, structure and fertility will be monitored to allow evaluation of their effect on the native and non-native plants at each test plot. Amendment application effects on soil pH, structure, and fertility will also be designed to minimize the potential for deleterious effects on the overall health and viability of the test plot ecosystems.

Although a primary focus of this study will be on reduction of lead exposure and bioavailability, the effects of the amendments on the co-located arsenic, and on other metals in the soils will also be evaluated during the study.

4.2.1 Phase I Objectives

The objectives of the initial phase of the study, the objectives of the study are:

- Phase IA - Characterize conditions at each of the test plots to provide data to support design of appropriate amendment options and to establish baseline conditions critical to evaluate the effectiveness and overall effects of the options selected for pilot testing.
- Phase IB – Screen the expected performance of the soil amendment technology options and design optimized site-specific amendment options (if necessary) using available information and site-specific data developed during Phase IA to identify appropriate option candidates for bench-scale testing under Phase II of the study.

4.3 STUDY APPROACH

The study includes two concurrent and integrated lines of inquiry – the identification and characterization of remedial test plot locales and identification and screening of amendment technology options.

4.3.1 Phase IA – Test Plot Selection and Characterization

This section includes a discussion of the initial test plot selection and the planned general process for characterizing soil and mineralogical conditions, ecology, and land use conditions relevant to the remedial option pilot testing planned for each DU. Field implementation of the characterization process is also included.

4.3.1.1 Test Plot Screening and Selection

Test plots for the study are planned on DUs 258, 401, and 441. Each test plot is planned to be an area of 100 feet by 100 feet (0.23 acre). Preliminary test plot locations on each DU are included in Figures 5, 6, and 7, respectively, and schematic of a test plot is shown in Figure 8. Each 0.23-acre test plot will be subdivided into four 2,500-square-foot sub-plots (Figure

9), of which three will be available for soil amendment testing and one will be used as a control.

Initial test plot selection is based on the following criteria:

- Reasonable access for personnel and equipment for each phase of study work at the test plots;
- Lead concentrations reported for shallow soils across and among the test plots should be greater than about twice the project-specific cleanup level of 250 mg/kg (500 mg/kg), but less than 2,000 mg/kg;
- Test plots should include a mix of vegetation conditions common in the site area, including forested and grassy areas;
- Test plots will avoid incorporating large areas of heavy brush in order to minimize resource damage during sampling and treatment activities;
- Test plots will incorporate various primary soil conditions found in the site vicinity as reflected in the USNRCS soil survey summarized in Section 3.2.1 and based on field observations; and
- The variability of vegetation and soil conditions across and among the test plots will be established in a manner that will allow evaluation of performance of each remedial option selected for pilot testing across each area.

Note that prior to the initiation of the test plot characterization field effort, the boundaries of the test plots may be adjusted to more effectively incorporate areas that meet the above criteria. Each test plot will be designated by the DU number followed by a sequential numeric designation. For example, the second test plot established on DU 258 will be "Test Plot 258-2."

4.3.1.2 Test Plot Baseline Soil Characterization Plan

A comprehensive understanding of soil chemical, mineralogical, and physical parameters, vegetation and habitat conditions, and human land use at each test plot will be critical to selecting appropriate amendment deployment characteristics and to monitor progress of each amendment in relation to specific conditions on each test plot. A summary of the data required to characterize soils on the test plots is included in Table 3. The program details for ecological and land use information required for test plot characterization as part of the Phase I effort will be developed and submitted in separate documentation. It is expected that the ecological and land use study will include an inventory of plant types and degree of vegetation on each test plot, and will include a review of available information regarding human land use at each of the DUs that contains test plots.

Test plots will be subject to two initial field characterization efforts: an initial screening effort and a second detailed characterization effort. The initial effort will include discrete near-surface soil sample collection to confirm the distribution of lead in shallow soils across each test plot and screen for variations in soil geochemistry. The data from the first phase will be used to consider which test plots are suitable for use for the pilot testing of amendment options, and it is expected that several initial test plots will be eliminated from further consideration. The guidelines that will be used to establish the final test plot areas are:

- Lead concentrations in discrete shallow soil samples collected within each test plot should be less than 2,000 mg/kg and should have a standard deviation (σ) of less than 30% of the mean[1];
- Test plots and available sub-plot treatment areas will allow pilot testing of up to four amendment options in similar soil and ecological/land use conditions; and
- Test plots and available sub-plot treatment areas will also allow pilot testing of up to four amendment options in a variety of soil and ecological conditions common to the study area.

Note that it is anticipated that the guidelines may not all be met on each test plot selected for use as final test plots. The guidelines above are to establish a baseline for test plot selection and planning purposes.

The second detailed characterization effort will focus on understanding conditions key to design and selection of appropriate amendment options for application at the test plots, and to establish baseline conditions to evaluate the amendment effects on the test plots when applied. It is anticipated that up to four test plots will be available based on the results of the initial test plot screening effort. With three sub-plots available for amendment application in each test plot, that provides capacity for up to four amendments to be applied during the pilot-scale testing. The test plot characterization effort will include:

- Incremental composite (IC) shallow soil samples collected within each sub-plot;
- Replicates (triplicates) of IC samples collected at a frequency proportional to lead variability across each test plot;

[1] Should a number of test plots exhibit a lead concentration σ of greater than 30%, the plots with the highest σ will be preferentially eliminated from inclusion in the study.

- Discrete-depth soil sampling from test pits (see Section 7.1.1.3) at each test plot; and
- Detailed evaluation and mapping of soil and ecological conditions.

Data from both field efforts will be used to screen the test plots using the criteria outlined above in this section. For the test plots selected for remedy deployment, the detailed soil and ecological information will be used to develop appropriate sub-plot treatment areas for material placement during the study Phase III, and to establish key baseline conditions for monitoring during pilot-scale testing as part of Phase IV.

4.3.2 Phase IB – Soil Amendment Alternative Selection

This section includes a summary of the initial list of soil amendments considered for the study, the preliminary screening process to confirm which of those options should be evaluated as part of the study, a process to design an optimized site-specific amendment engineered to address study objectives, if warranted, and the results of amendment selection carried forward.

Amendments carried forward will be evaluated based on performance against the study objectives during the Phase II bench scale testing effort. Based on the results of the evaluations completed during those phases, a final list of amendments for pilot-scale testing by application on the test plots will be developed. Specific soil amendment performance evaluation criteria for Phase II will be developed in the work plan for that effort.

4.3.2.1 Soil Characteristics Review

As part of Phase IA, test plot coil chemical, mineralogical, and physical properties will be evaluated. These data will be reviewed by technical/subject matter team members to identify key stoichiometric, metallurgical, and hydrogeological relationships within the soils. The goal if this review is to develop a site-specific understanding of mineral forms present, chemical reactions that could reduce reactivity of metal constituents, and identification of appropriate amendments to drive those reactions. The evaluation will also seek to understand the migration conditions and availability of soluble amendments applied to the soil.

4.3.2.2 Initial List of Primary Soil Amendment Alternatives

The initial list of primary soil amendments considered for the study is included in Table 4 and includes those soil amendments that would be expected to perform in a manner that would meet all or a majority of the project objectives outlined in Section 4.2. These amendments are briefly described below.

Phosphorous as Apatite

Apatite, a sparingly-soluble calcium phosphate mineral mined or found in bone material, is typically applied to soil as a powder or as small fragments and has been demonstrated to slowly release phosphorous into surrounding soils as the mineral decomposes. Under a wide range of soil conditions, dissolved phosphorous complexes with lead contaminants to form pyromorphite and pyromorphite-like minerals that significantly reduce the bioaccessibility of lead in the soil. A fundamental plant nutrient, phosphorous also may help increase the vegetation mass present over the treatment area.

Phosphorous as Monoammonium Phosphate

The phosphorous available from monoammonium phosphate (MAP) sequesters lead and nourishes plants in a similar manner to phosphorous from apatite described above. However, MAP readily dissolves in water and can therefore be applied and infiltrated into soil as an aqueous solution rather than a solid.

Wood Ash

Wood ash, the residue and charred fragments remaining after the combustion of wood, is a common soil conditioner and contains abundant calcium and some potassium, magnesium, sodium, aluminum, and phosphorous. Addition of wood ash can increase the overall organic content of the soil, depending on the amount of char remaining in the ash, and provide some nutrients and increased soil moisture retention capacity to increase vegetation growth in the treated area. The phosphorous content (typically <2%) may nominally increase pyromorphite generation in lead-contaminated soils. Wood ash also tends to increase the pH of the soil, which can result in decreased lead dissolution and mobility.

Biochar

Biochar is a charcoal-like material created by pyrolysis of biomass (e.g., agricultural and wood wastes) resulting from heating and thermal decomposition of the material within an oxygen-poor environment. The biochar material produced by this process has a high carbon content, is very porous, and provides cation nutrients, primarily calcium, magnesium, and potassium, to soils. Biochar also can influence soil pH, soil water holding characteristics, increase cation exchange capacity (CEC) and related nutrient availability in soil. Biochar structure and porosity tends to sequester some nutrients, including phosphorous, and can reduce mobility and availability of soil contaminants such as lead.

Municipal Biosolids

Municipal biosolids are the product of municipal wastewater treatment processes, typically in urban areas, and are a source of organic material and a wide range of macronutrients and micronutrients at a variety of concentrations. In addition to nutrients, municipal biosolids can improve moisture capacity of soils, improve soil structure, and reduce mobility of soil contaminants. Municipal biosolid qualities may vary significantly between treatment processes, presence/absence of combined sewer, and concerns with odor, chemical contaminants, and pathogens are challenges to using municipal biosolids as a soil amendment.

Woody Debris

Woody debris is defined in this case as waste materials from lumber operations, including small fragments of wood and bark, wood shavings, and sawdust. As a soil amendment, woody debris contributes organic matter to the soil, as well as relatively low concentrations of a variety of soil nutrients. Woody debris helps increase retention of soil moisture and nutrients, especially as decomposition progresses. However, the initial stages of the woody debris decomposition process depletes available soil nitrogen , which can result in decreased plant growth in the treated soil.

Compost

Composted organic material, such as yard waste or agricultural wastes, provides many of the same benefits as municipal biosolids – it is a source of organic material and some additional nutrients to soil, it increases soil structure, and it has potential for reducing the mobility of contaminants such as lead. Concerns about secondary contamination (such as herbicides from composted materials), presence of pathogens, and odor are somewhat reduced compared with biosolids, especially when the compost is from controlled sources and the decomposition process is complete. Incompletely composted material can lead to nitrogen depletion in soils while the remaining organic material decomposes. Chemical contamination may also be an issue with some composts.

Manganese Oxides

Manganese oxides such as birnessite have shown promise in reducing bioaccessibility and mobility of lead in soils (Beak et al. 2008) by lead sorption onto the oxide surfaces. Manganese oxides provide negligible soil nutrient or soil structure benefit, except for use of potassium permanganate to generate manganese oxides, which could increase soil potassium. However, use of manganese oxides and permanganate can discolor the application area, and permanganates can be biocidal to plants and soil microorganisms and are reactive with organic material.

ECOBOND™ Lead and Other Proprietary Applications

A variety of proprietary applications are available that are targeted at reducing mobility and bioaccessibility of lead in soils. Although the chemistry of many of these approaches is undisclosed or poorly described in available literature, indications of the use of phosphorous, manganese, iron, and iron sulfate are indicated or suggested. Each of these approaches reports effectiveness only if the amendment is fully blended with the lead-impacted soil.

4.3.2.3 Preliminary Screening of Soil Amendment Alternatives

A preliminary screening of the initial list of primary soil amendments in Table 4 was completed to eliminate those options that have critical performance or application issues, or would obviously underperform relative to other available soil amendments. The scoring was semi-quantitative, partially subjective, and focused on evaluating evidence-based remedy performance against known and assumed site-specific conditions and study objectives. No assignment of comparative rank of remedies beyond an initial pass/fail screening is intended or implied, and the scoring should not be considered predictive of bench- or pilot-scale study results for those remedies carried forward.

A numeric score was developed for each initial soil amendment option in nine categories that evaluated the expected performance of the remedy against general remedial performance criteria and specific study objectives:

- Decreases lead bioaccessibility;
- Enhances soil structure;
- Improves soil fertility;
- Applies surficially or with light soil disturbance;
- Ease of even application over treatment areas;
- Evidence of toxic effects;
- Aesthetic issues (i.e., odor and visual impact);
- Local sourcing; and
- Cost.

Performance of each amendment under each category was assigned a numeric score ranging from 0 (least favorable) to 5 (most favorable). The process and results of the preliminary screening of the soil amendment options is summarized in Table 5. A

summary of the scoring criteria used and the scoring guidelines used to develop each numeric score are summarized below.

Decreases Lead Bioaccessibility

Each option was given a score dependent on the following factors, in order of descending weight:

- Reduces lead bioaccessibility by rendering the lead insoluble in human gastrointestinal tracts by changing the lead mineral species or by chemical encapsulation;
- Reduces lead mobility in soil; or
- Otherwise increases physical barriers to direct human exposure.

Enhances Soil Structure

Degree of increase to soil cohesion, resistance to erosion, and/or enhancement of nutrient exchange by increasing soil organic content, increasing soil moisture capacity, or organic or mineral armoring.

Improves Soil Fertility

Scoring dependent on the expected extent that each remedy option would add macro- and micro-nutrients to the soil, would increase available organic material, and minimize deleterious nutrient conditions (e.g., excessive salinity).

Applies Surficially or with Light Tilling

The score for this category reflects the expected effectiveness with little or no soil disturbance, with greater degrees of required soil disturbance leading to lower scores.

Even Application Over Treatment Areas

Scoring in this category considered the potential and required effort to broadcast material to evenly affect a 0-6" depth soil prism across entire treatment area, with consideration of limitations for soil blending (e.g., roots and cobbly soils) for those remedies that would require soil disturbance.

Toxic Effects

This scoring category reflects the potential for ecological and/or human toxic effects from the primary amendment materials or from potential amendment impurities.

Aesthetic Issues

Scoring for aesthetic issues considers the short and long-term disturbance of vegetation or soil, odor, discoloration of soil surface, or visual impact to scenery.

Local Source

The scoring category reflects the distance from the nearest source or bulk supplier of an appropriate volume of material for full-scale application to Northport. Specific scoring parameters used are:

- 5 = 0 – 50 miles to source/bulk supplier;
- 4 = 50 – 200 miles;
- 3 = 200 – 400 miles;
- 2 = >400 miles, in US;
- 1 = >400 miles, outside US; and
- 0 = Not available in bulk.

Cost

The scoring for this category assumes cost of a single application based on material and transportation costs in Table 4, and application cost requirements. Application cost was assessed in two general categories – material that could be spread surficially as a solution or slurry (lower cost), and material that requires some level of soil blending (higher cost).

Results

The results of the screening are summarized on Table 5, with green-highlighted scores indicating a technology that will be moved forward as a primary amendment, and a red score indicating technologies that will not be moved forward.

Two general scoring clusters emerged from the preliminary evaluation process. Amendments with scores between 21 and 24 were eliminated, and those with scores between 31 and 36 were retained. Note that the results of this screening do not eliminate the amendments for evaluation for use as secondary augmentation to primary technologies as part of the study. Note that other secondary treatment materials, such as iron-based water treatment residuals, will be considered as part of bench-scale testing under Phase II of the study.

Technologies retained as primary amendment options include:

- Phosphorous as MAP;
- Wood ash;

- Biochar;
- Municipal biosolids
- Woody debris; and
- Compost.

Primary amendment selection for the bench-scale treatability study effort in Phase 2, to include consideration of secondary amendments to be evaluated to address treatment gaps for primary amendments, will be completed as part of the Phase 2 work plan. The results of Phase I of this study reported in the Data Summary Report will be incorporated into the amendment selection process completed in consultation with the project technical team.

4.3.2.4 Optimized Site-Specific Amendment Development

Soil characteristics data will be used to evaluate whether a site-specific amendment formulation could be identified, developed, and tested as part of the study. Soil mineralogy will be reviewed to identify soil mineral associations, metallic forms, and soil geochemistry (e.g., by developing Piper diagrams). These conditions will be used to identify the potential for specific chemical reactions that could be employed to convert reactive and bioaccessible metallic mineral forms to more stable, less bioaccessible forms. If identified, these reactions will be documented by identifying candidate amendment chemicals and applicable reaction stoichiometry.

Physical and chemical properties of soil will be reviewed to identify processes that could affect the effectiveness of amendment applications. As these conditions are identified, strategies to enhance or amend these limiting properties will be developed to facilitate amendment application. For instance, if low soil permeability is a limiting factor, surfactants and/or soil aeration strategies may be applied to increase amendment efficacy.

Note that screening and development of site-specific amendment approaches would proceed similarly to the primary amendment screening described in Section 4.3.2.3.

The activities to evaluate whether optimized site-specific amendment approaches could be identified, developed, and tested as part of the study will be conducted by subject matter experts during the development of the work plan for the bench scale treatability study.

5. SCHEDULE

5.1 PROJECT SCHEDULE

The study is expected to have a total duration of 4 to 5 years. The general schedule for each phase is summarized as follows.

Phase	Year Completed
I – Test plot characterization and remedial alternatives screening	2017-2018
II – Bench-scale treatability studies	2018-2019
III - Test plot field implementation	2019
IV - Test plot monitoring	2019-2021

5.2 PHASE I SCHEDULE

A more detailed schedule has been developed for Phase I – Test plot characterization and remedial alternatives screening to address development of this work plan, field screening and characterization efforts, amendment screening, and reporting. The schedule is included in Table 6.

5.3 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

TAI has assembled a technical team with the requisite experience and technical skills to successfully complete the study. Field personnel will be familiar with the cultural resources coordination plan (Appendix A), and will hold current U.S. Occupational Safety and Health (OSHA) 40-hour Hazardous Waste Operations training certification. Persons in field supervisory positions will have also completed the additional OSHA 8-Hour Supervisory Training. Additionally, any field staff collecting, handling and shipping samples will have completed hazardous materials training to comply with shipping and transportation regulations under the Department of Transportation (DOT) and International Air Transport Association (IATA).

Prior to the commencement of field activities, copies of applicable training certificates for subcontractor personnel will be provided to Ramboll Environ for verification of training requirements. Subcontractor personnel will be required to provide verification of training (i.e., copies of records/certificates) prior to performing sampling activities at the Site. Copies of training certificates and records will be kept in the project file.

6. DOCUMENTATION AND RECORDS

6.1 FIELD DOCUMENTATION

Field personnel will prepare comprehensive documentation covering various aspects of field sampling, field analysis, and sample COC. This documentation consists of a record that allows reconstruction of field events to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained in the project file. Examples of field forms are included in Appendix B. The detailed SOP for field documentation is included in Appendix C (SOP 1).

The various forms of documentation to be maintained throughout the investigation include:

- Sampling Information – Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate). The number of the photographs taken and information related to the photographs will also be noted.
- Sample COC – COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by field personnel responsible for sample custody. In the event that samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to each laboratory, and copies will be forwarded to the project files.
- Field Equipment, Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory calibrated.

Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

6.2 LABORATORY DOCUMENTATION FILES

6.2.1 Laboratory Project Files

Each laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs, and COC forms. The laboratory will retain project files and data packages for a period not less than ten years as described in the Agreement or shall provide TAI project files and data packages for archiving at the conclusion of each study phase.

6.2.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated QC checks. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance with this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

6.2.3 Computer and Hard Copy Storage

All electronic files and deliverables will be retained by the laboratory for not less than ten years; hard copy data packages (or electronic copies) will also be retained for not less than ten years. Alternately, all electronic files and deliverables can be provided to TAI at the conclusion of the project for archiving.

6.3 DATA REPORTING REQUIREMENTS

Data will be reported both in the field and by the analytical laboratory, as described below.

6.3.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the Work Plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and (as necessary) incorporated into the data evaluation process.

Field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs, documents, and data reductions will be kept in the project file.

6.3.2 Laboratory Data Reporting

Each laboratory is responsible for preparing Level 2 data packages for all samples. Level 2 – Modified reporting is used for analyses that are performed following standard EPA-approved methods and QA/QC protocols. Based on the intended data use, modified reporting may require some supporting documentation, but not full Contract Laboratory Program- (CLP-) type reporting.

Level 2 Laboratory data report required elements:

- Chain-of custody;
- Case Narrative;
- Final parameter concentration for all samples;
- Preparation or extraction and analysis dates/times;
- Method Blanks;
- Surrogate recoveries;
- ICP-MS Serial Dilution % Difference
- Matrix Spike (MS) and Matrix Spike Duplicate (MSD) recoveries and RPD;
- Laboratory Duplicate RPD;
- Laboratory Control Sample (LCS) recoveries

Chemistry laboratory analysis will be performed by a USEPA-approved laboratory; this could include study-specific approval for university-based laboratories. Analytical results will be reported by the laboratory within 15 working days from the date of receipt of the samples (standard turnaround), except as specifically requested otherwise. Final data packages in the electronic data deliverable (EDD) format outlined in SOP-2 in Appendix C and of the results report sheets in a PDF or electronic spreadsheet format, will be provided within 20 working days from date of receipt.

Data reports for all parameters will include, at a minimum, the following items:

Narrative

Summary of activities that took place during the course of sample analysis, including the following information:

- Laboratory name and address.
- Date of sample receipt.
- Cross reference of laboratory identification number to sample identification.
- Analytical methods used.
- Deviations from specified protocol.
- Corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results

These will be reported according to analysis type and include the following information, as applicable:

- Sample ID
- Laboratory ID
- Date of collection
- Date of receipt
- Date of extraction
- Date of analysis
- Dilution factor
- Detection limits

Sample results on the report forms will be corrected for dilutions, if applicable. Unless otherwise specified, all chemical results will be reported uncorrected for blank contamination. All solid matrices will be reported in dry weight as appropriate.

The analytical results will be reported by the laboratory in the EDD requested by the sampling subcontractor.

6.4 PROJECT FILES

Project documentation will be placed in project files according to Ramboll Environ and TAI requirements. Sampling subcontractors will transfer all project documentation to Ramboll Environ. Sampling subcontractors will also store project documentation in project files in a manner that is retrievable and in compliance with requirements in this document. Generally, field data and laboratory reports are filed by calendar year and task. Documents will be retained for the duration described in the Agreement.

7. SOIL CHARACTERIZATION PROCESS

This section summarizes the field observation and sample collection and analysis program to be used to characterize the soil conditions at each test plot for the study.

In the event that unanticipated or changed circumstances occur in the field, the field supervisor will institute the necessary corrective actions, complete a corrective action record (an example is included in the Field Forms in Appendix B), and ensure that the appropriate procedures are followed. If corrective actions require a departure from this work plan, these changes will be documented on a field change request form (Appendix B). In any other circumstances where sampling conditions are unexpected, the appropriate sampling actions consistent with this task's objectives will be conducted. Any 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 the USEPA. 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 the USEPA. The USEPA will be notified of any problems that may affect the final outcome of this task.

Because field sampling methods associated with these studies involve soil collection or ground penetration and disturbance, TAI and its technical team will 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. A cultural resources coordination plan (Appendix D) has been prepared for the RI/FS to provide relevant background information about site-related cultural resources, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and tribal parties with interests in the cultural resources of the Site. Proposed sampling methods for the RI/FS, including those planned for the study, are summarized in the cultural resources coordination plan in Appendix D and in the Cultural Resource Monitoring Protocol Summarized in SOP-3 in Appendix C.

The health and safety plan addendum for the field effort involved with the study is included in Appendix E. This document is an addendum to the general UCR site health and safety plan (SHSP) (TAI 2009).

7.1 SOIL SAMPLING PROCESS DESIGN

The soil sampling process in Phase I of the study includes two phases of field sample collection: an initial test plot screening program and a second test plot characterization program. The soil sample process design for each approach is summarized in this

subsection, and samples and analyses indicated are summarized in Tables 7a and 7b and Figure 10. Sample analytical methods are presented in the table and discussed in more detail in Section 13.

7.1.1 Soil Sample Location Selection

7.1.1.1 Test Plot Area Delineation

Soil samples will be collected to characterize conditions within the boundaries of each test plot. Test plots will be established based on the criteria discussed in Section 4.3.1.1. The corners of each test plot and sub-plot will be marked by durable flush-with-ground markers, such as a survey stake with a brass or plastic cap. Similar markers will be used to delimit the corners of each of the four subplots in those test plots selected for comprehensive characterization. Marker materials will be selected based on consultation with the cultural resource team.

7.1.1.2 Initial Screening

For the initial screening, soil samples will be collected from a grid within each test plot. The test plot will be divided into a grid of 100 10-foot by 10-foot squares, and a soil sample will be collected from as close to the center of each grid square as is reasonable. The soil sample will be collected from the upper 3 inches of soil beneath the vegetation and undecomposed organic litter at the surface (i.e., will include partially-decomposed organic material). Each of these samples will be collected and analyzed in a laboratory for total arsenic and lead. In addition, all soil samples from each test plot will be analyzed in the field for pH with a portable pH probe. For the initial screening phase, each soil sample will be collected as a discrete samples. The field team will use a GIS generated predetermined sample location grid that can be adjusted to the plot datum once it has been selected in the field.

Field duplicate samples will be collected to evaluate precision of field techniques and the homogeneity of the discrete samples. Five field duplicates will be randomly collected from the 100 grid square sample locations at each test plot. For the initial screening phase, field duplicate samples will be co-located grab samples. Soil will be collected from two co-located soil samples from the upper 3 inches of soil. The soil will be homogenized in the field, then split into two aliquots and placed into sample jars for analysis as two separate samples.

7.1.1.3 Characterization

The second field effort will focus on baseline soil characterization at each test plot and will be completed only on test plots selected for application of soil amendments based on the

criteria outlined in Section 4.3.1.1. The comprehensive field effort will focus on detailed evaluation of soil properties within each planned 2,500 square-foot sub-plots that will be used for applying various soil amendments and for control. For the characterization phase, discrete soil samples will be collected from test pits on each sub-plot, and incremental composite samples will be collected from soils at 0 to 3 inches in depth at each sub-plot.

Test Pits

One test pit will be completed within each of the four sub-plots at each test plot. Within each sub-plot, test pit locations will be selected based on the grid location with the highest lead concentration in soil identified during the initial screening. These test pit locations will be selected prior to mobilizing to the field, and sample locations will be plotted in a GIS format prior to mobilizing into the field using the geolocation data from the initial screening sampling. Approximate dimensions of test pits will be 2 feet long, 2 feet wide, and 18-inches deep.

At the location of each test pit, but prior to test pit excavation, discrete soil samples will be collected from 2-inch depth intervals beginning at the soil surface (0 in.) to a depth of 12 in. below ground surface (bgs). Note, as with the initial screening samples, collection of soil at the surface interval of this discrete test pit will begin beneath the vegetation and undecomposed organic litter at the surface (i.e., will include partially-decomposed organic material). Each of the soil interval samples will be analyzed for total Target Analyte List (TAL) metals. Also prior to the excavation of the test pit, two undisturbed soil samples will be collected, each from 0 to 6 inches bgs at the test pit location to be evaluated for *in situ* permeability and maximum unsaturated soil moisture capacity. An additional undisturbed soil sample will be extracted from the bottom of the test pit (18 inches) an additional 6 inches to capture the 18 to 24 inch interval. Upon excavation of the test pit, a soil sample from the upper 3 inches of soil will be collected for analysis of arsenic and lead mineralization and total soil mineralogy. Soil conditions, including soil types and horizons, will be described by an experienced soil scientist for the soil profile exposed in each test pit. Soil horizon development and soil structure will be characterized based on parameters described in Schoeneberger et al. (2012). The 18 to 24 inch undisturbed sample will be retained and archived for possible future analysis.

Field duplicate samples will be collected to evaluate precision of field techniques and the homogeneity of the discrete samples collected at the test pits. One field duplicate sample for metals analysis will be collected randomly from one depth-discrete sample at each test plot. The soil from the target depth interval will be homogenized in the field, then split into two aliquots and placed into sample jars for analysis as two separate samples.

Incremental Composite Samples

At each sub-plot, one incremental composite soil sample will be collected at 30 locations from 0 to 3 inches in depth for analyses for total, leachable, and bioaccessible metals, and for soil quality parameters that may affect or be affected by soil amendment application. The IC sampling method is described in detail by the Interstate Technology and Regulatory Council (ITRC) and consists of single-point increment samples composited and subsampled according to a detailed SOP prior to laboratory analysis (ITRC 2012). ALS' IC processing SOP-4 is described in detail in Appendix C. The field team will establish IC sample locations in a GIS format prior to mobilizing into the field using the geolocation data from the initial screening sampling.

Triplicate IC soil samples will be collected to evaluate precision of field techniques and the homogeneity of the IC samples. Triplicate samples will be collected from co-located samples at each increment location, and each of the three increment sets will be developed and submitted as separate IC samples. Triplicate incremental composite sample frequency will be determined based on the coefficient of variation (CV) or geometric standard deviation (GSD) of the screening analysis lead concentrations by test plot. Triplicates will not generally be collected from test plots exhibiting low CV or GSD as defined in ITRC incremental composite sampling guidance (one IC sample will be collected in triplicate, selected randomly, if all test plots exhibit low CV or GSD, ITRC 2012). One triplicate, selected randomly, from one of every four subplots with high to medium CV or GSD sample will be collected. Triplicate IC samples will be analyzed for metal-related tests (i.e., TAL metals, SPLP TAL metals, bioavailability).

IC soil samples for general chemistry analyses will be collected in duplicate from one sub-plot selected randomly (at a single test plot) of the 16 sub-plots. In other words, a single IC sample duplicate will be collected to represent the entire IC sample set. The duplicate IC soil samples will be collected to evaluate precision of field techniques and the homogeneity of the IC samples. The duplicate samples will be collected from co-located samples at the thirty increment locations, and both of the increment sets will be developed and submitted as separate IC samples that will be homogenized then analyzed at the laboratory.

7.2 SAMPLING METHOD REQUIREMENTS

This section details the equipment and procedures that will be used to collect soil samples during the soil investigation. The total number of field samples that will be collected from the three DUs included in the project site are listed in Tables 7a and 7b.

The field sampling team will have the necessary knowledge and experience to perform all field activities. Such knowledge includes experience with GPS unit, specified sampling gear, and soil collection. All crew members will be familiar with this work plan, and will participate in site and equipment orientation prior to initiating sample collection. Note that soil sampling activities in the study area will require compliance with the cultural resource coordination plan in Appendix D. This will include inspection of all excavated soils by a qualified cultural resource specialist. For those analyses requiring undisturbed soil samples, the cultural resource specialist will inspect the visible soil prior to sealing the sample. Specific study cultural resource monitoring and response protocols are summarized in SOP-3, Appendix C.

7.2.1 Minimum Sample Mass

DQOs for this field effort cannot be met without the collection of sufficient soil mass for laboratory analysis. Minimum sample sizes for the IC samples and each increment comprising them were conservatively calculated as described in this section.

Minimum masses required for each discrete and IC sample are included in Table 3. The total mass of soil required for each discrete and IC sample was calculated similarly to the USEPA QAPPs for the 2014 residential and upland soil studies. As described in the QAPPs, for purposes of estimating the required mass, it was assumed that the < 2 mm particle size fraction would be approximately 80 percent of the soils collected[2]. The < 150 μm particle size fraction is assumed to comprise 5 percent of the soil. To calculate the minimum mass of soil to be collected in the field, the mass of the soil required for the laboratory was divided by either 0.8 or 0.05 depending on the fraction needed for analysis (<2 mm and <150 μm, respectively). Bulk sample masses were not adjusted for particle size fraction.

The volume of soil needed to be collected in the field to meet these minimum requirements is dependent on the soil densities that will be encountered in the field.

Sampling techniques discussed in this work plan include directions that will allow collection of appropriate mass of soil for sample analysis. 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:

[2] This proportion was estimated in the 2014 Upland Study Field Sampling Plan using average grain size data from the NURE data set. The assumption that 80% of the composite sample would pass through the 2 mm sieve was determined by summing two thirds of the average proportion of sand (60%), and all silt and clay (40%).

$$M=\varrho\times n\times D\times\pi\times(\theta/2)\text{^}2$$

Where:

M = targeted mass of sample (g)

D = sampling depth (cm)

n = number of increments

7.3 SOIL SAMPLE DESIGNATION SYSTEM

Soil samples will be designated based on type and location of sample collection. This designation is summarized below and additional detail is provided in SOP-5 in Appendix C.

7.3.1 Initial Screening Samples

For the initial screening program, a grid at 10-foot vertical (X) and horizontal (Y) intervals will be established across each test plot from a fixed and recorded plot corner. Each row will be designated alphabetically ranging from A to J, and each column numerically from 1 to 10. One soil sample will be collected from each grid square during the initial screening process, and will be designated with the following information:

- Test plot number;
- Y interval (row letter);
- X interval (column number); and
- 6-digit date.

The test plot number will include the DU number and, if more than one test plot is present in a DU, a sequential numerical identifier (i.e., 1, 2, or 3) preceded by a dash. An example sample identifier for a soil sample collected on July 22, 2017 from row C, column 7 from test plot 258-2 would be "258-2-C7-072217".

7.3.2 Characterization Samples

For the test plot soil characterization program, each test plot sub-plot will be designated alphabetically (A, B, C, and D, Figure 9). Soil samples collected from each sub-plot will be designated with the following information:

- Sample type (IC ["IC"] or discrete ["D]);
- Test plot number;

- Sub-plot letter;
- 6-digit date; and
- Depth interval in inches (discrete samples only).

For example, an IC soil sample collected on August 17, 2017 from subplot "A" in test plot 258-2 would be designated "IC-258-2A-081717". Similarly, a discrete sample collected on that date from a depth of 4 to 6 inches in a test pit completed at that subplot would be designated "D-258-2A-081717-4-6".

7.3.3 Field QA/QC Samples

If IC samples are collected in triplicate from a subplot, then the sample designators will begin with "IC1-", "IC2-", and "IC3-".

The field duplicate QC sample designator will be the designator for the original sample collected in parallel with the duplicate sample, followed by a "-D".

7.3.4 Discrete Soil Samples

Three different types of discrete soil samples will be collected at each test plot for the study:

Initial Screening

- Surficial soil samples collected from 100 points from a depth of 0 to 3 inches bgs,

Characterization

At each test pit, the following discrete soil samples will be collected prior to or during the excavation of the test pit:

- Depth-discrete soil samples beginning at a depth of 0 inches and ending at a depth of 12 inches bgs for metals analysis;
- One undisturbed soil sample from a depth of 12 to 24 inched bgs for potential future evaluation or analysis;
- Two undisturbed samples collected from a depth of 0 to 6 inches bgs for *in situ* permeability testing and maximum unsaturated soil capacity (soil moisture holding capacity); and
- At the location of the test pit at the highest lead concentration on each test plot, one additional soil sample collected from a depth of 0 to 3 inches bgs for

arsenic/lead general soil minerology and general mineralogical evaluation during test pit excavation.

A brief overview of the discrete soil sample collection procedure is provided below and described in more detail in the Discrete Soil Sample Collection SOP (SOP-6) in Appendix C.

1. For the initial screening, plot the sample grid in GIS to obtain spatial coordinates prior to mobilizing into the field. The GIS generated predetermined sample location grid should be adjusted to the plot datum once it has been selected in the field. For test plot characterization, establish sample locations in a GIS format prior to mobilizing into the field using the geolocation data from the initial screening sampling.
2. Transport field personnel and sampling equipment to the DU selected for sampling.
3. Locate each sample point using a handheld GPS, mark each point with a pin flag, and convey sampling equipment/personnel to this location. Field location procedures are described in the Positioning at Sample Collection Areas SOP (SOP-7) in Appendix C.
4. Document the vegetation and any anthropogenic features in the vicinity of the sample point in the field notebook. Take digital photographs of the discrete locations (record in the photo log). Note that multiple sampling locations can be included in a single photograph.
5. Select the point to collect the soil sample within 0.5 m of the GPS sample locations based on the test plot map in Figure 7. The actual discrete sample point may be shifted from the planned GPS location by no more than 2 feet to target available soil and avoid obstacles such as woody vegetation or rocks.
6. At each sampling point, clear vegetation and surface debris (e.g., woody debris, undecomposed leaves and pine needles, and surficial rocks) from the discrete sample point (resulting surface is considered the 0-inch depth) using a decontaminated sampling trowel. Retain surficial materials for replacement after sampling.
7. For test pit sample collection, excavate a test pit to approximately 18 inches in depth using decontaminated hand tools. Collect shallow driven soil samples from the test pit location prior to excavating through the target depth intervals. Collect deeper driven samples from the base of the test pit after clearing slough from the

bottom. Retain surficial material and mineral soils separately for backfilling and restoration of the test pit excavation.

8. Using a soil punch (or similar sampling tool) decontaminated using the methods described in SOP-8, Appendix C, and Section 7.5, collect the discrete sample(s) from each point.

   - Surface samples for laboratory analysis will be collected using a 2-inch-diameter soil punch (or similar sampling tool) from the 0 to 3 inches depth interval.
   - Depth-discrete interval samples from test pits will be collected by driving a 2-inch-diameter split-spoon coring device (or similar sampling tool) vertically into the ground, and then segmenting the resulting soil core at each target depth interval (0-2", 2-4", 4-6", 6-8", 8-10", and 10-12") using a stainless steel sampling knife or trowel. If there is insufficient recovery in the driven sample, then depth-discrete samples may be collected directly from the test pit wall using a square-sided stainless steel sampling scoop or similar.
   - At each test pit, an additional soil sample for potential future supplemental analysis or evaluation will be collected from 18 to 24 inches bgs by driving a 2-inch-diameter soil punch (or similar sampling tool) equipped with an acetate or stainless steel sampling sleeve vertically into the ground.
   - Test pit mineraological samples will be collected using a 2-inch-diameter soil punch (or similar sampling tool) from the 0 to 3 inches bgs interval.
   - Undisturbed soil samples for *in situ* permeability analysis will be collected in a 2-inch-diameter acetate or stainless steel sampling sleeve pushed vertically from 0 to 6 inches at the location of each test pit *prior to* test pit excavation.
   - For locations where duplicate samples will be collected, the duplicate samples should be collected as close as possible to the planned original sample point and the samples should be collected in close proximity (<0.1 m) to one another.
   - Place the soil samples for laboratory analysis into appropriate containers (4-ounce glass jars for metals analysis), or cap the sampling sleeve with a Teflon sheet and tight-fitting polymer cap (undisturbed samples only).
   - Allow the cultural resource representative to inspect the sample before the sample is transferred from the sampling device to the sample container, or prior to capping the ends of the *in situ* permeability sample.

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

9. Measure the pH of the soil at a depth of 1 inch bgs in each increment location with a portable pH probe.

10. Complete field documentation for this soil sample point as outlined in the Field Documentation SOP (SOP-1) in Appendix C.

11. For vertical samples, fill the sampling hole to 0.5 inch bgs with wooden dowel or branch segment with saw-cut ends as a marker to prevent future re-sampling of each point. Wood used must not be treated. Place previously removed vegetation/plant debris or local soil over top of plug. For the test pit area, backfill the hole with excavated materials and place a semi-permanent marker (metal rod with plastic or brass cap) at the location.

12. Fully decontaminate sample collection equipment between each soil sampling point as described in Section 7.5 and SOP 8.

13. Discard disposable sample-dedicated equipment such as gloves.

14. Soil samples will be maintained in sample coolers and stored on ice at 4±2°C.

15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation following the requirements of the Sample Custody SOP (SOP-9) and Sample Storage and Packaging SOP (SOP-10), both in Appendix C. The sample-filled collection cooler(s) will also be packed with sufficient ice to ensure samples arrive at the analytical laboratory at 4±2°C.

7.3.5 Incremental Composite Soil Samples

A brief overview of the IC soil sample collection procedure is provided below and described in more detail in the Incremental Composite Soil Sample Collection SOP (SOP-12) in Appendix C.

1. The field team will establish IC sample locations in a GIS format prior to mobilizing into the field. Using Table 8, develop a list of increment locations using geolocation methods, confirming and recording latitude and longitude for each increment location, and enter the points into a GPS unit.

2. Transport field personnel and sampling equipment to the DU selected for sampling.

3. Locate each increment location using the handheld GPS, mark each location with a pin flag, and convey sampling equipment/personnel to this location. Field location procedures are described in the SOP Positioning at Sample Collection Areas (SOP-7) in Appendix C.

4. Document the vegetation and any anthropogenic features in the vicinity of the increment location in the field notebook. Take digital photographs of the increment locations (record in the photo log). Note that multiple soil sample locations can be included in a single photograph.

5. Select a location to collect the soil sample within 0.5 m of the GPS increment locations based on the subplot map in Figure 11 and the increment location plan outlined in Table 8. Note that incremental composite samples will not be collected from the sub-plot areas within 4 feet of adjacent sub-plots because of potential overspill of planned future remedy materials between sub-plots. 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. The sample relocation should be a minimum distance required to avoid the obstacle, and should not exceed 2 feet from the original sample location.

6. Clear vegetation and large surface debris (e.g., woody debris, undecomposed leaves and pine needles, and surficial rocks) from the increment location with a decontaminated sampling trowel. The resulting surface is considered the 0-inch depth. Retain surficial materials for replacement after sampling.

7. Collect the increment(s) from each increment location (see Table 8) using a decontaminated soil punch or equivalent sampling device.

    - Increment samples for laboratory analysis will be collected using a 3-inch-diameter soil punch from the 0 to 3 inches depth interval.
    - For locations where multiple increment samples will be collected, all increments collected at an increment location should be collected as close as possible to the planned GIS location and in close proximity (<0.1 m) to one another. The first duplicate sample should be collected 5 centimeters north of each original sample location, and the second 5 centimeters east of each original sample.

- Place the increment for laboratory analysis into a quart-sized zipper closure plastic bag dedicated to the IC sample.
- Allow the cultural resource representative to inspect the increment in the quart-sized bag(s).
- If the increment passes the cultural resources review, continue sampling procedures.
- If the increment does not pass the cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.

8. Transfer the increment for laboratory analysis from the quart-sized inspection bag into an appropriately-sized dedicated clean container containing previously collected increments dedicated to that specific incremental composite sample.
9. Complete field documentation for this increment location.
10. Fill sampling hole with 2.5-inch-long, wooden dowel or branch segment with saw-cut ends as a marker to prevent future re-sampling of location. Place previously removed vegetation/plant debris or local soil over top of plug.
11. Dry decontaminate (brush off) sample collection equipment between increment locations within each sub-plot. Fully decontaminate sampling equipment between sub-plots as described in Section 7.5 and SOP 8.
12. Discard sub-plot-dedicated sampling equipment such as gloves, quart-sized inspection bags, and other disposable equipment.
13. ICS samples will be maintained in sample coolers and stored on ice at 4±2°C.
14. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation following the requirements of the Sample Custody SOP (SOP-9) and Sample Storage and Packaging SOP (SOP-10), both in Appendix C. The sample-filled collection cooler(s) will also be packed with sufficient ice to ensure samples arrive at the analytical laboratory at 4±2°C.

7.4 SAMPLE HANDLING AND CUSTODY REQUIREMENTS AND PROCEDURES

7.4.1 Field Custody Procedures

The objective of field sample custody is to ensure that samples are not tampered with or modified from the time of collection through transport and transfer to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel. Details of sample custody management are included in SOP-10 in Appendix C.

Field custody documentation consists of both field logbooks and field COC forms.

7.4.2 Field Logbooks

Field logbooks will provide the means of recording the data collecting activities that are performed. As such, entries will be described in as much detail as possible so that persons going to the Site could reconstruct a particular situation without reliance on memory. Field documentation requirements for the study are detailed in AOP-7 in Appendix C and are summarized in this section.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project specific document number. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned and contact information
- Logbook number
- Project name
- Project start date
- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, and signature of the person making the entry will be provided. The names of visitors to the Site and field sampling or investigation team personnel, as well as the purpose of their visit, will also be recorded in the field logbook. The make, model, and

serial number of monitoring and screening equipment used during field work should be recorded along with documentation of field calibration procedures and results.

Measurements made and samples collected will be recorded. Entries will be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the person making the correction. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The number of the photographs taken and information related to the photographs, if any, will also be noted. All equipment used to make measurements will be identified, along with the date and method of calibration. Where field sampling forms are provided, these data may be entered onto the forms in lieu of the field logbook, but the forms should be identified and catalogued in the field logbook.

Samples submitted to the laboratory for analysis will be collected following the sampling procedures documented above. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, analyses selected for the samples, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description in the logbook.

7.4.3 Sample Labelling

The following information is required on each sample label:

- Project name
- Date collected
- Time collected
- Location
- Sampler
- Analysis to be performed
- Preservative
- Sample identification number

7.4.4 Chain-of-Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC forms will contain the unique sample

identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms will be used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink. The labels will include the information listed in SOP-5 in Appendix C. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate COC will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

7.4.5 Sample Packing, Handling, and Shipping

Sample packaging and shipment procedures are designed so that the samples will arrive at the laboratory, with the COC, intact.

Samples will be packaged for shipment as outlined below:

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- Wrap the sample container cap with clear packing tape to prevent the label from becoming loose.
- Complete the COC form with the required sampling information and confirm that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
- Wrap glass sample containers in bubble wrap or other cushioning material. Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.

- Place ice in double-lined plastic bags, seal the bags, and place the bags loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place COC forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler and secure with duct tape.
- Wrap strapping tape (or equivalent) around both ends of the cooler at least twice.
- Mark the cooler on the outside with the shipping address and return address, affix "Fragile" labels, and draw (or affix) arrows indicating "this side up." Cover the labels with clear plastic tape. If the samples are being delivered directly to the laboratory or will be picked up by the lab's courier service, this step is eliminated.
- Place a signed custody seal over the sample cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. Ensure that the samples qualify as an excepted quantity (especially if sample preservatives are used), and ship or delivered by ground as necessary (e.g., some preservatives may prevent shipment of samples by air). The samples will be hand delivered or delivered by an express carrier within 24 hours of the time of collection. In most cases, the analytical method may require analysis within a shorter holding time, and arrangements will need to be made to accommodate the laboratory requirements. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used.

Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample cooler, and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

7.4.6 Laboratory Custody Procedures

7.4.6.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in USEPA guidance documents.

Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

7.4.6.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler, and compare the contents against the field COC. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, the Technical Team Coordinator and/or QAC will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The technician will check sample temperature upon receipt and will store the samples in a refrigerated area at 4±2°C. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system, which will note that samples will be maintained by the laboratory until disposal is authorized in writing by the USEPA. Relevant custody documentation will be placed in the project file.

7.4.6.3 Sample Analysis

Analysis of an acceptable sample will be initiated by a work sheet that will contain pertinent information for analysis. The routing sheet will be forwarded to the analyst, and the sample will be moved into an appropriate storage location to await analysis. The Analytical Laboratory QA Manager or a designated document control officer will file COC forms in the project file. Samples will be organized into sample delivery groups (SDGs) by the laboratory. Field duplicates are considered field samples for the purposes of SDG assignment. All field samples assigned to a single SDG will be received by the laboratory over a maximum of seven calendar days and must be processed through the laboratory (preparation, analysis, and reporting) as a group. If reanalysis of a sample is required it may be re-run separately from the original SDG and the resulting data will be reported within the SDG in which the samples were re-run.

Every SDG must include a minimum of one method blank (MB) and one matrix spike/matrix spike duplicate (MS/MSD) (or matrix spike/laboratory duplicate) pair; each SDG will, therefore, be self-contained for all of the required QC samples. Project samples to be used for MS/MSDs will be noted on the COC. Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded in a laboratory notebook by the analyst. These notes will be dated and identify the analyst, the instrument used, and the instrument conditions.

7.4.6.4 Sample Storage Following Analysis

Samples will be maintained by the laboratory until disposal is authorized in writing by the USEPA. The laboratory will be responsible for the eventual and appropriate disposal of the samples. The analytical laboratory will inform the Analytical Chemistry Laboratory Coordinator before any samples are disposed.

7.4.7 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in Table 9.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased clean to USEPA Office of Solid Waste and Emergency Response Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples, as appropriate.

7.5 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

Decontamination will be completed on reusable sample equipment between collection of individual samples during the study to reduce the potential for sample cross-contamination. Two decontamination methods will be used during soil sample collection activities completed as part of the study: dry decontamination and full decontamination. Dry decontamination will be completed between soil increments collected for the same incremental sample. Full decontamination will be completed between discrete soil samples and between separate incremental composite sample increment sets. Decontamination procedures are detailed in the sampling equipment decontamination SOP (SOP-8) in Appendix C and are summarized below.

7.5.1 Dry Decontamination

For dry decontamination of sampling equipment between collection of soil increments within the sample incremental composite sample, sampling tools should be brushed off

using a clean cloth or paper towel so that no visible soil remains adhered to the sampling equipment.

7.5.2 Full Decontamination

Full decontamination of sampling equipment will be completed on sampling equipment that may come into direct or indirect contact with the samples being collected. Full decontamination will be completed prior to collection of each discrete sample and between collection of incremental composite sample sets using the procedure summarized below:

- Rinse the sample equipment with tap water to remove visible soil or debris;
- Vigorously and completely wash the equipment by scrubbing using a laboratory detergent solution with water, taking care to remove all particulate matter and surface films;
- Rinse the equipment using tap water.

Note that sampling equipment decontaminated off-site or equipment that will not be immediately re-used for sample collection should be wrapped in aluminum foil (dull side facing the cleaned equipment) and stored and transported in a clean plastic bag.

7.6 MANAGEMENT OF INVESTIGATION-DERIVED MATERIALS AND WASTES

Investigation-derived wastes (IDW) include soils, decontamination water sampling supplies, and personal protective equipment. These wastes are generated during sampling, and other sampling activities. The intent of managing IDW is to insure that impacted materials and media are not allowed to contaminate non-impacted materials and media. Where necessary to promote the safe, efficient, and environmentally protective performance of work, management of investigation-derived materials and wastes will be performed consistent with the USEPA guidance Guide to Management of Investigation – Derived Wastes, 9345.3-03FS (USEPA 1992). Disposable equipment (including personal protective equipment) will be containerized, appropriately labeled during the sampling events, and disposed of accordingly. Water generated during equipment decontamination will be containerized, temporarily stored at a designated staging area in scalable containers, and disposed or recycled appropriately based on analytical results.

8. POST-CHARACTERIZATION SITE RESTORATION

After soil sampling procedures are completed, the small holes created at near-surface soil sample locations will be plugged with a similar diameter wooden dowel or wood fragment with saw-cut ends that is approximately 0.5 inch shorter than the depth of the hole, and then covered with removed vegetation, vegetation debris, or local soil. This wood will mark the increment location to prevent the location from being re-sampled during future incremental sampling events.

Test pit locations will be backfilled using soils excavated from the pit, and organic material removed from the ground surface prior to excavation will be spread to approximate ground cover conditions prior to excavation. After backfilling, a semi-permanent marker (e.g., metal rod with brightly-colored brass or plastic cap) will be placed at the center of each test pit to mark the area for avoidance during future sampling efforts.

Stakes, flagging, and other temporary markers used during sample collection activities will be removed after each sample collection event, except for semi-permanent markers at the sub-plot corners within each established test plots, and at the location of the test pit on each sub-plot.

9. ANALYTICAL METHOD REQUIREMENTS

9.1 LABORATORY PARAMETERS AND METHODS

The methods listed below include the range of analyses expected to be performed. Laboratory SOPs will be provided and reviewed prior to the start of work. The QA officers at each laboratory will be responsible for conducting and reporting corrective actions if problems arise during the course of laboratory analytical procedures.

Laboratory analytical requirements presented in the sub-sections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. Current USEPA approved and SW-846 methods will be used for all applicable parameters and sample media.

9.1.1 Standard Laboratory Methods

General analytical requirements for soil and for solid waste in Section 9.2.1 of the TCRA QAPP (Arcadis 2015) will be followed for the study, and include the requirements summarized in the following tables:

- Table 9: Sample Containers, Preservation, and Holding Times
- Table 10: Parameters, Methods, and Target Reporting Limits
- Table 11: Analytical QC Limits

The primary sources for methods used in this investigation are provided in Test Methods for Evaluating Solid Waste, SW-846 Third Edition, Update 4 (USEPA 1996).

Analyses in this category will relate to soil samples. Analyses will be performed following the methods and QC frequencies listed in Tables 7a and 7b, with method detection and reporting limits listed in Table 10, and QC limits listed in Table 11. Results will be reported in mg/kg dry weight. Moisture content will be reported separately for each sample.

10. QUALITY CONTROL REQUIREMENTS

10.1 SELECTION OF MEASUREMENT PARAMETERS, LABORATORY METHODS, AND FIELD TESTING METHODS

10.1.1 Field Parameters and Methods

Applicable field parameter measurement procedures are described in this work plan.

10.1.2 Laboratory Parameters and Methods

Soil laboratory analyses will be performed as described in Tables 7a and 7b of this Work Plan. Tables 7a and 7b list by matrix the anticipated analyses to be performed along with the required field QC sample frequencies. Table 9 presents the selected analytical methods organized according to sample matrix, and the preservation and hold time for the analytical methods.

10.2 QUALITY ASSURANCE OBJECTIVES AND CRITERIA

The overall QA objective for this assessment is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action such that valid data will be generated for site assessment purposes. Quality assurance objectives are generally defined in terms of six parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy
6. Sensitivity

Each parameter is defined in Section 10.2 of the TCRA QAPP (Arcadis 2015). Specific objectives for this assessment are set forth in other sections of this Work Plan.

10.3 FIELD QUALITY CONTROL CHECKS

10.3.1 Sample Containers

The sample containers supplied for the project will meet the requirements of USEPA Office of Solid Waste and Emergency Response Directive 9240.05A.

10.3.2 Field Duplicates

Field duplicates will be collected to verify the reproducibility of the sampling methods. In general, field duplicates will be analyzed approximately at a 5 percent frequency (every 20 samples) for critical chemical constituents analyzed in grab samples. For IC samples, up to one set of every four IC sample will be collected in triplicate depending on skewness and dispersion of the discrete sample lead concentration. Tables 7a and 7b summarize the number of field duplicates to be prepared for each applicable parameter at each test plot.

10.4 ANALYTICAL LABORATORY QUALITY CONTROL CHECKS

Internal laboratory QC checks will be used to monitor data integrity. These checks will include method blanks, LCSs, MS/MSD, laboratory duplicates, internal standards, surrogate samples and calibration standards. Project QC limits are identified in Table 11. Laboratory control charts will be used to determine long-term instrument trends.

10.4.1 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, must be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank be initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources that could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

10.4.2 Matrix Spike/Matrix Spike Duplicates

MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices and will be Site specific. MS/MSD pairs will be analyzed at a 5 percent frequency (every 20 samples). Additional sample media volume will be collected to complete the MS/MSD analysis.

When MS recoveries are outside quality control limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results.

10.4.3 Laboratory Control Samples

Laboratory Control Samples (LCS) are standards of known concentration and are independent in origin from the calibration standards. The intent of LCS analysis is to provide insight into the analytical proficiency within an analytical series. This includes preparation of calibration standards, validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

10.4.4 Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions but that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry and GC methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified QC limits, the analytical results must be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable, and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

10.4.5 Laboratory Duplicates

Laboratory duplicates may be analyzed to assess laboratory precision when MS/MSD is not performed. Laboratory duplicates are defined as a separate aliquot of an individual sample that is analyzed as a separate sample.

10.4.6 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the

beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, samples analyzed since the last acceptable calibration check standard will be re-analyzed.

10.4.7 Internal Standards

Internal standard compliance and retention times will be monitored for organic analyses performed by GC/MS methods, and for metals performed by ICP-MS. Method specified internal standard compounds/metals will be spiked into all field samples, calibration standards, and quality control samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, the cause will be investigated, the instrument will be recalibrated if necessary, and all affected samples may be re-analyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

10.4.8 Serial Dilution

The serial dilution of field samples quantitated by ICP-MS determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration is sufficiently high (concentration in the original sample is >50 times the MDL), the serial dilution analysis (a five-fold dilution) shall then agree within a 10 Percent Difference (%D) of the original determination after correction for dilution. If field sample(s) exhibits a sufficiently high concentration, a serial dilution analysis will be performed on an associated field sample in each Sample Delivery Group or one per 20 field samples, whichever is more frequent.

10.5 DATA PRECISION ASSESSMENT PROCEDURES

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation and analysis.

Laboratory data precision for analyses will be monitored through the use of matrix spike duplicates (MSDs), laboratory duplicates and field duplicates.

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = (A - B) \div \big((A + B) \div 2\big) \times 100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement
Precision objectives for duplicate analyses are identified in Table 11.

10.6 DATA ACCURACY ASSESSMENT PROCEDURES

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, laboratory confirmation of field measurements and corresponding linear regression analysis, and adherence to established protocols. The accuracy of field meters will be evaluated by review of calibration and maintenance logs.

Laboratory accuracy will be assessed by using MSs, surrogate spikes, internal standards and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\%\ Recovery = (A - X) \div B \times 100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for MS recoveries are identified in Table 11.

10.7 DATA COMPLETENESS ASSESSMENT PROCEDURES

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \left(\frac{\text{Number valid results}}{\text{Total number of results generated}}\right) \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for the intended purposes.

11. INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Testing and maintenance schedules have been developed for both field and laboratory instruments. This section summarizes the testing and maintenance activities to be performed.

11.1 FIELD INSTRUMENTS AND EQUIPMENT

Prior to field sampling, each piece of field equipment will be calibrated (if necessary) and inspected to confirm that it is operational. If the equipment is not operational, it will be serviced prior to use. All field equipment that requires charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, the appropriate task manager or field personnel will be responsible for following the maintenance schedule and arranging for timely service. Field instruments will be maintained according to the manufacturers' instructions.

11.1.1 Logbooks

Logbooks will be kept for each field instrument. Logbooks will contain records of operation, maintenance, calibration and any problems and repairs. Logbooks for each piece of equipment will be maintained in project records. The task managers will review calibration and maintenance logs.

11.1.2 General Equipment

All measuring and test equipment to be used in support of the field sampling activities that directly affect the quality of the analytical data will be subject to preventive maintenance measures that minimize equipment downtime. Equipment will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to confirm that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to verify that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out. However, in most cases, field personnel will use field meters maintained and calibrated by national, reputable environmental rental equipment companies; calibration and maintenance records are provided with these pieces of rental equipment and will be maintained as part of the project file.

Field equipment returned from a site will be inspected to confirm that it is in working order. The inspection will be recorded in the logbook or field notebooks, as appropriate.

It will also be the obligation of the last user to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts for field equipment/meters will be available from the rental companies or manufacturers. Consultant-/subcontractor-owned or leased equipment will be maintained in accordance with the manufacturer's instructions.

11.2 LABORATORY INSTRUMENTS AND EQUIPMENT

Laboratory instrument and equipment documentation procedures include details of any observed problems, corrective measure(s), routine maintenance and instrument repair (including information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

Maintenance schedules for laboratory equipment adhere to each manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures are performed through service contracts with the manufacturer or qualified contractors. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

Laboratory systems managers are responsible for the routine maintenance of instruments used in the laboratory. Any routine preventive maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used and/or the judgment of the Analytical Laboratory Project Manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

12. INSTRUMENT CALIBRATION FREQUENCY

12.1 FIELD EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Calibration checks will be performed daily or as often is required to ensure the accuracy of field equipment. Field calibration solutions, standards and gases will be used within specified expiration dates and will be obtained from manufacturers or authorized suppliers. Calibration solutions, standards and gases will be discarded or returned to the supplier if expiration dates have been exceeded. Field personnel are responsible for confirming that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. A calibration log for each specific field instrument (as identified by serial/instrument number) will be used to link daily calibrations to that specific field instrument. Where applicable, each log will include, at a minimum, the following information in order to link daily calibrations to specific field instruments:

- Name of device and/or instrument calibrated
- Device/instrument serial/identification numbers
- Calibration method
- Tolerance
- Calibration standard used
- Frequency of calibration
- Date(s) of calibration(s)
- Name of person(s) performing calibration(s)

Instruments and equipment used to gather generate or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. If an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. Equipment found to be out of tolerance during the period of use will be removed from the field, and measuring and testing activities performed using the equipment will be addressed via the corrective action system described in Section 15.3 of this Work Plan.

12.2 LABORATORY EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. The analytical methods for chemical constituents are identified in Tables 7a and 7b. When analyses are conducted according to USEPA methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate laboratory SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to QA audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors. All standards used to calibrate equipment are traceable, directly or indirectly, to the National Institute of Standards and Technology (NIST). All standards received will be logged into standard receipt logs maintained by the individual analytical groups. Each group will maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

12.2.1 Inspection/Acceptance Requirements for Supplies and Consumables

All supplies to be used in the field and laboratory will be available when needed. They will be free of target chemicals and interferences. All laboratory reagents will be tested for acceptability, prior to use in the analyses of Site samples. All standards will be verified against a second source standard. The laboratory will follow a "first in/first out" procedure for the storage and use of all consumables to minimize the risk of contamination and degradation. The various supplies and consumables required will be noted in the laboratory SOPs. The laboratory will be selected prior to implementation of this Work Plan.

13. DATA ACQUISITION REQUIREMENTS FOR NON-DIRECT MEASUREMENTS

Historical data sets have been used in preparing the Work Plan, specifically, data from the 2014 Residential Soil Study (CH2MHill 2016). Historical data that have been generated consistent with appropriate laboratory requirements may be used in decision making as part of the study. The criteria for usable analytical data are that the data must be generated through procedures consistent with good data collection practices such as CLP, must contain backup to facilitate validation, and must be deemed acceptable for use following validation of the supporting laboratory documentation.

14. DATA MANAGEMENT

The purpose of the data management is to provide for the accuracy and ready accessibility of all of the necessary data to meet the analytical and reporting objectives of the project. The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all Site-related information. More specifically, data management procedures will be used to process the information collected efficiently such that the data are readily accessible and accurate. These procedures are described in detail in the following section. The data management plan (DMP) has four elements: 1) sample designation system; 2) field activities; 3) sample tracking and management; and 4) data management system.

14.1 SAMPLE DESIGNATION SYSTEM

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be used during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected. Samples will be identified with a unique designation system that will facilitate sample tracking. An alpha-numeric system is considered appropriate and will be used by field personnel to assign each sample with a unique sample identification number. See Section 7.3 and SOP-5 in Appendix C for specifics on sample identification. Samples will be labeled with their sample identifier immediately after collection using the nomenclature described in Section 7.3 and SOP-5 in Appendix C.

14.2 FIELD ACTIVITIES

Field activities designed to gather the information during the field investigation process require consistent documentation and accurate record keeping. During Site activities, standardized procedures will be used for documenting field activities, data security, and QA. These procedures are described in further detail in the following subsections.

14.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators

realize that field notes are an important part of the review and validation process. To provide for the thorough documentation of the field investigation, several different information records, each with its own specific reporting requirements, will be maintained, including:

- Field logs
- COC forms
- Photographs

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during sampling. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. Items to be included are the locations sampled, the sampling methodologies used, duplicate/replicate and sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any noteworthy events that occurred. So that it can be confirmed at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed by Global Positioning System (GPS) devices or measuring tapes to accurately record their locations. The survey crew will use their own field logs and will supply the sampling location coordinates to the Data Manager.

COC Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the COC procedure.

Photographs

In addition to field logs that detail all observations and measurements made during sampling, personnel performing the field activities will take photographs of observations and field events as necessary to document field conditions accurately. Photographs will be labeled and stored in the Project File (see Section 6.1).

14.2.2 Data Security

Measures will be taken during the field investigation to prevent samples and records from being lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office or locked in the field vehicle. Access to these files will be limited to the field personnel who use them. An electronic copy (e.g., scan to pdf) of all field data and laboratory data are available to all project team members.

14.3 SAMPLE TRACKING AND MANAGEMENT

A record of all field documentation will be maintained to provide verification of the validity of data used in the Site analysis. To execute such documentation effectively, specific sample tracking and data management procedures will be used throughout the sampling program. Sample tracking will begin with the completion of COC forms, as summarized in Section 7.4.4. The completed COC forms associated with samples collected will be photographed and/or scanned and emailed to the Data Manager. Copies of all completed COC forms will be maintained in the field office. The laboratory will verify receipt of the samples electronically (via email) on the following day. When analytical data are received from the laboratory, the QAC or their designee will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed up by the QAC.

14.4 DATA MANAGEMENT SYSTEM

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

The data management plan (DMP) and its amendments establishes standard procedures for management of all documents and environmental data (field and laboratory) generated during the RI/FS (TAI 2010c). The DMP describes procedures regarding creation, acquisition, handling, storage, and distribution of study-related data to data management users. Data management systems and procedures 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, 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 GIS files, and citations of documents related to collection, analysis, or interpretation of environmental data that are stored in the database. A relational database is used to facilitate data retrieval and interpretation. Both current and historical data are stored in the project database. Access to the data is password controlled, with various levels of access available to users on a "need to know" basis, as determined by the project managers.

Geographic information system (GIS). 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 project technical reports.

Web site. (http://www.ucr-rifs.com). Makes available draft documents and other project information via the secure domain. Users with appropriate privileges will be able to download electronic data and documents.

The Phase 1 soil sampling and future SATES activities will use spatial data sets and analyses for planning, data interpretation, decision support, and data presentation. Links between soil data in the project database and GIS files will be established via common identifiers for sampling locations and other geographic features.

14.4.1 Survey Information

In general, the sample grid and each location sampled will be surveyed or located using a GPS with sub-meter accuracy to confirm that accurate documentation of sample locations for mapping and GIS purposes (if appropriate) to facilitate the re-sampling of select sample locations during future monitoring programs, if needed, and for any potential remediation activities. The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sample locations, as appropriate. All field books associated with the surveying activities will be stored as a record of the project activities.

14.4.2 Field Observations

Data that are generated during soil collection and sample preparation will be manually entered into the field logbook, field data forms, and COC forms (see attachments to Appendix B). Data from these sources will be entered into the project database directly

from the field logbook and field data forms or by scanning them and uploading pdf files. These data include sample collection coordinates, plot and subplot designations, sampling dates, sample identifiers and numbers, and additional station and sample information (e.g., weather, visual description of soils). All entries will be reviewed for accuracy and completeness by a second individual, and errors will be corrected before the data are approved for release to data users.

14.4.3 Analytical Results

A variety of manually entered and electronic instrument data are generated at the analytical chemistry laboratory. Data are manually entered into:

Standard logbooks

Storage temperature logs

Balance calibration logs

Instrument logs

Sample preparation and analysis worksheets

Maintenance logs

Individual laboratory notebooks

Results tables for soil measurements (i.e., grain size distribution).

All data manually entered into the laboratory information management system will be proofed at the analytical chemistry laboratory prior to being released. All data collected from each laboratory instrument, either manually or electronically, will be reviewed and confirmed by analysts before reporting.

Laboratory data will be entered directly into the project database through an electronic upload at the laboratory or through conversions of laboratory EDDs to the appropriate format for upload that will be managed by the Database Administrator. The electronic data will then be made available for download and review by the data validator. Data qualifiers will be entered into the spreadsheet and subsequently uploaded into the database along with electronic validation reports.

15. ASSESSMENT AND RESPONSE ACTIONS

Performance and systems audits will be completed in the field and the laboratory during the sampling, as described below.

15.1 FIELD AUDITS

The following field performance and systems audits may be completed during this project. The Technical Team Coordinator and field team leader will monitor field performance. Field performance audit summaries will contain an evaluation of field activities to verify that the activities are performed according to established protocols. In addition, systems audits comparing scheduled QA/QC activities from this Work Plan with actual QA/QC activities completed will be performed. The appropriate Task Manager and QAC will periodically confirm that work is being performed consistent with this Work Plan.

15.2 LABORATORY AUDITS

Internal laboratory audits are conducted by the Laboratory QA Manager. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory QA manual and SOPs. The results of the audits are summarized and issued to each department supervisor, the Laboratory Manager, and the Laboratory Director. A systems audit of each laboratory may be performed by the QA Manager to determine whether the procedures implemented by each laboratory are in compliance with the QA manual and SOPs. As a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification in addition to the laboratory's internal audits. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

15.3 CORRECTIVE ACTION

Corrective actions are required when field or analytical data are not within the objectives specified in this Work Plan. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the assessment are described below.

15.3.1 Field Procedures

If, during field work, a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented by the Field Coordinator or a designee will be documented on a Corrective Action Form and reported to the appropriate Task Manager, QAC, and PM. The QAC or their designee will be responsible for follow-up and acceptance of corrective actions. Examples of situations that would require corrective actions are provided below:

- Protocols as defined by the Work Plan have not been followed;
- Equipment is not in proper working order or properly calibrated;
- QC requirements have not been met; and
- Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

15.3.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented, and reported to the appropriate project manager and QAC.

Corrective action may be initiated, at a minimum, under the following conditions:

- Protocols as defined by this Work Plan have not been followed;
- Predetermined data acceptance standards are not obtained;
- Equipment is not in proper working order or calibrated;
- Sample and test results are not completely traceable;
- QC requirements have not been met; and
- Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities. Corrective action will be initiated upon identification of the problem. At whatever level this occurs (analyst, supervisor, data review or QC), it will be brought to the attention of the Analytical Laboratory QA Manager and, ultimately, the Laboratory Director. Final approval of any action deemed

necessary is subject to the approval of the Laboratory Director. If previously reported data are affected by a situation requiring correction or if the corrective action impacts a project budget or schedule, the action will directly involve the Project Manager (and QAC). Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, reanalysis, cleanup, dilution, matrix modification or other activities.

16. REPORTS TO MANAGEMENT

The QAC will audit the implementation of the Work Plan QA/QC requirements. Each project component will result in some type of QA report or, by its absence, will indicate that no significant QA or QC deviations occurred. Items that may result in a QA report include:

- Changes or updates to the Work Plan;
- Deviations from Work Plan specification;
- Results of system and performance audits;
- Significant QA/QC problems, recommended solutions and results of corrective actions; and
- Limitations on the use of measurement data.

16.1 FIELD REPORTS

Reporting of the quality of field sample collection and field measurements will be the responsibility of the field team leader designated by the Technical Team Coordinator. Information from the field logbooks will be compiled, and a summary report on field activity QA will be prepared for the project file.

16.2 LABORATORY REPORTS

The laboratory will maintain QA records related to analyses, QC and corrective action. This information will be made available to the PM upon request. Routine reporting will include documenting all internal QC checks performed for this project.

17. DATA REDUCTION AND REVIEW

17.1 GENERAL

After field and laboratory data are obtained, the data will be subject to the following:

- Reduction, or manipulation mathematically or otherwise into meaningful and useful forms;
- Data validation;
- Review; and
- Organization, interpretation, and reporting.

17.2 FIELD DATA REDUCTION AND REVIEW

17.2.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks, data sheets, and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the Work Plan and the QA/QC requirements for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and (as necessary) incorporated into the data evaluation process.

17.2.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAC. Logs and documents will be checked for:

- General completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness in comparison to present and past data collected;
- Correct sample locations; and
- Correct calculations and interpretations.

17.3 LABORATORY DATA REDUCTION AND REVIEW

17.3.1 Laboratory Data Reduction

The calculations used for data reduction will be in accordance with the analytical methods. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered must be sufficient to document all factors used to arrive at the reported value. Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using internal standards for GC/MS methodology. Concentration calculations for metals and wet chemistry, if appropriate, will be based on linear regression. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

17.3.2 Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The Laboratory Project Manager will review all data reports prior to release for final data report generation. The QA Manager will review the final data reports, and the Laboratory Director will review a cross section of the final data reports prior to shipment to the environmental consultant. If discrepancies or deficiencies are present in the analytical results, corrective action will be taken, as discussed in Section 15.3. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the Project Manager and QAC for further distribution, as necessary

18. DATA VERIFICATION AND VALIDATION

Data validation is a standardized review process for judging the analytical quality and usefulness of a discrete set of chemical data and is necessary to ensure that data of known and documented quality are used in making environmental decisions that meet the DQOs of the Site. Data validation is a systematic process that compares a body of data to the requirements in a set of documented acceptance criteria to ascertain its completeness, correctness, and consistency.

18.1 DATA VALIDATION PROCESS

All soil data generated will be validated using the USEPA's National Functional Guidelines (USEPA 2010) for data validation available at the time of project initiation, where appropriate. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, and editing to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this Work Plan. Any deviations from the analytical method or any special reporting requirements apart from those specified in this Work Plan will be detailed on COC forms. Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package.
- Verify that field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedances, if they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the methods specified.
- Review QA/QC data (i.e., confirm that duplicates, blanks and LCS were analyzed for the required number of samples, as specified in the method and verify that duplicate RPDs are acceptable).

- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the PM and/or Laboratory Manager, as appropriate. Level 4 data packages may be requested to evaluate anomalies. Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each method:
    - Assessment of the data package;
    - Description of any protocol deviations;
    - Failures to reconcile reported and/or raw data;
    - Assessment of any compromised data;
    - Overall appraisal of the analytical data;
    - Table of Site name, sample quantities, matrix, and fractions analyzed; and
    - Impact to decisions made using deficient data.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without QC qualifiers. Qualified data can provide useful information. During the review process, laboratory qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data reviewer. Results will be qualified with the following codes in accordance with National Functional Guidelines:

Concentration (C) qualifiers

U The analyte/compound was analyzed for but not detected. The associated value is the compound quantitation limit.

J The compound was positively identified; however, the associated numerical value is an estimated concentration only.

Quantitation (Q) qualifiers

For Inorganics:

B The compound has been found in the sample as well as its associated blank, its presence in the sample may be suspect.

E The reported value is estimated due to the presence of interference.

N Spiked sample recovery not within control limits.

Validation qualifiers

U	The analyte was detected at or above the associated detection limit.
U*	This analyte should be considered not detected because it was detected in an associated blank at a similar concentration.
J	Quantitation is approximate because of limitations identified during data validation.
UJ	This analyte was not detected, but the detection limit is probably greater because of a low bias identified during data validation.
UB	Compound considered non-detect at the listed value due to associated blank contamination.
EMPC	Chromatographic peaks are present in the expected retention time window; however, the peaks do not meet all of the conditions required for positive identification. The detection limit represents the estimated maximum possible concentration if the analyte was present.
R	Unusable result; unknown whether analyte is present or absent in this sample.

Two facts will be noted to all data users. First, the "R" flag means that the associated value is unusable. In other words, due to significant QC problems, the analysis is invalid and provides no information as to whether the compound is present or not. "R" values indicate data rejected as part of the validation process and will not be included in the data analyses for the study. The second fact is that no compound concentration, even if it has passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data but any value potentially contains error. Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the QAC at this point. Data validation reports will be kept in electronic format (PDF) at the environmental consultant's office. In addition, data validation reports will also be maintained in the Upper Columbia River Project Database maintained by Exponent.

19. RECONCILIATION WITH USER REQUIREMENTS

The data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- Retrieval of missing information;
- Request for additional explanation or clarification;
- Reanalysis of sample from extract (when appropriate); and
- Recalculation or reinterpretation of results by the laboratory.

These actions may improve the data quality, reduce uncertainty, and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- Extrapolation of missing data from existing data points;
- Use of historical data; and
- Evaluation of the critical/non-critical nature of the sample.

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, additional sample collection and analysis may be required.

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TABLES

Table 1

Summary of Arsenic and Lead Concentrations in Soil
Decision Units 258, 401, and 441
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Decision Unit	Sample Designation	Sample Depth (inches)	Residential Soil Study 2014			
			Total Arsenic (mg/kg)	Total Lead (mg/kg)	Arsenic IVBA (percent bioaccessible)	Lead IVBA (percent bioaccessible)
Incremental Composite Samples						
258	2014R-SS-258-IC-01	0 - 3	43.4	763	na	na
	2014R-SS-258-IC-02	0 - 3	48.2	584	na	na
	2014R-SS-258-IC-03	0 - 3	48.9	686	30.7	80.6
401	2014R-SS-401-IC-01	0 - 3	80.8	1,120	29.3	70.4
441	2014R-SS-441-IC-01	0 - 3	43.6	624	37.8	84
Discrete Samples						
258	2014R-SS-258-D-01-01	1 - 6	21.8	322	na	na
	2014R-SS-258-D-02-01	1 - 6	32.8	132	na	na
	2014R-SS-258-D-03-01	1 - 6	17.6	90.1	na	na
	2014R-SS-258-D-04-01	1 - 6	34	274	na	na
	2014R-SS-258-D-05-01	1 - 6	16.3	185	na	na

Notes:

IVBA = In vitro bioaccessibility
mg/kg = Milligrams per kilogram
na = Not analyzed

Table 2

Test Plot Surficial Soil Types
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Decision Unit	Soil Types Present	Soil Profile			Hydric Soil?	K_{sat} (inches per hour)
		Horizon 1	Horizon 2	Horizon 3		
258	225 - Springdale sandy loam, 0 to 15 percent slopes	0 - 4" ashy sandy loam	4 - 11" gravelly ashy sandy loam	11 - 60" extremely cobbly coarse sand	N	High - 1.98 - 5.95
401	30 - Bisbee loamy fine sand, 0 to 15 percent slopes	0 - 4" loamy fine sand	4 - 18" loamy fine sand	18 - 60" sand	N	High - 1.98 - 5.95
441	85 - Garrison gravelly loam, 0 to 5 percent slopes	0 - 16" gravelly ashy loam	16 - 24" gravelly loam	24 - 60" stratified very gravelly loamy coarse sand to very gravelly sandy loam	N	Moderately high to high 0.57 - 1.98
	172 - Peone silt loam	0 - 14" ashy silt loam	14 -43" silt loam	43 - 60" stratified loamy coarse sand to silt loam	Y	Moderately high to high 0.57 - 1.98

Notes:

K_{sat} = Saturated hydraulic conductivity

Source: U.S. Natural Resources Conservation Service (NRCS) Web Soil Survey at https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Table 3

Soil Characterization Data Requirements
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Soil Parameter	Rationale	Soil Sample Type	Soil Fraction	Minimum Field Collected Soil Volume (grams)	Homogenized and/or Sieved[c] Soil Volume Provided for Analysis (grams)	Minimum Soil Volume Needed for Analysis (grams)	Laboratory Selected for Analysis
Test Plot Screening							
Total arsenic and lead	Confirm concentration and variability across each test plot	Discrete	<2 mm	25	20	10	ALS
pH	Screen for soil chemistry variability; effects bioavailability of metals	Discrete	NA	NA	NA	NA	Probe in field
USCS description	Fundamental soil conditions	Discrete	*In situ*	NA	NA	NA	Conducted in field
Test Plot Characterization							
Total Target Analyte List metals (except Hg)	Establish baseline TAL metals concentrations	Discrete[a]	<2 mm	25	20	10	OSU
		IC	<150 µm	400	20	10	OSU
		IC	<2mm	25	20	10	OSU
SPLP Target Analyte List metals (except Hg)	Confirm long-term metals leachability	IC	<2 mm	250	200	100	ALS
Bioaccessible arsenic and lead (at pH 1.5)	Establish baseline bioavailable metals concentrations in bulk soil and suspendible dust fraction	IC	<150 µm	400	20	10	OSU
Bioaccessible arsenic and lead (at pH 2.5)				400	20	10	
Mehlich III extractable lead and phosphorous	Screening bioaccessible lead levels and available phosphorous levels	IC	<150 µm	800	40	20	OSU
Electrical conductivity	Surrogate for soil salinity	IC	Bulk	40	40	20	OSU
Chloride	Soil nutrient balance	IC	<2 mm	50	40	20	OSU
Sulfate and sulfide	Soil nutrient balance	IC	<2 mm	100	80	40	OSU
Total Carbon and Nitrogen	Soil nutrient balance	IC	<2mm	50	40	20	OSU
Total organic carbon	Soil structure and nutrient balance	IC	Bulk	20	20	10	ALS
Soil moisture holding capacity	Soil structure	Discrete	Bulk	200	200	100	OSU
Grain size analysis	Soil texture	IC	Bulk	200	200	100	OSU
Lead/arsenic and general soil mineralogy	Confirm metals mineralogy related to treatability, soil structure, and nutrient balance	Discrete	< 2 mm[e]	500	--	500	Hazen Labs
		Discrete	< 2 mm	25	20	10	USEPA Cyclotron (Kirk Schekel)
		IC	<150 µm	400	20	10	
Soil horizon descriptions[b]	Fundamental soil conditions	Discrete	*In situ*	NA	NA	NA	Description by soil scientist in field
Bulk density	Soil structure	IC	Bulk	500	500	500	OSU
In situ permeability	Amendment fluid infiltration rates	Discrete	Bulk	500	--	500	HWA Geosciences, Inc.
Soil Collected for Future Analysis (opportunistic sample)	Sample will be collected from 18 to 24" in anticipation of potential future analysis or evaluation.	Discrete	Bulk	To be determined	To be determined	To be determined	Archive at ALS

Notes:
IC = Incremental composite
mm = Millimeter
NA = Not applicable
SPLP = Synthetic Precipitation Leachate Procedure
USCS = Unified Soil Classification System
µm = Micrometer

[a]Discrete samples will be reserved for depth-profile evaluation only

[b]Based on Schoeneberger, et al. 2012

[c]ALS Global Laboratories will receive each sample to be sieved and process them prior to analysis or redistribution to the laboratories listed above. Processing will include homogenization and/or sieving of samples with a specified soil fraction for analysis. Homogenization will be conducted on each IC sample.

[d] Sieved IC sample volumes are reported as 2x the required volume for analysis. Unsieved samples and discrete samples are 1x the required analysis volume.

[e] Sample will be collected as in situ bulk in the field and sieved by Hazen Labs to <2 mm fraction.

Table 4

Primary Soil Amendment Technology Alternatives List
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Amendment Description	Local Supplier Location	Distance to Nearest Supplier (miles from Northport)	Estimated Delivered Cost per Ton	Estimated Treatment Needs (tons per acre)[a]	Material Cost per Treated Acre	Soil Blending Required?
Phosphorous as apatite	None identified, likely in-state	Not known	$200	1	$200	Y
Phosphorous as monoammonium phosphate	None identified, likely in-state	Not known	$500	0.19	$93	N
Wood ash	Kettle Falls, WA	35	$30	8	$240	N
Biochar (wood, agricultural, or blended wastes)	Spokane, WA	110	$40	8	$320	N
Municipal biosolids	Spokane, WA Vancouver, BC	110	$30	10	$300	N
Woody debris	Colville, WA and other lumber mills in region	40	$30	12	$360	N
Compost	Spokane, WA	110	$40	10	$400	N
Manganese oxides (e.g., birnessite)	Outside region	250+	$250 - $1,000+	2	$500 - $2,000+	N
ECOBOND™ Lead	Outside region	250+	$250	21	$5,250	Y

Notes:

[a]Based on assumption of treatment of 800 cubic yards of lead-impacted soil per acre (1 acre to depth of 6 inches) and assumed performance of the amendments.

Table 5

Soil Amendment Technology Alternatives Preliminary Screening
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Amendment Description	1 - Decreases lead bioaccessibility	2 - Enhances soil structure	3 - Improves soil fertility	4 - Applies surficially or with light soil disturbance	5 - Even application over treatment areas	6 - Toxic effects	7 - Aesthetic issues	8 - Local source	9 - Cost	**Subtotal**
Phosphorous as apatite	3	1	2	2	4	5	3	2	2	**24**
Phosphorous as monoammonium phosphate	4	2	4	5	5	4	4	3	5	**36**
Wood ash	2	4	2	4	4	3	3	5	4	**31**
Biochar (wood, agricultural, or blended wastes)	2	5	3	4	4	5	3	4	3	**33**
Municipal biosolids	2	5	5	4	4	3	2	5	3	**33**
Woody debris	2	5	3	4	4	5	5	5	3	**36**
Compost	2	5	5	4	4	5	4	4	3	**36**
Manganese oxides (e.g., birnessite)	4	0	1	2	4	3	3	2	2	**21**
ECOBOND™ Lead	4	3	2	0	4	4	2	2	1	**22**

Notes:

Scoring ranges from 0 (least favorable) to 5 (most favorable)

National Contingency Plan Balancing Criteria key:

Overall protection of human health and the environment - 1, 2, 3
Compliance with ARARs - 6
Long-term effectiveness and permanence - 1, 2, 3
Reduction of toxicity, mobility, or volume - 1, 2, 3
Short-term effectiveness - 1, 2, 3, 4, 5
Implementability - 4, 8
Cost - 9
State acceptance - 1, 2, 3, 7
Community acceptance - 1, 2, 3, 7, 8

Retained as alternative
Eliminated from further consideration as a primary remedy

Table 6

Upper Columbia River Treatability Study Phase I Schedule
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Task	Completion Date	Comments
SATES Phase I Technical Meeting	May 9, 2017	In Northport, Washington
Draft Phase I Work Plan	Late May 2017	- -
Draft Phase I Work Plan Review by USEPA	Mid-June 2017	2-week duration
Final Phase I Work Plan and Response to Comments Document	7/1/2017	2-week duration
Treatability Study Phase I Field Effort	August - October 2017	Two field efforts
Complete Initial Test Plot Screening	August 2017	Approximately 6 - 8 field days
Key Decision Point: Select Test Plots for Full Characterization	September 2017	Engage full technical team for decision
Complete Test Plot Characterization	September/October 2017	Approximately 8 field days
Draft Treatability Study Phase I DSR	January 2018	- -
Draft Treatability Study Phase I DSR Review by USEPA	February 2018	1-month duration
Begin Phase II Planning	February 2018	Scope of work development
Final Treatability Study Phase I DSR Report	March 2018	- -

Notes:

DSR = Data Summary Report
USEPA = U.S. Environmental Protection Agency

Table 7a

Test Plot Screening Soil Sampling and Analysis Summary
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Analysis	Sample Preparation Method Reference	Sample Preparation Procedure	Sample Analysis Method Reference	Sample Analysis Procedure	Number of Soil Samples per Test Plot (Grab Samples 0 - 3" Depth)	QA/QC Samples per Test Plot Field Duplicates
Total Arsenic and Lead	USEPA 3050B	Acid digestion	USEPA 6010	ICP-AES	100	5
pH	NA	NA	NA	Probe	100	NA
Soil description	NA	NA	NA	Unified Soil Classification System	100	NA

Notes:

ICP-AES = Inductively-coupled plasma - atomic emission spectroscopy
NA = Not Applicable
USEPA = United States Environmental Protection Agency

Table 7b

Test Plot Characterization Soil Sampling and Analysis Summary
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

					Number of Soil Samples per Test Plot		QA/QC Samples per Test Plot		
					Sample Type/ Depth				
					Grab	IC[a]	Field Duplicate		Field Triplicate
					Varies (0 - 12")	0-3"	Grab	IC	IC
Analysis	**Sample Preparation Method Reference**	**Sample Preparation Procedure**	**Sample Analysis Method Reference**	**Sample Analysis Procedure**	- -	- -	- -	- -	- -
Total TAL Metals (except Hg)	USEPA 3051A	Acid digestion	USEPA 6010	ICP-AES	24	8[b]	1	0	To be determined[c]
SPLP TAL Metals (except Hg)	USEPA 1312	SPLP	USEPA 6010	ICP-AES	0	4	NA	0	To be determined[c]
Bioaccessible As and Pb	USEPA 9200.2-86 Modified	Glycine extraction (Modified - pH 2.5)	USEPA 6010B	ICP-AES	0	4	NA	0	To be determined[c]
Bioaccessible As and Pb	USEPA 9200.2-86 Modified	Glycine extraction (Standard - pH 1.5)	USEPA 6010B	ICP-AES	0	4	NA	0	To be determined[c]
Mehlich III Extractable Lead and Phosphorous	Mehlich 1984	Acetic and nitric acid; ammonium fluoride and ammonium nitrate; EDTA	USEPA 6010	ICP-AES	0	4	NA	1[d]	0
Electrical Conductivity	NA	NA	SM 2510B	Conductivity Meter	0	4	NA	1[d]	0
Chloride	NA	Water solution	USEPA 300.0	ICP	0	4	NA	1[d]	0
Sulfate	NA	NA	USEPA 300.0	ICP	0	4	NA	1[d]	0
Sulfide	NA	NA	SM 4500-S2D	Probe	0	4	NA	1[d]	0
Total Carbon and Nitrogen	NA	NA	Bremner and Mulvaney 1982, Nelson and Sommers 1982	Dry Combustion at 900°Celsius	0	4	NA	1[d]	0
Total Organic Carbon	NA	NA	USEPA 9060A	IR/FID	0	4	NA	1[d]	0
Soil Moisture Holding Capacity	0 bar	Water saturation	ASTM D2216/Cassel, D.K. and D.R. Nielsen 1986	Gravimetric	4	0	NA	0	0
Grain Size Analysis	NA	NA	ASTM D422	Sieve/Hydrometer	0	4	NA	0	0
Lead/Arsenic and General Soil Mineralogy	NRMRL QMP L18735 ~500 mg of <250 µm freeze dried soil	~100 mg of soil blended with 10 mg of PVP binder, pressed into a 7 mm pellet and encased in Kapton tape	NRMRL QMP L18735 Athena software data analysis	Synchrotron X-rays	1	4	NA	0	0
Lead/Arsenic and General Soil Mineralogy	QEMSCAN® Process	Suspend <2 mm soil fraction in resin, develop polished section	QEMSCAN® Process	SEM/X-ray detectors	1[e]	0	NA	0	0
Soil Horizon Descriptions	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bulk density	ASTM E1109-86	Gross sample homogenized and divided into four sub-samples using the quartering technique	ASTM E1109	Scale	0	4	NA	0	0
In Situ Permeability	NA	NA	ASTM D5084 - 16a	Permeameter	4	0	0	0	NA
Soil Collected for Future Analysis	NA	NA	NA	NA	4 (collected from 18 to 24")	0	0	0	0

Notes:

ASTM = American Society for Testing and Materials
CVAA = Cold vapor atomic absorption
EDTA = Ethylenediaminetetraacetic acid
ICP = Inductively-coupled plasma
ICP-AES = Inductively-coupled plasma - atomic emission spectroscopy
IR/FID = Infrared or flame ionizaiton detector
NA = Not Applicable
NID = Nondispersive infrared detector
NRMRL QMP = National Risk Management Research Laboratory Quality Management Plan
ORP = Oxidation/reduction potential
PVP = Polyvinylpyrrolidone
QEMSCAN® = Qualitative evaluation of minerals by scanning electron microscopy
SEM = Scanning electron microscope
SPLP = Synthetic Precipitation Leaching Procedure
TAL = Target Analyte List
USEPA = United States Environmental Protection Agency

[a] Assumes sample collection from each of four 50'x50' subplots on each test plot
[b] Four soil samples will be sieved to <2 mm prior to analysis, and 4 will be sieved to <150 µm prior to analysis
[c] Triplicate incremental composite sample frequency will be determined based on CV or GSD of the screening analysis lead concentrations by test plot. See discussion in Section 7.1.1.3 in the Work Pl
[d] One duplicate sample will be collected from a single test plot selected randomly. No duplicates for this parameter will be collected from the other test plots
[e] Analysis may be completed on an as-needed basis

Table 8

Test Plot Soil Incremental Sample Collection Plan
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Location	X Coordinate (feet)	Y Coordinate (feet)
Sub-Plot Datum[a]	0	0
Sample Collection Area Boundary		
Sampling Field Corner 1	4	0
Sampling Field Corner 2	4	50
Sampling Field Corner 3	50	46
Sampling Field Corner 4	46	4
Increment Sampling Points		
Increment Sampling Point 1	4	0
Increment Sampling Point 2	4	9
Increment Sampling Point 3	4	18
Increment Sampling Point 4	4	28
Increment Sampling Point 5	4	37
Increment Sampling Point 6	12	0
Increment Sampling Point 7	12	9
Increment Sampling Point 8	12	18
Increment Sampling Point 9	12	28
Increment Sampling Point 10	12	37
Increment Sampling Point 11	19	0
Increment Sampling Point 12	19	9
Increment Sampling Point 13	19	18
Increment Sampling Point 14	19	28
Increment Sampling Point 15	19	37
Increment Sampling Point 16	27	0
Increment Sampling Point 17	27	9
Increment Sampling Point 18	27	18
Increment Sampling Point 19	27	28
Increment Sampling Point 20	27	37
Increment Sampling Point 21	35	0
Increment Sampling Point 22	35	9
Increment Sampling Point 23	35	18
Increment Sampling Point 24	35	28
Increment Sampling Point 25	35	37
Increment Sampling Point 26	42	0
Increment Sampling Point 27	42	9
Increment Sampling Point 28	42	18
Increment Sampling Point 29	42	28
Increment Sampling Point 30	42	37

Notes:

[a]See Figure 10 for datum location relative to each sub-plot

Table 9

Sample Containers, Preservation, and Holding Times
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Analysis	Sieve Fraction	Sample Analysis Method Reference	Sample Analysis Procedure	Container Type	Preservation	Holding Time (from sample collection date)
Total Arsenic and Lead	<2 mm	USEPA 6010	ICP-AES	1 x 4-oz glass jar with Teflon®-lined lid	Cool to <4±2°C	180 days to analysis
Total TAL Metals (except Hg)	<2 mm (grab)	USEPA 6010	ICP-AES	1 x 4-oz glass jar with Teflon®-lined lid	Cool to <4±2°C	28 days to analysis
	<2 mm (IC)	USEPA 6010	ICP-AES	IC Container	Cool to <4±2°C	28 days to analysis
	<150 µm (IC)	USEPA 6010	ICP-AES	IC Container	Cool to <4±2°C	28 days to analysis
SPLP TAL Metals (except Hg)	<2 mm	USEPA 6010	ICP-MS	IC Container	Cool to <4±2°C	28 days to analysis
Bioaccessible As and Pb (at pH 1.5 and 2.5)	<2 mm	USEPA 6010B	ICP-AES	IC Container	Cool to <4±2°C	180 days to analysis
Mehlich III Extractable Lead and phosphorous	<150 µm	USEPA 6010	ICP-AES	IC Container	Cool to <4±2°C	180 days to analysis
Electrical Conductivity	Bulk	SM 2510B	Conductivity Meter	IC Container	Cool to <4±2°C	28 days
Chloride	<2 mm	USEPA 300.0	ICP	IC Container	Cool to <4±2°C	28 days
Sulfate	<2 mm	USEPA 300.0	ICP	IC Container	Cool to <4±2°C	28 days
Sulfide	<2 mm	SM 4500-S2D	Probe	IC Container	Cool to <4±2°C	7 days
Total Carbon and Nitrogen	<2 mm	Bremner and Mulvaney 1982, Nelson and Sommers	Dry Combustion at 900°Celsius	IC Container	Cool to <4±2°C	60 days
Total Organic Carbon	Bulk	USEPA 9060A	IR/FID	IC Container	Cool to <4±2°C	28 days
Soil Moisture Capacity (Water Holding Capacity)	Bulk	ASTM D2216	Gravimetric	Capped 6" driven tube	NA	28 days
Grain Size Analysis	Bulk	ASTM D422	Sieve/Hydrometer	IC Container	NA	180 days to analysis
Lead/Arsenic and General Soil Mineralogy	<150 µm	NRMRL QMP L18735 Athena software data analysis/QEMSCAN®	Synchrotron X-rays	IC Container	NA	180 days to analysis
Bulk Density	Bulk	ASTM E1109	Scale	IC Container	NA	NA
In Situ Permeability	Bulk, undisturbed	ASTM D5084 - 16a	Permeameter	Capped 6" driven tube	NA	NA
Soil Collected for Future Analysis	Bulk, undisturbed	To be determined	To be determined	Capped 6" driven tube (Drive 6" into the base of test pit)	Cool to <4±2°C	To be determined

Notes:

ASTM = American Society for Testing Materials
°C = degrees Celsius
IC = Incremental composite soil sample
ICP = Inductively-coupled plasma
ICP-AES = Inductively-coupled plasma - atomic emission spectroscopy
IR/FID = Infrared or flame ionization detector
mm = Millimeter
NA = Not applicable
NRMRL QMP = National Risk Management Research Laboratory Quality Management Plan
oz = Ounce
QEMSCAN® = Qualitative evaluation of minerals by scanning electron microscopy
RPD = Relative Percent Difference
SM = Standard Method
SPLP = Synthetic Precipitation Leaching Procedure
TAL = Target Analyte List
USEPA = United States Environmental Protection Agency
µm = Micrometer

Table 10

Parameters, Methods, and Target Laboratory Reporting Limits
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

Analyte	CAS Number	Laboratory MDL	Laboratory RL
TAL Metals (6010)			
Aluminum	7429-90-5	30	30
Antimony	7440-36-0	2	4
Arsenic	7440-38-2	2	4
Barium	7440-39-3	0.3	0.8
Beryllium	7440-41-7	0.08	0.2
Cadmium	7440-43-9	0.09	0.2
Calcium	7440-70-2	1	100
Chromium	7440-47-3	0.3	0.8
Cobalt	7440-48-4	0.2	0.4
Copper	7440-50-8	0.4	0.8
Iron	7439-89-6	2	40
Lead	7439-92-1	0.7	2
Magnesium	7439-95-4	0.2	100
Manganese	7439-96-5	0.04	1.0
Nickel	7440-02-0	0.2	0.8
Potassium	7440-09-7	10	100
Selenium	7782-49-2	2	5
Silver	7440-22-4	0.3	0.8
Sodium	7440-23-5	5	100
Thallium	7440-28-0	1	2
Vanadium	7440-62-2	0.3	2
Zinc	7440-66-6	0.2	5
Other Analyses			
SPLP TAL Metals (except Hg)	NA	0.7	1
Bioaccessible Arsenic and Lead (at pH 1.5 and pH 2.5)	NA	NA	NA
Mehlich III Extractable Lead and Phosphorous	NA	NA	NA
pH	NA	NA	NA
Electrical Conductivity	NA	NA	NA
Chloride	NA	0.5	2
Sulfate	NA	10	10
Sulfide	NA	5	5
Total Carbon and Nitrogen	NA	Equal to RL	Varies
Total Organic Carbon	NA	1,000	1,000
Soil Moisture Capacity	NA	NA	NA
Grain Size Analysis	NA	NA	NA
Lead/Arsenic and General Soil Mineralogy	NA	NA	NA
Bulk Density	NA	NA	NA
In Situ Permeability	NA	NA	NA

Notes:

[a]RLs for carbon (C) and nitrogen (N) can vary depending on the amount of soil used in combustion. For example, for a 100 mg sample, typical RLs would be 0.7% for C and 0.05% for N (with 100 mg sample).

Concentrations are reported in milligrams per kilogram dry weight, unless otherwise noted
From USEPA. Office of Solid Waste and Emergency Response. Test Methods for Evaluating Solid Waste. SW-846 3rd ed. Update 4. Washington, D.C. 1996.

The laboratory supplied the lowest method achievable MDLs and RLs to meet the soil standards listed in this table.

CAS = Chemical Abstracts Service

MDL = Method detection limit

mg/kg = milligram per kilogram

NA = Not applicable

RL = Reporting limit

SPLP = Synthetic Precipitation Leaching Procedure

TAL = Target Analyte List

USEPA = United States Environmental Protection Agency

Table 11

Laboratory Quality Control Limits
SATES Test Plot Characterization and Initial Amendment Alternatives Evaluation Work Plan
Upper Columbia River Area, Washington

		Accuracy - Percent Recovery			Precision - RPD		
Analysis	**Sample Analysis Method Reference**	**Surrogate**	**MS/MSD**	**LCS**	**MS/MSD**	**LCS/LCSD**	**Field Duplicate**
Total Arsenic and Lead	USEPA 6010	--	75-125	80-120	30	20	50
Total TAL Metals (except mercury)	USEPA 6010	--	75-125	80-120	30	30	50
SPLP TAL Metals (except mercury)	USEPA 6010	--	75-125	85-115	20	20	50
Bioaccessible Arsenic and Lead (at pH 1.5 and pH 2.5)	USEPA 245.1	--	75-125	85-115	20	20	50
Mehlich III Extractable Lead and Phosphorous	USEPA 6010B	--	75-125	85-115	20	20	50
Electrical Conductivity	USEPA 9045	--	NA	85-115	NA	NA	20
Chloride	SM 2510B	--	80-120	80-120	20	20	50
Sulfate	ASTM G200-09	--	80-120	80-120	20	20	50
Sulfide	USEPA 300.0	--	45-150	55-130	43	43	50
Total Carbon and Nitrogen	Bremner and Mulvaney 1982, Nelson and Sommers 1982	--	23-174	82-131	20	20	50
Total Organic Carbon	USEPA 9060A	--	72-122	72-122	20	20	50
Soil Moisture Capacity	ASTM D2216/Cassel, D.K. and D.R. Nielsen 1986	--	NA	NA	NA	NA	NA
Grain Size Analysis	Sieve/Hydrometer/Pipette	--	NA	NA	NA	NA	20
Lead/Arsenic and General Soil Mineralogy	NRMRL QMP L18735 Athena software data analysis/QEMSCAN®	--	NA	NA	NA	NA	NA
Bulk Density	ASTM E1109	--	NA	NA	NA	NA	NA
In Situ Permeability	ASTM D5084 - 16a	--	NA	NA	NA	NA	NA

Notes:
ASTM = American Society for Testing and Materials
LCS = Laboratory control spike
LCS/LCSD = Laboratory control spike/laboratory control spike duplicate
MS/MSD = Matrix spike/matrix spike duplicate
NA = Not applicable
NRMRL QMP = National Risk Management Research Laboratory Quality Management Plan
QEMSCAN® = Qualitative evaluation of minerals by scanning electron microscopy
RPD = Relative percent difference
SPLP = Synthetic Precipitation Leaching Procedure
TAL = Target Analyte List
USEPA = United States Environmental Protection Agency

FIGURES

DRAFT

RAMBOLL ENVIRON

0 0.25 0.5 Kilometers

0 0.25 0.5 Miles

N

Figure 1
Test Plot Decision Units
Upper Columbia River SATES Program

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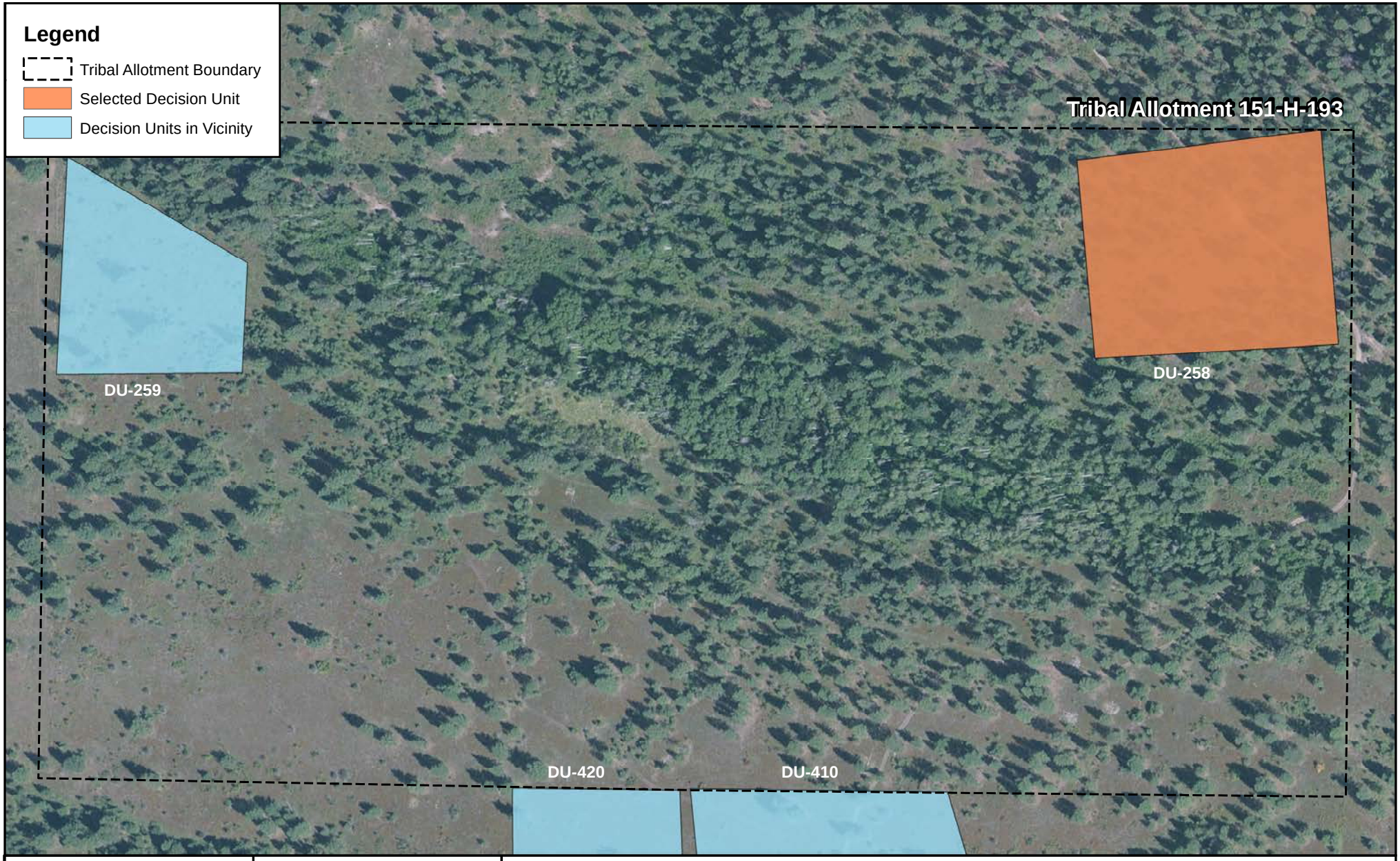


RAMBOLL ENVIRON

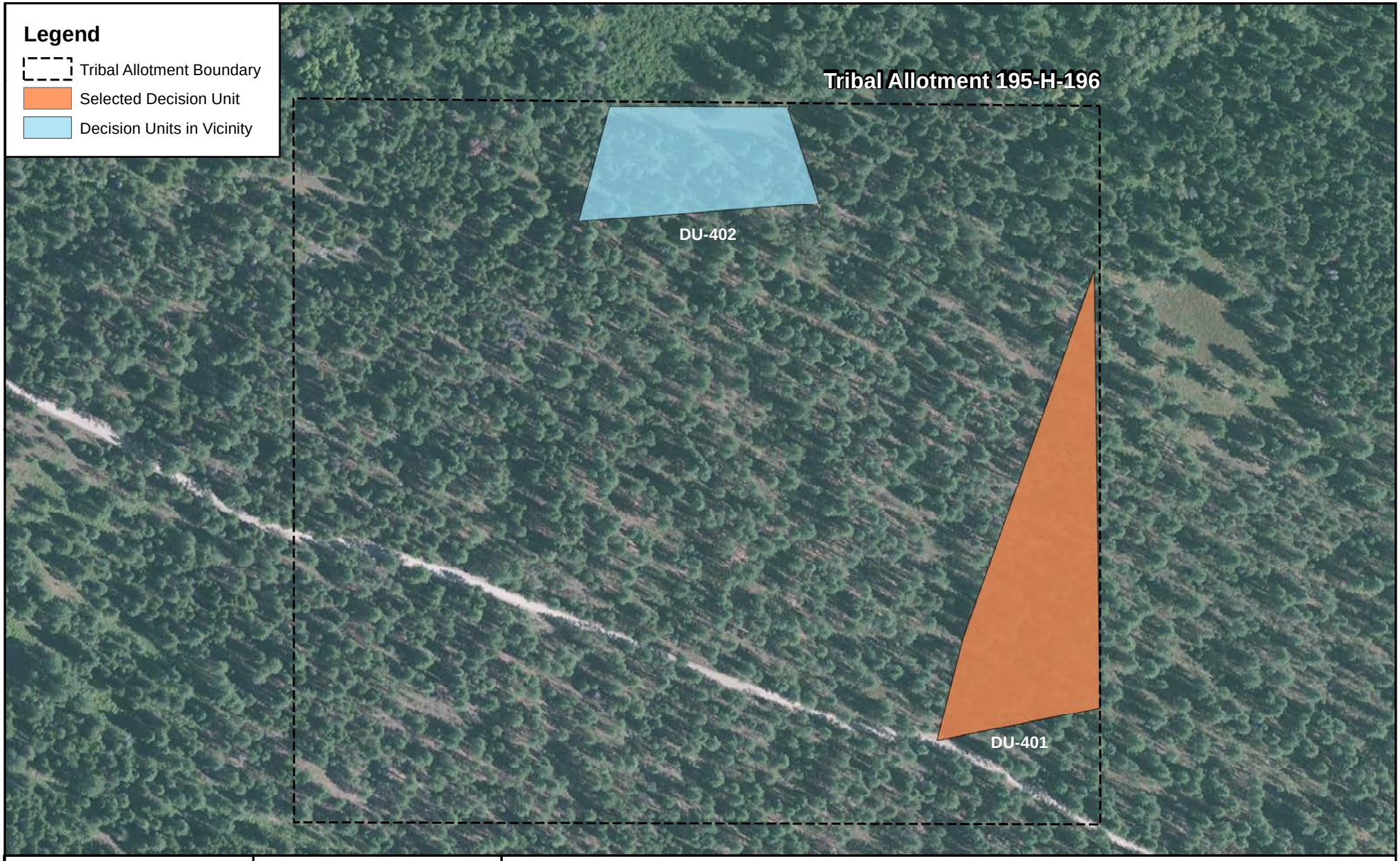
0 25 50 Meters

0 100 200 Feet

N

Figure 2
Decision Unit DU-258 Vicinity
Upper Columbia River SATES Program

DRAFT



RAMBOLL ENVIRON

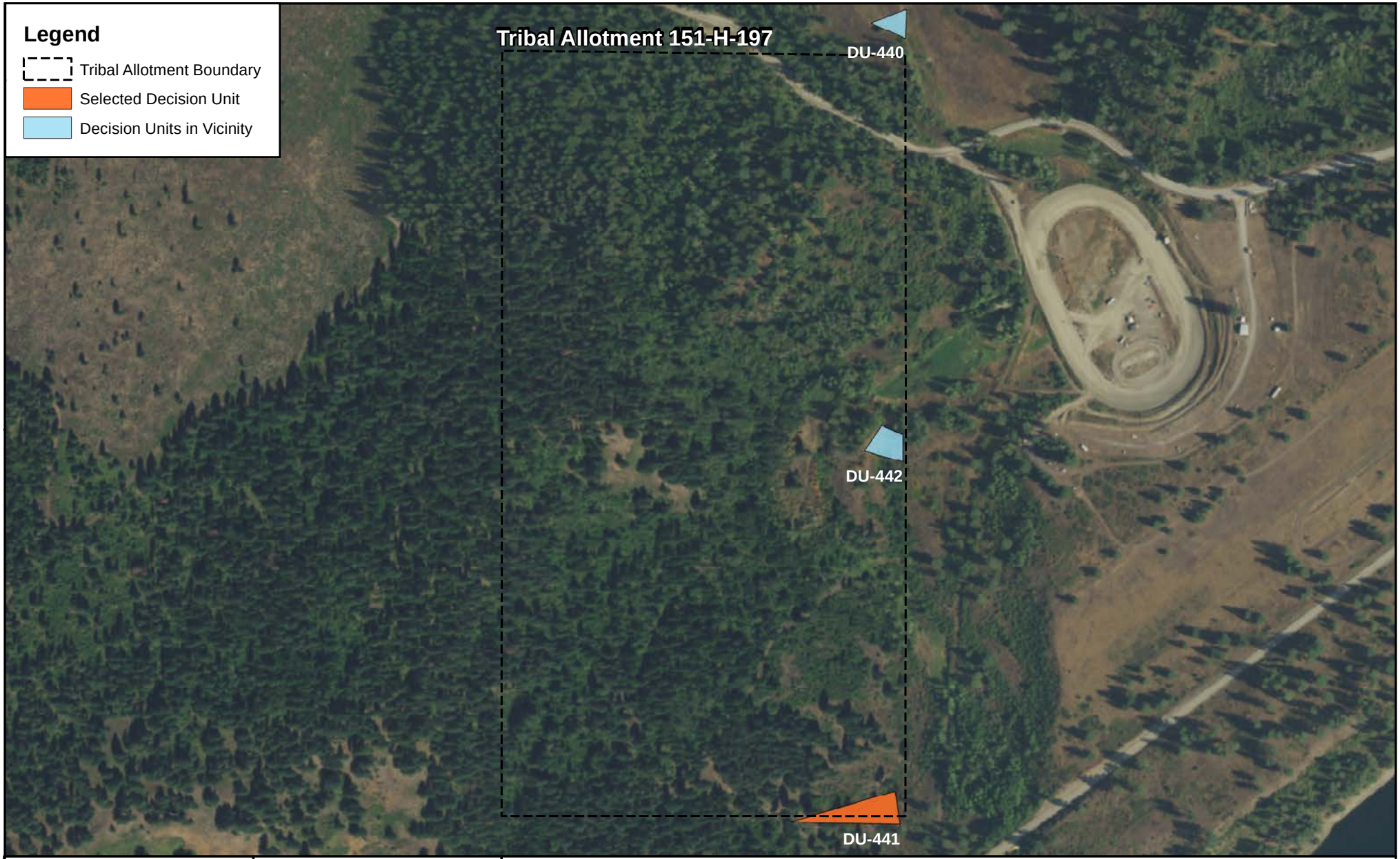
0 25 50 Meters

0 100 200 Feet

N

Figure 3
Decision Unit DU-401 Vicinity
Upper Columbia River SATES Program

DRAFT



RAMBOLL ENVIRON

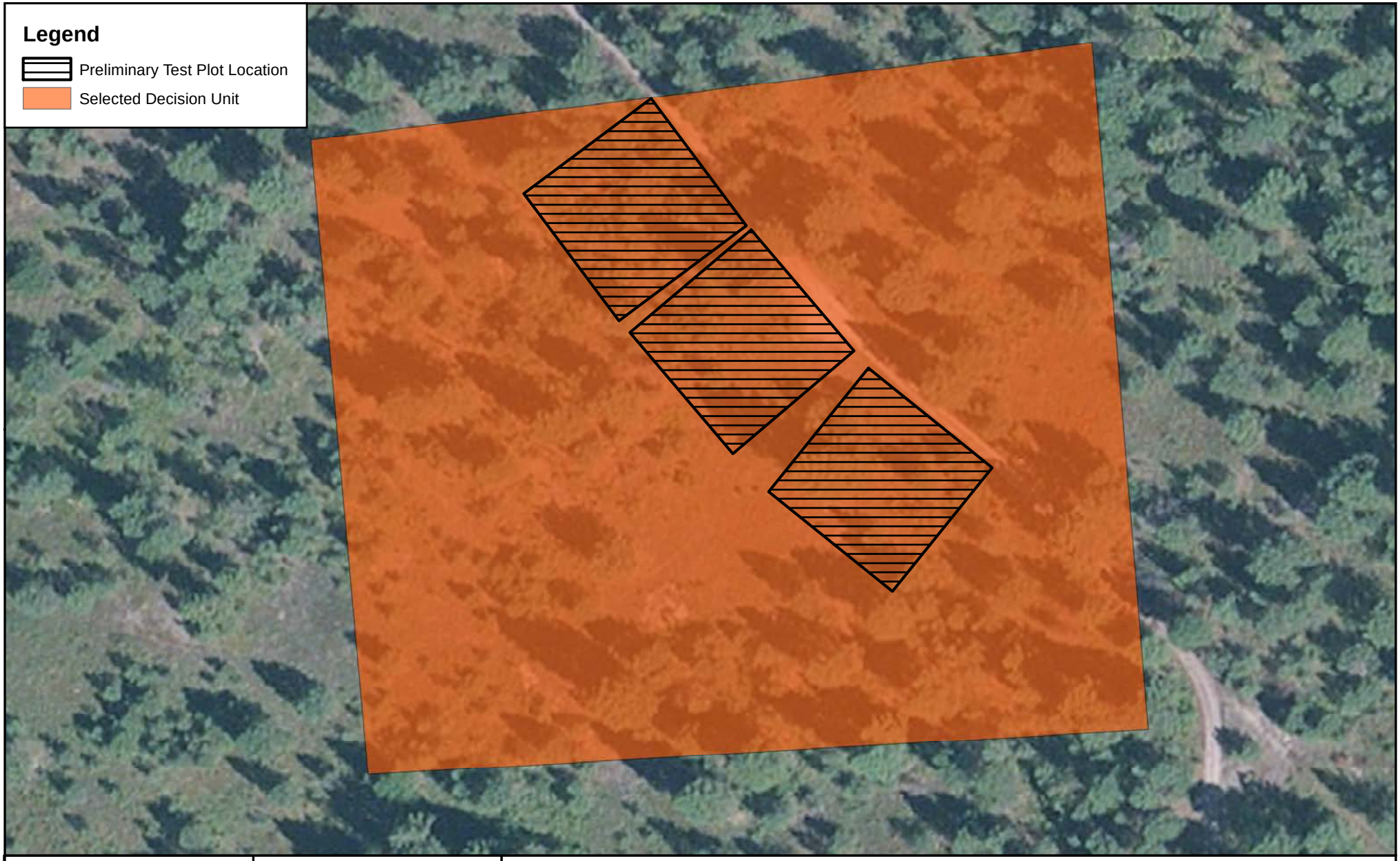
0 25 50
Meters

0 100 200
Feet

N

Figure 4
Decision Unit DU-441 Vicinity
Upper Columbia River SATES Program

DRAFT



RAMBOLL ENVIRON

0 12.5 25 Meters

0 50 100 Feet

N

Figure 5
Preliminary Test Plot Locations- Decision Unit 258
Upper Columbia River SATES Program

DRAFT

RAMBOLL ENVIRON

Figure 6
Preliminary Test Plot Locations- Decision Unit 401
Upper Columbia River SATES Program

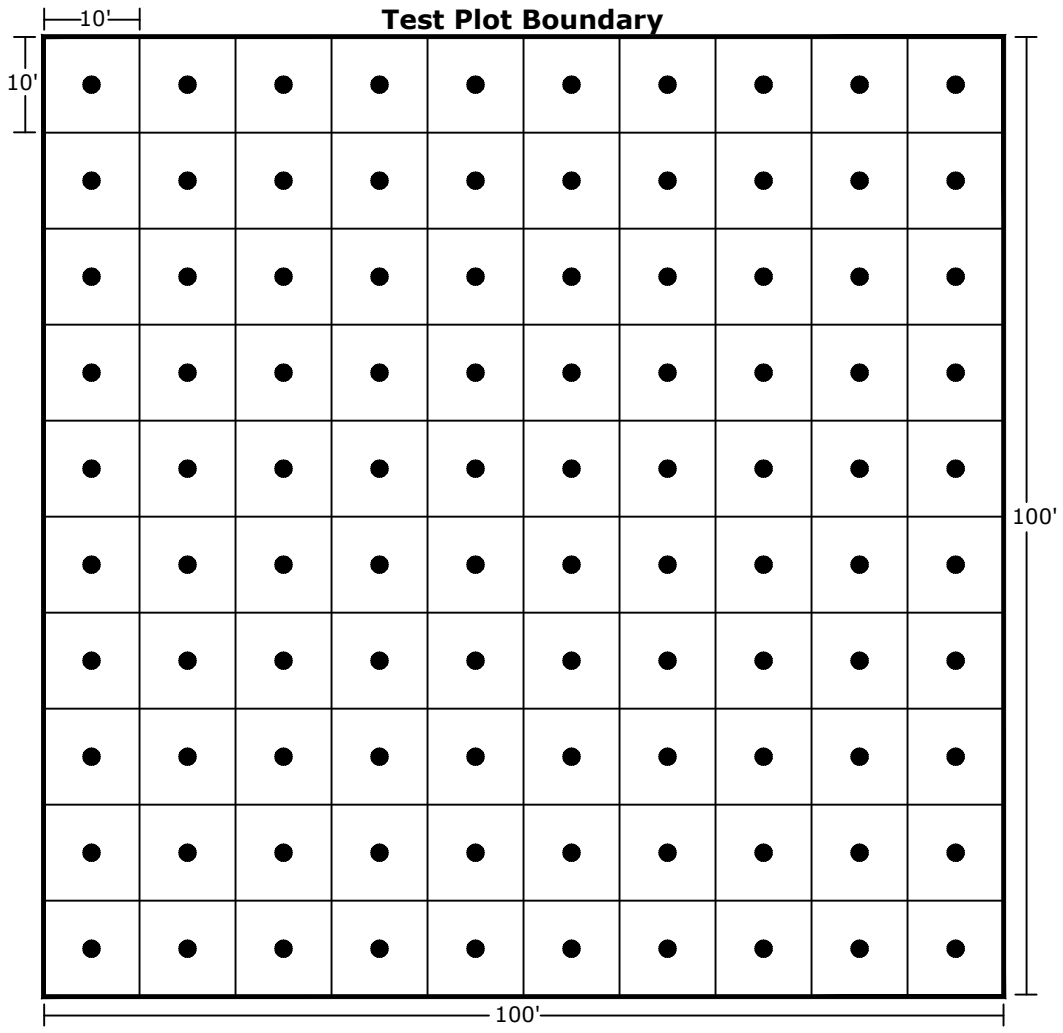
RAMBOLL ENVIRON

0 12.5 25
Meters

0 50 100
Feet

N

Figure 7
Preliminary Test Plot Locations- Decision Unit 441
Upper Columbia River SATES Program



LEGEND:

● SCREENING SOIL SAMPLE LOCATION

0 20

SCALE IN FEET

RAMBOLL ENVIRON

DRAFTED BY: RGM

DATE: 4/28/2017

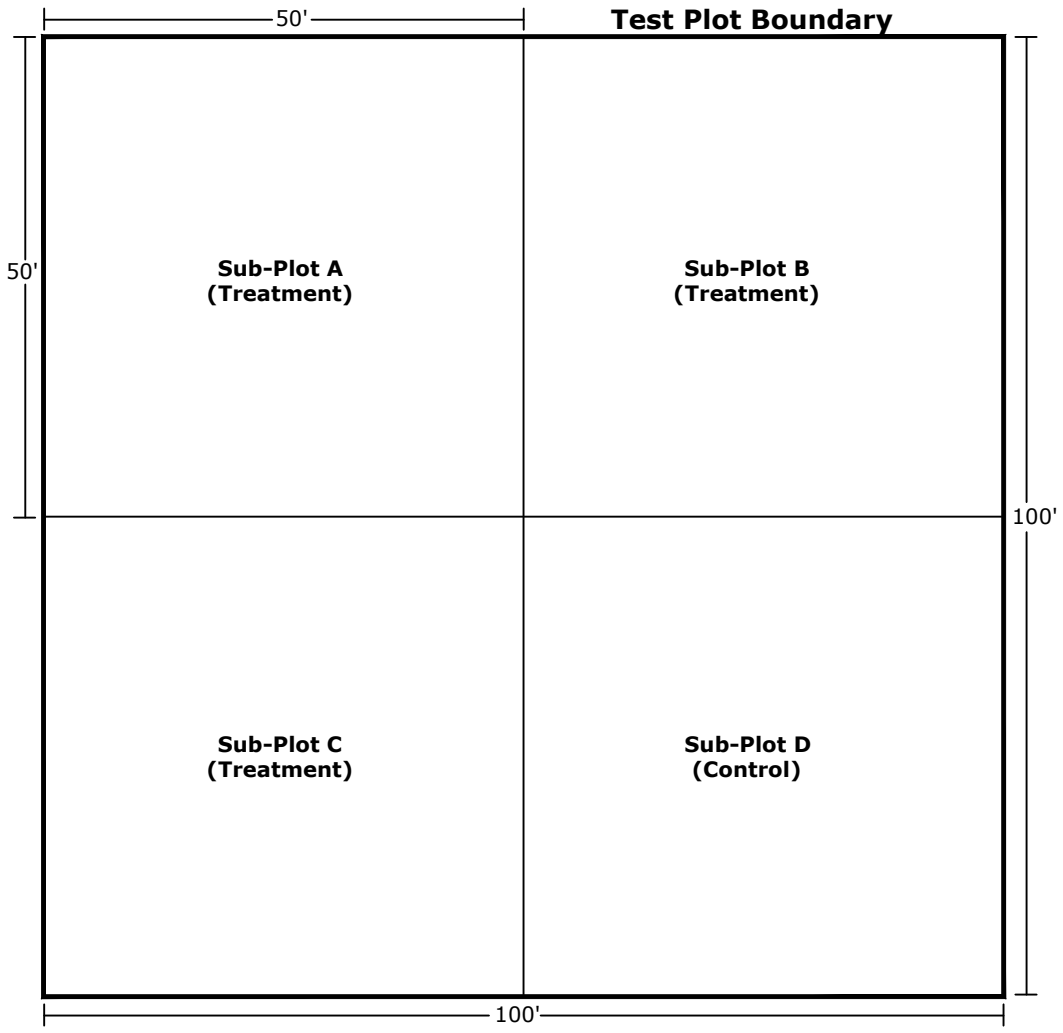
TEST PLOT
INITIAL SCREENING SOIL SAMPLING

UPPER COLUMBIA RIVER
SATES PROGRAM

FIGURE
8

PROJECT: 30-23907E

GMILES 4/28/17 F:\GRAEME\30-23907E < TEST PLOT INITIAL SCREENING SOIL SAMPLING >



0 20
SCALE IN FEET

RAMBOLL ENVIRON

DRAFTED BY: RGM | DATE: 4/28/2017

SUB-PLOT SCHEMATIC
UPPER COLUMBIA RIVER
SATES PROGRAM

FIGURE
9

PROJECT: 30-23907E

GMILES 4/28/17 F:\GRAEME\30-23907E < SUB-PLOT SCHEMATIC >

Discrete Samples

ALS Kelso-Environmental Laboratory

Bulk

HWA Geosciences, Inc.	
Analyses	Soil Volume (g)
In situ permeability	500

OSU	
Analyses	Soil Volume (g)
Soil moisture holding capacity	200

ALS	
Analyses	Soil Volume (g)
Soil Collected for Future Analysis (On Hold)	500

Hazen Labs	
Analyses	Soil Volume (g)
Lead/arsenic and general soil mineralogy	500

Sieve Samples

<2mm

USEPA Cyclotron Kirk Scheckel	
Analyses	Soil Volume (g)
Lead/arsenic and general soil mineralogy	20

OSU	
Analyses	Soil Volume (g)
Total Target Analyte List Metals	20

OSU	
Analyses	Soil Volume (g)
Electrical Conductivity	40
Grain size analysis	200
Bulk density	500

ALS	
Analyses	Soil Volume (g)
Total organic carbon	20

Incremental Composite Samples
(IC Samples)

ALS Kelso-Environmental Laboratory

Homogenize Samples

Bulk ← Sieve Samples → <150 um

<2mm

OSU	
Analyses	Soil Volume (g)
Total Target Analyte List Metals	20
Chloride	40
Sulfate/Sulfide	80
Total Carbon and Nitrogen	40

ALS	
Analyses	Soil Volume (g)
SPLP Target Analyte List metals	200

<150 um

OSU	
Analyses	Soil Volume (g)
Total Target Analyte List Metals	20
Bioaccessible arsenic and lead (at pH 1.5)	20
Bioaccessible arsenic and lead (at pH 2.5)	20
Mehlich III Extractable Lead and Phosphorus	40

USEPA Cyclotron Kirk Scheckel	
Analyses	Soil Volume (g)
Lead/arsenic and general soil mineralogy	20

Note: Sample volume provided is *Homogenized and/or Sieved Soil Volume Provided for Analysis* listed in Table 3.

GMILES 8/3/17 F:\GRAEME\30-23907E < SOIL SAMPLE HANDLING FLOW CHART >

RAMBOLL ENVIRON

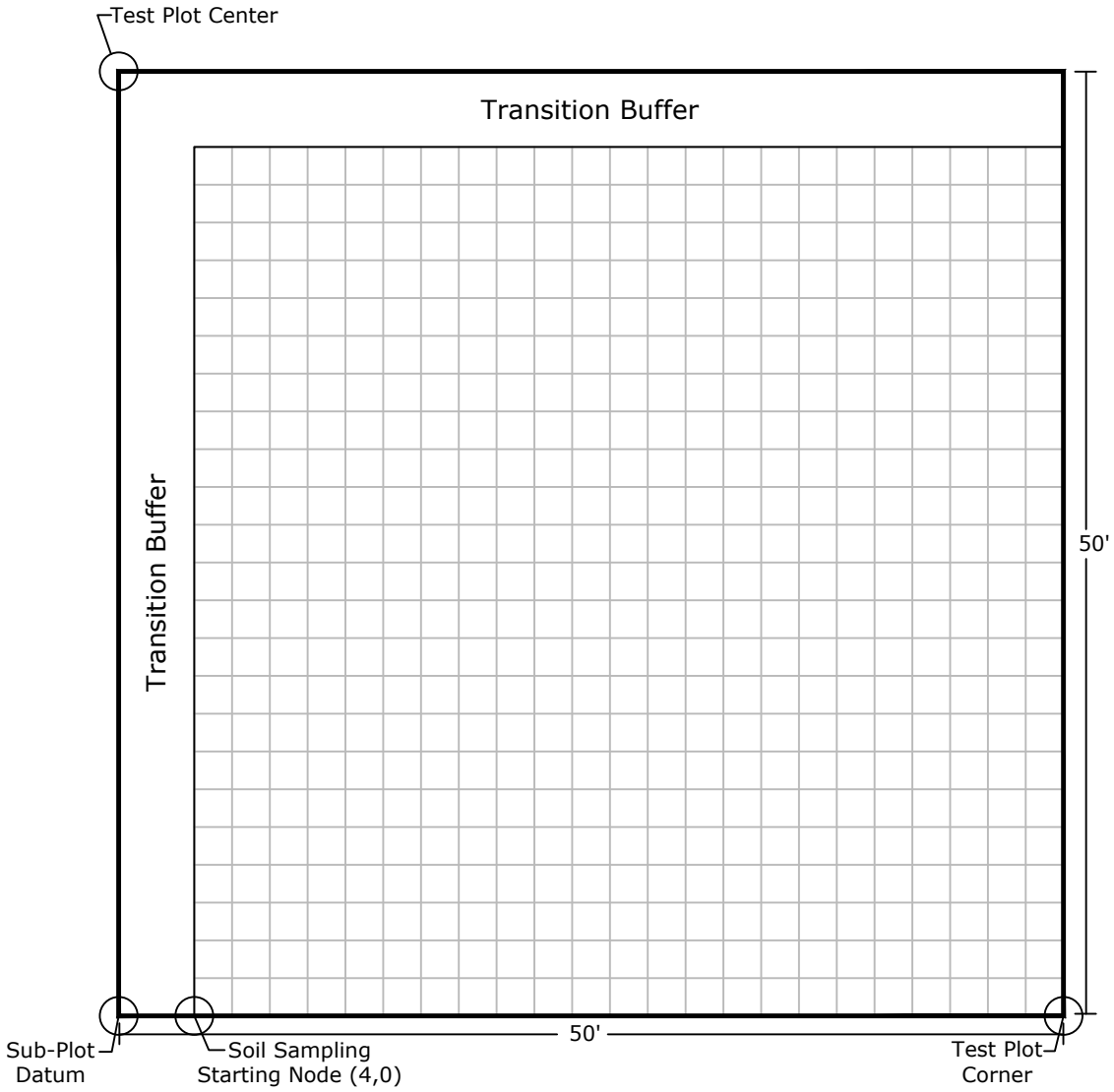
DRAFTED BY: RGM | DATE: 6/22/2017

TEST PLOT CHARACTERIZATION SOIL SAMPLE HANDLING FLOW CHART

SATES TEST PLOT CHARACTERIZATION AND INITIAL AMENDMENTS
ALTERNATIVES EVALUATION WORK PLAN
UPPER COLUMBIA RIVER AREA, WASHINGTON

FIGURE
10

PROJECT: 30-23907E



0 10
SCALE IN FEET

RAMBOLL ENVIRON

SUB-PLOT INCREMENTAL COMPOSITE SAMPLING PLAN
UPPER COLUMBIA RIVER
SATES PROGRAM

FIGURE
11

DRAFTED BY: RGM | DATE: 5/16/2017 | PROJECT: 30-23907E

GMILES 5/17/17 F:\GRAEME\30-23907E < SUB PLOT INCREMENTAL PLAN >

APPENDICES

APPENDIX A

DATA QUALITY OBJECTIVES DOCUMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
HANFORD/INL PROJECT OFFICE
825 Jadwin Avenue Suite 210
Richland, Washington 99352

June 21, 2016

Kris McCaig
Project Manager
Teck American Incorporated
501 North Riverpoint Boulevard, Suite 300
Spokane, Washington 99202

VIA ELECTRONIC MAIL ONLY

Re: UCR Soil Amendment Technologies Evaluation Study DQOs

Dear Ms. McCaig,

As you are aware, the 2014 Residential Soil Sampling program and the 2014 Upland Soil Sampling results indicated elevated levels of metals in the soil in the Columbia River valley. The residential soil results were sufficiently elevated to warrant a Time Critical Removal Action, performed by Teck American Inc. (TAI) on properties with lead over 590 ppm in areas of the property that people frequently use. EPA appreciates that TAI's work to complete these time critical removal actions (TCRAs). During the performance of the TCRAs, EPA, the Confederated Tribes of the Colville Reservation (CCT), and Teck agreed to defer conducting TCRAs at three of the CCT Tribal Allotments in order to study additional less intrusive options for addressing the elevated metals concentrations in surface soil. This agreement was memorialized in Section IV, Paragraph 14 of the 2015 Administrative Settlement and Order on Consent for Removal Action (CERCLA-10-2015-0140):

> Based on communication with the Tribes, the three tribal allotments at which lead was found to exceed700 ppm are not being addressed through this TCRA to allow time to further evaluate removal alternatives. TAI will be addressing the lead and arsenic contamination at these three tribal allotments at a later time.

Section II.A.1. of EPA's Action Memorandum also described the need to defer conducting TCRAs at these allotments in order to conduct additional studies: II. A. 1.

> Sampling conducted in 2014 and 2015 also identified tribal allotments where lead and arsenic concentrations exceed action levels; however, this removal action does not include those tribal allotments because the benefits of alternative removal or remedial techniques are being further evaluated for potential future cleanup actions.

The removal actions conducted in 2015 involved soil removal and replacement around the current highest used areas of the properties. The properties in the study area includes many large properties (1-2000 acres). Soil removals and replacement may not be feasible or appropriate in all situations where metals are above a human health or ecological action levels on Tribal allotments or other private properties. EPA has determined that a treatability test is needed to determine if soil amendment

technologies can be developed as an alternative to soil removal and replacement. The requirement to perform treatability studies is outlined in the 2006 RI/FS Settlement Agreement. Given the work that EPA has already coordinated related to the treatability study, and given the close coordination needed with the Tribes in conducting the treatability study, EPA is proposing to perform the treatability study with Teck's funding.

EPA R10 worked with EPA Office of Research and Development (ORD), Professor Sally Brown from University of Washington, School of Forest Resources and the CCT to develop the UCR Soil Amendment Technologies Technology Evaluation DQOs (enclosed). EPA has assembled a team from ORD and the University of Washington with extensive experience with the evaluation and application of a wide range of soil amendments for remediation. Dr. Sally Brown was one of the lead authors on the US EPA 2007 guide on the use of soil amendments for remediation, revitalization, and reuse. Dr. Kirk Scheckel, Dr. Mark Johnson, and Dr. Todd Luxton with ORD all have ongoing research in the area of soil amendment applications and have supported the design and application of amendment technologies at numerous Superfund sites. In addition, the CCT has offered to work with EPA to allow us to conduct the treatability test on their tribal allotments. EPA would like Teck's support on this approach.

Kira Lynch, the Region 10 Superfund Technology Liaison, will take the lead in developing the treatability test plan and conducting the treatability test. We will continue to share information and documents with TAI for comment and discussion. If TAI has any objections to the approach outlined above, please notify me in writing by July 6, 2016.

Sincerely,

Laura C. Buelow
Project Manager

cc: Kira Lynch, U.S. EPA
Dustan Bott, U.S. EPA
Dan Audet, U.S. Department of Interior
Patti Bailey, Confederated Tribes of the Colville Reservation
Randy Connolly, Spokane Tribe of Indians
John Roland, Washington Department of Ecology

UCR Soil Amendment Technologies Evaluation Study DQOs

June 21, 2016

The purpose of this document is to outline the data quality objectives (DQOs) for a pilot study program to evaluate the potential use of soil amendment technologies as a component of the remedial action for the UCR Superfund site. For purposes of this document two approaches to the use of amendment technologies will be evaluated.

The first approach will incorporate amendments to physically or chemically render the metals, which are present in soil within Tribal allotments/UCR site, less biologically available to environmental receptors. This approach would require incorporating amendments, necessary to directly alter the form of selected metals to reduce their mobility and biologic availability, and under some scenarios could involve or consider large scale disturbance and temporary loss of vegetation. There would likely be minimal to no significant dilution of lead in the surface soil due to the volumetric addition of amendments with this approach. This amendment application approach would only be applicable to sites where it is determined that the negative consequences of disturbance of vegetation and the surface layer are outweighed by the potential remedial action benefits.

The second approach tests selected amendment mixtures placed or applied on the surface of the soil with minimal disturbance to enhance the soil qualities that would reduce potential terrestrial uptake of lead and other metal complexes to reduce potential human or ecological exposure. Soil qualities that could be improved include pH and soil organic matter/carbon. Increasing the pH of a soil will reduce potential terrestrial uptake of lead. Increasing the soil organic matter (SOM) content has many benefits including: a) increased nutrients for improved soil fertility, b) increased cation ion exchange capacity for retaining nutrients, c) improved rainfall infiltration reducing runoff, d) enhanced soil stability/improved soil structure reducing erosion, and e) enhanced and diversified microbial community. Depending on the amendments used, this approach would result in a significant reduction of total soil lead or other metals of concern in the surface amended horizon.

Further surface application of an organic amendment at 1-2 inches can establish a biologically active layer that may reduce exposure and decrease contaminant terrestrial uptake.

The selection of testing site(s) to evaluate the stated approaches to physically or chemically bind metals will require the selection of site(s) where disturbance of the surface layer and loss of existing vegetation will be acceptable so as to effectively test various amendment approaches. For this initial field study, all test plots would be located at the same physical location to allow direct comparison of results. At a minimum the selection of three test plots will be required for the field pilot testing of treatments and establishment of control plots.

1. **State the Problem**
    a. Metals contamination (e.g., As, Cd, Cu, Pb, Zn) in surface soil may present unacceptable risks to people and the environment
    b. Contamination extent is not bounded, but is likely widespread
    c. Contamination occurs in forests and other locations where dig & haul may be highly disruptive and damaging to the environment
    d. Sustainable and feasible alternatives to dig & haul are needed to mitigate risk from metals contamination and assure soil and ecosystem safety, particularly on CCT Allotments and other rural locations where:
        i. Exposure occurs, but is less than an occupied dwelling unit
        ii. Habitat and vegetation would be damaged by heavy equipment
        iii. Access by heavy equipment may limited

2. **Identify the Decision**
    a. Pursue a pilot program to support & inform subsequent steps:
        i. Expand cleanup alternatives or early actions
        ii. Development and Screening of Alternatives
        iii. Feasibility Study
        iv. Proposed Plan
        v. Record of Decision

3. **Identify Inputs to the Decision**
    a. Action levels, screening levels, & PRGs
    b. Soil concentration, bioavailability, chemical & physical parameters
    c. Current land use including soil and vegetation characteristics
    d. Future or desired land use and disturbance
    e. Neighboring land use
    f. Ownership
    g. Access

4. **Define the Study Boundaries**
    a. Areas of unacceptable risk from arsenic & lead and other selected metals in soil.
    b. Initial area includes upper reaches of Columbia River Valley.
    c. Outer boundary is not delineated.
    d. The minimum size recommend for each study plot is 100 X 100 ft. The total number of plots and treatment options will be established.
    e. The expected timeframe for a study and monitoring would be 2 years minimum.
    f. Baseline testing and site surveys will precede amendment treatments.
    g. Amendments options should be identified by evaluating material availability. Transportation cost and availability will have a significant impact on viability so identifying local sources for amendment materials would be important.

h. Laboratory testing of potential biochar amendments would be recommended prior to final amendment selections. Biochar should be evaluated as a potential amendment.
i. The following application methods, at a minimum, will be evaluated: various surface spreading ranging from by hand to with loaders, blowing in composts, ripping materials into the surface, aggressive tillage.

5. Develop a Decision Rule

Experimental designs will be developed. A pilot test program will be designed to answer several key questions in regards to the benefit and cost of a surface soil amendment approach. Bench-scale testing also may be appropriate prior to field pilots. Anticipated questions include:

a. What viable materials are available in sufficient quantity within a reasonable haul distance that would be expected to provide a benefit to soil and/or change in mineral form of the Pb and other metals.
b. What technologies are available for distributing the amendment mixtures and what is the associated cost and difficulty.
c. How does the site look after the amendment mixture has been placed and what is its impact on existing vegetation? What are the reaction cycles? What is the recovery time frames?
d. Have the soil qualities (identified above) been modified as expected?
e. What are reasonable performance goals if this approach was to be applied more broadly? Some ideas for potential performance goals:
    i. Is pH and organic carbon of surface soil horizon optimal to reduce exposure
    ii. Total organic carbon in surface soil horizon
    iii. Surface soil quality as measured by microbial activity (FAME) improved.
    iv. Has the application method allowed relatively complete surface coverage
    v. Has the vegetative cover of the area improved
    vi. Have chemical amendments succeeded in reducing the bioavailable fraction of lead or other metals as determined by the IBVA method or other indicators, and by what relative amounts?
    vii. Has soil nutrient or biological productivity been modified?
    viii. Has there been a reduction in physical exposure potential to protect human health or the environment?
    ix. Have organic amendments resulted in a reduction of lead or other metals bioavailability?
    x. Has the speciation of lead and other metals been altered after amendment application?

6. **Specify Limits on Decision Errors**
    a. Risks
    b. Costs
    c. Benefits, risk reduction
    d. FS & CERCLA Criteria

7. **Optimize the Design for Obtaining Data**
    a. Identify next steps to initiate pilot study
    b. Location criteria
    c. Willing land owners
    d. Define controls & treatments
    e. Define amendment sources or products for application
    f. Monitoring plan & performance criteria
    g. Support remedial action assessment, feasibility study & alternative development

APPENDIX B

EXAMPLES OF 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 ____

Project: TAI UCR Soil Sampling

Samplers: Field S. Ampler, Helper S. Amplers

Example

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: _____ Time: _____

Sampler Signature: _____

Sample Label

Example

Soil

Sample No: _____ Date: _____

Sampler: _____ Time: _____

Preservative: _____

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:

SOIL COLLECTION FIELD FORM

Project Name:______________________________ Project No.:__________________________ Page: ____of_____

Date:______________ Sampling Crew: ____

Weather: __________________________Sampling Equipment____

Time:___________ Station No.:_____________ Elevation: __________________

Latitude:________________ Longitude: __________________ Accuracy: __________________

Sample ID: ____ Depth: ____________

Sample analysis: ____ No. sample containers:____

Soil Volume: ____

Vegetation: ____

Photograph numbers: ____

Comments: ____

Time:___________ Station No.:_____________ Elevation: __________________

Latitude:________________ Longitude: __________________ Accuracy: __________________

Sample ID: ____ Depth: ____________

Sample analysis: ____ No. sample containers:____

Soil Volume:____

Vegetation: ____

Photograph numbers: ____

Comments: ____

Time:___________ Station No.:_____________ Elevation: __________________

Latitude:________________ Longitude: __________________ Accuracy: __________________

Sample ID: ____ Depth: ____________

Sample analysis: ____ No. sample containers:____

Soil Volume: ____

Vegetation: ____

Photograph numbers: ____

Comments: ____

APPENDIX C

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE SOP-1

FIELD DOCUMENTATION

Scope and Applicability

This standard operating procedure (SOP) presents the general information that should be documented for all 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
- Waterproof black-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 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. 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
- Onsite 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 soil composition or transport
- The locations of nearby surface water features (e.g., streams, wetlands, oxbows) or anthropogenic influences (e.g., roads, houses, campsite, evidence of firearm discharge)
- 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 Teck 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 collection of each soil sample 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 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 of 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.). Do not take a photograph without a reference. Use a whiteboard with descriptive information if necessary. Photographs may also be taken of sample characteristics and routine sampling activities. 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 electronic media. The electronic media 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 (or other electronic media)
- Original signed COC forms

SOP-2—ELECTRONIC DATA DELIVERABLE SPECIFICATIONS

Laboratory analytical data generated as part of the Soil Amendment Technology Evaluation Study (SATES) program will be reported in an electronic data deliverable (EDD) format that will be consistent with the EDD format used universally for the Upper Columbia River project. This SOP includes the comprehensive EDD requirements under the UCR project that will be applied to the SATES laboratory data reporting.

The database manager uses several different databases to manage environmental data, including a custom-developed database that can accommodate most types of laboratory quality control data. This document describes the target format for laboratory EDDs that are to be loaded into the database. The target EDD format includes up to 12 data tables that may be completed and provided by the laboratory. These tables describe laboratory samples and analytical methods and contain the results of analyses of environmental samples as well as blanks, spikes, laboratory control samples (LCSs), and surrogates. Depending on the needs of the project, as indicated in the work order issued to the laboratory, from 4 to 12 tables may be relevant for each data package or sample delivery group.

The 12 different tables that form an EDD contain the following different types of information:

- A description of each laboratory data package or set of samples that is analyzed and reported together
- The correspondence between laboratory sample identifiers and client sample identifiers
- Analytical results for each client sample, by laboratory sample identifier
- Details of the preparation, extraction, digestion, and analytical methods used
- The dates of sample extraction and analysis, and the mass or volume of sample analyzed, for each analysis conducted
- Instrument calibration dates
- Laboratory quality control "batches" (which may, but need not, be unique for each data package)
- Laboratory quality control sample descriptions
- Analytical results for spikes and matrix spikes
- Analytical results for method blanks
- Analytical results for LCSs

- Analytical results for surrogates.

The first four of these are the minimum that is required for any project. If laboratory quality control data are also to be reported in electronic format, then some or all of the other tables may also be required (per the work order). This information is also presented in Table C-1.

EDDs should be provided in Microsoft® Access database files, in which each of the EDD tables corresponds to a separate database table. The name of the Access file should correspond to the data package. Other formats can also potentially be used, but should be approved by the database management staff prior to use. The delivery format should be specified in the laboratory work order. Each set of EDD data tables must be accompanied by an electronic version of a transmittal document (or case narrative) that names the data package(s) and the data file(s) that are being transmitted. If an EDD is resubmitted, the transmittal document must also identify specifically which elements (tables and/or laboratory samples) of the previous transmittal are to be replaced.

The fields, or columns, making up each of the EDD tables are described in Table C-2. Information such as sample material descriptions, analyte names, and measurement basis codes should be represented by a consistent set of names or codes, both within and across tables. An explicit list of valid values for analyte names and other similar information has been developed for this project and will be provided to the laboratory. If the laboratory encounters any questions or difficulties while populating the EDD tables, the database manager should be contacted to discuss and resolve the problem.

TABLES

Table C-1. Table descriptions

Table Name	Description	Required[a]	Comment
d_labanal	Analysis dates and aliquot masses/volumes	O	The dates of sample digestion and analysis, and the mass/volume of sample analyzed for each laboratory sample, data package, and method.
d_labcalbatch	Laboratory calibration batch identifiers and descriptions	O	Because instrument calibration data may apply to data in several data packages (SDGs), calibration "batches" can be defined separately from data packages. However, if calibration is performed for each data package, the calibration batch ID and the data package ID may be the same. If the same calibration batch applies to multiple data packages, the calibration batch descriptions need only be provided once, not with every data package.
d_labpkg	Laboratory package (SDG) descriptions	R	Laboratory packages represent distinct sets of samples that are typically analyzed and reported together. Every analytical result for a client sample is linked to a data package description; this table must always be completed.
d_labqcbatch	Laboratory quality control batch identifiers and descriptions	O	Like calibration data, laboratory quality control measurements may apply to data in several data packages (SDGs). Consequently, quality control "batches" can be defined separately from data packages. However, if all quality control measurements are made separately for each data package, the quality control batch ID and the data package ID may be the same. If the same quality control batch applies to multiple data packages, the quality control batch descriptions and data (for LCSs, spikes, blanks, and surrogates) need only be provided once, not with every data package.
d_labqcsamp	Laboratory quality control sample descriptions	O	A list of the identifiers of all quality control samples created by the laboratory (e.g., method blanks and LCSs)
d_labresult	Laboratory analysis results for client samples	R	All of the analytical results for client (database manager) samples.
d_labsample	Laboratory sample identifiers	R	Laboratory sample IDs for each client (database manager) sample number or laboratory quality control sample.
d_lcs	Laboratory control samples	O	Analytical results for LCSs.
d_matrixspike	Laboratory matrix spikes	O	Analytical results for matrix spikes and spike duplicates.
d_methodblank	Laboratory method blanks	O	Analytical results for method blanks.
d_surrogate	Surrogate results	O	Analytical results for surrogates, including both client (database manager) samples and laboratory quality control samples
e_analmethod	Description of laboratory methods (preparation, digestion, analysis)	R	Details of the methods used to prepare, extract, digest, and analyze samples.

Note: LCS - laboratory control sample
SDG - sample delivery group

[a] R = always required; O = optional, depending on work order requirements

Table C-2. Fields per table

Table Name	Column	PK[a]	Data Type	Length Limit	Description	Required	Valid Values[b]	Comments
d_labanal	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_pkg	x	Text	16	Laboratory package (SDG) identifier	x	Per d_labpkg table	
	anal_type	x	Text	10	Type of analysis performed	x	Per d_labpkg table	
	labsample	x	Text	20	Laboratory sample identification	x	Per d_labsample table	
	material_analyzed	x	Text	20	Material analyzed	x	"Soil", "Sediment", "Sediment < 100um", "Porewater", etc.	
	method_code	x	Text	60	Analysis method code	x	Per e_analmethod table	
	date_extracted		Date/Time		Date that the sample was digested or extracted			
	date_analyzed		Date/Time		Date that the sample was analyzed by the specified method			
	mass_gm		Double		Mass of sample (aliquot) analyzed, in grams			
	vol_ml		Double		Volume of sample (aliquot) analyzed in milliliters			
d_labcalbatch	lab	x	Text	50	Name of laboratory performing the analysis	x		
	lab_cal_batch	x	Text	50	Laboratory calibration batch identifier	x		The calibration batch ID may be the same as the data package ID.
	instrument_type		Text	50	Type of laboratory instument used in analysis	x		
	instrument_id		Text	50	Identifier of instument used in analysis	x		The laboratory's identifier for the specific instrument used.
	initial_cal_date		Date/Time		Initial calibration date	x		
d_labpkg	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_pkg	x	Text	16	Laboratory package (SDG) identifier	x		
	anal_type	x	Text	10	Type of analysis performed	x	"Metals", "PestPCBs", "SVOCs", etc.	Should distinguish different types of analyses performed on the same set of samples (typically 20).
	anal_begun		Date/Time		Date the analysis started	x		
	anal_completed		Date/Time		Date the analysis was completed	x		
	analyst		Text	32	Person performing the analysis	x		
	comments		Memo		General notes and information			
d_labqcbatch	lab	x	Text	50	Laboratory performing the analysis	x		
	lab_qc_batch	x	Text	50	Laboratory quality control batch number	x		The laboratory quality control batch ID may be the same as the data package ID.
	prep_date	x	Date/Time		Quality control batch preparation date	x		
	extraction_date	x	Text	50	Date of extraction	x		
d_labqcsamp	lab	x	Text	10	Laboratory performing the analysis	x		
	labqc_samp	x	Text	20	Laboratory quality control sample identifier	x		There should be a matching entry (or entries) in the labqc_samp field of the d_labsample table.
	qc_type		Text	12	Type of quality control sample	x	"MethodBlank", "LCS"	
	comments		Memo		General notes and information			

Table C-2. (cont.)

Table Name	Column	PK[a]	Data Type	Length Limit	Description	Required	Valid Values[b]	Comments
d_labresult	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_pkg	x	Text	16	Laboratory package (SDG) identifier	x	Per d_labpkg table	
	anal_type	x	Text	10	Type of analysis performed	x	Per d_labpkg table	
	labsample	x	Text	20	Laboratory sample identification	x	Per d_labsample table	
	material_analyzed	x	Text	20	Material analyzed	x	"Soil", "Sediment", "Sediment < 100um", "Porewater", etc.	This description should reflect the results of any sample processing in the laboratory that results in a subdivision of the material analyzed, other than just the extraction of an aliquot. Any sample subdivision method should be indicated in the lab_prep_method of the e_analmethod table.
	method_code	x	Text	60	Analysis method code	x	Per e_analmethod table	
	analyte	x	Text	16	Name of analyte measured	x		
	meas_basis	x	Text	10	Measurement basis	x	"Dry", "Total", "Dissolved"	
	lab_rep	x	Text	6	Laboratory replicate identifier	x		
	meas_value		Double		Measured concentration or equivalent value	x		Use the detection limit for undetected measurements.
	units		Text	10	Units associated with the measured value	x		
	std_dev		Double		Standard deviation			Ordinarily carried only for radiological measurements.
	detected		True/False		Was the value detected?			
	detection_limit		Double		Detection limit			
	quantification_limit		Double		Quantification limit			
	reporting_limit		Double		Project-specific reporting limit			
	maximum_limit		Double		Maximum limit for right-censored data			Applicable only to some types of analyses (e.g., grain size fractions calculated by subtraction) where the "detection limit" is an upper, rather than lower, bound.
	lab_flags		Text	8	Laboratory-assigned process notation flags			Flags should identify undetected values, tentatively identified compounds, and any other result-specific observations that affect data interpretation or usability.
	comments		Memo		General notes and information			
	lab_qc_batch		Text	50	Laboratory quality control batch number		Per d_labqcbatch table	
	lab_cal_batch		Text	50	Laboratory calibration batch number		Per d_labcalbatch table	
d_labsample	lab	x	Text	10	Laboratory performing the analysis	x		
	labsample	x	Text	20	Laboratory sample identifier	x		Analytical sample identifier assigned by the laboratory.
	study_id		Text	25	Client (database manager) study identifier	x[c]		A database manager work order number may be used.
	sample_no		Text	20	Client (database manager) sample number	x[c]		The database manager sample number as on the sample container and COC form.
	labqc_samp		Text	20	Laboratory quality control sample identifier	x[c]		
	receipt_date		Date/Time		Date of written acknowledgment of having received the samples			Relevant only when the sample_no field is used.
	coc_id		Text	12	COC form number			Relevant only when the sample_no field is used.

Table C-2. (cont.)

Table Name	Column	PK[a]	Data Type	Length Limit	Description	Required	Valid Values[b]	Comments
d_lcs	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_qc_batch	x	Text	16	Laboratory quality control batch identifier	x	Per d_labqcbatch table	
	lcs_id	x	Text	25	Laboratory control sample identifier	x		
	analyte	x	Text	10	Name of analyte measured	x		
	meas_basis	x	Text	10	Measurement basis	x		
	lcs_type		Text	1	Laboratory control sample type	x	"S" or "L"	Indicates solid or liquid.
	true_lcs_conc		Double		True laboratory control sample concentration	x		
	meas_lcs_conc		Double		Measured laboratory control sample concentration	x		
	lcs_lowlimit		Double		Laboratory control sample lower limit			
	lcs_highlimit		Double		Laboratory control sample high limit			
	units		Text	10	Units associated with measurement	x	e_unit	
	conc_qual		Text	1	Concentration qualifier		e_concqual	
d_matrixspike	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_qc_batch	x	Text	16	Laboratory quality control batch identifier	x	Per d_labqcbatch table	
	labsample	x	Text	20	Laboratory sample identifier	x	Per d_labsample table	There should be a matching row in the d_labsample table (and rows in the d_labresult table),
	method_code	x	Text	10	Analysis method code	x	Per e_analmethod table	
	analyte	x	Text	16	Name of analyte measured	x		
	meas_basis	x	Text	10	Measurement basis	x		
	spike_no	x	Integer		Spike number (replicate)	x		Ordinarily only one spike (data row) for inorganic analytes, two for organics.
	samp_conc		Double		Sample concentration value	x		Ordinarily this value will also be reported in the d_labresult table.
	initial_qual		Text	1	Initial qualifier			
	spike_added		Double		Amount of spike added	x		
	spiked_conc		Double		Spiked sample concentration value	x		
	final_qual		Text	1	Final qualifier			
	lab_flags		Text	8	Laboratory flags			
	units		Text	10	Units associated with measurement	x		
d_methodblank	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_qc_batch	x	Text	16	Laboratory quality control batch number	x	Per d_labqcbatch table	
	labsample	x	Text	25	Laboratory sample identifier	x	Per d_labsample table	
	method_code	x	Text	15	Analyzation method code	x	Per e_analmethod table	
	analyte	x	Text	16	Name of analyte measured	x		
	lab_rep	x	Text	6	Laboratory replicate identifier	x		
	concentration		Double		Measured concentration or equivalent value			
	retention_time		Double		Column retention time			
	units		Text	10	Units associated with measurement	x		
	lab_flags		Text	8	Laboratory validation flags			

Table C-2. (cont.)

Table Name	Column	PK[a]	Data Type	Length Limit	Description	Required	Valid Values[b]	Comments
d_surrogate	lab	x	Text	10	Laboratory performing the analysis	x		
	lab_qc_batch	x	Text	16	Laboratory quality control batch number	x	Per d_labqcbatch table	
	labsample	x	Text	25	Laboratory sample identifier	x	Per d_labsample table	
	method_code	x	Text	15	Analyzation method code	x	Per e_analmethod table	
	surrogate	x	Text	16	Name of analyte measured	x		
	meas_basis	x	Text	10	Measurement basis	x		
	column_no	x	Text	2	Laboratory column number	x		
	lab_rep	x	Text	4	Laboratory replicate identifier	x		
	recovery		Double		Percent recovery	x		
	out_flag		Text	1	Laboratory validation flag			
e_analmethod	method_code	x	Text	15	Analysis method code	x		
	description	x	Text	255	Narrative description of the analysis method	x		
	lab_prep_method		Text	60	Sample preparation method, if used		"Sieved to 100um", "Filtered", "Centrifuged/supernatant"	Describes any physical subdivision of the sample received that is performed prior to analysis, and that results in analysis of material that is different than material received. Use of a sample preparation method may also affect the values used in the material_analyzed and meas_basis fields of the d_labresult table.
	lab_leach_method		Text	60	Sample leaching method, if used		e_leachmethod	Describes any chemical subdivision of the sample received that is performed prior to analysis. Use of a leaching method may affect the value used in the meas_basis field of the d_labresult table.
	lab_extraction_method		Text	60	Laboratory extraction method		e_labextract	Extraction or digestion method. Required if different from any extraction method implied by the analysis method used.
	lab_anal_method	x	Text	60	Laboratory analysis method		e_labmethod	

Note: LCS - laboratory control sample
SDG - sample delivery group

[a] R = always required; O = optional, depending on work order requirements

[a] Primary key.

[b] Values listed here are only examples; other values may also be used as appropriate.

[c] Either study_id and sample_no or labqc_samp must be included.

STANDARD OPERATING PROCEDURE SOP-3

CULTURAL RESOURCES COORDINATION AND REPORTING

Scope and Applicability

This standard operating procedure (SOP) described the procedures to be followed by all Teck American Incorporated (TAI) technical team 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 Soil Amendment Technology Evaluation Study (SATES). 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 U. S. Environmental Protection Agency (USEPA) has responsibilities under the National Historic Preservation Act (NHPA) to consider how its undertakings would affect historic properties. To meet the NHPA requirements, the USEPA must ensure that sampling and other activities would avoid, minimize, or mitigate any adverse effects on any historic properties. The procedures detailed below were developed to assure compliance with the NHPA 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).

Archaeological and Cultural Resources Monitoring in the Sampling Program

Each of the DUs included in the SATES program are located on Colville Tribal allotments; therefore, an archaeological monitor and tribal representative will be present at all times during ground disturbance activities. The archaeological monitor will visually examine all samples to determine if cultural resources are present. The archaeological monitor will not make physical contact with the sample unless cultural deposits are present. If cultural resources are present, the archaeological monitor will record the finding. The cultural resources materials will then be re-deposited at their original location or collected for further analysis at the discretion of the archaeological monitor.

Throughout the course of the project, the archaeological monitor will document their observations on a daily basis in their field notes and photographs. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

The archaeological monitor(s) 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 monitor will also be required to meet requirements for personal protective equipment. In addition and for safety reasons, all on-site personnel are subject to the directions of the task field supervisor at all times.

Discoveries When an Archaeological Monitor is Present

At the discretion of the archaeological monitor, ground-disturbing sampling or associated activity may be slowed or halted at any time that a suspected archaeological resource is encountered. The objective of slowing or halting the ground-disturbing cleanup activity is to allow the archaeological monitor/ to confirm and/or make a preliminary assessment of the discovery. 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, 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, or collected for further analysis at the discretion of the archaeological monitor.

The archaeological monitor or a member of the TAI 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 USEPA 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. If inadvertent disturbance occurs, 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, or other tribal lands, must also be reported immediately to the respective Tribe.

The TAI technical team will assist the archaeological monitor 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 Archeological Monitor is Not Present

As previously stated, an archaeological monitor 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 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 this 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 an archaeologior/and tribal representative in a timely manner. If the archaeologist confirms the presence of cultural resources, 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 provided with training in recognizing these materials by an archaeologist prior to the initiation of any soil sampling.

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 Tribe will designate the curation facility for cultural materials recovered from tribal lands.

Reporting Within 150 days of completion of the field activity that is covered under this plan, an archaeologist will prepare a confidential written monitoring report or letter report that presents the results of the archaeological monitoring and responses to any discoveries of archaeological resources or burials. The report will include: 1) copies of field notes, descriptions, and maps of all locations at which sampling-related archaeological monitoring was conducted; 2) descriptions of any discoveries made during such monitoring and the outcomes of the discoveries (including the rationale for the decisions for the disposition of any finds); 3) descriptions and maps of all non-monitored locations at which inadvertent discoveries were made and the outcome of those discoveries; and 4) recommendations for any changes in the monitoring protocol or coordination plan that may be appropriate to address results of the monitoring or how well existing coordination procedures worked.

The monitoring report or letter report will be provided to the USEPA for dissemination to the consulting parties.

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 TAI of any such inquiries. To the extent permitted by law, prior to any release of information, TAI in coordination with USEPA 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-4

SUBSAMPLING AND COMPOSITING OF SAMPLES

See attached laboratory SOP.

ALS Standard Operating Procedure

DOCUMENT TITLE:	SUBSAMPLING AND COMPOSITING OF SAMPLES
REFERENCED METHOD:	N/A
SOP ID:	SOILPREP-SUBS
REVISION NUMBER:	0
EFFECTIVE DATE:	02/17/2017

ALS-Kelso SOP Annual Review Statement

SOP Code: SOILPREP-SUBS
Revision: 0

An annual review of the SOP listed was completed on (date): **2/17/17**

☐ The SOP reflects current practices and requires no procedural changes.

Supervisor: Date:

☒ Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	**Description of Revision Needed**	**Date Procedure Change Implemented**	**Supervisor Initials** Indicating Approval of Revision
11.7.2	When creating aliquots for METALS, Mercury aliquots should be 5 grams and all other metals aliquots should be 10 grams.	5/30/17	SC

SUBSAMPLING AND COMPOSITING OF SAMPLES

ALS-KELSO

SOP ID:	SOILPREP-SUBS	Rev. Number:	0	Effective Date:	02/17/2017

Approved By: _____ Date: 2/16/17
Department Manager - Les Kennedy

Approved By: _____ Date: 2/16/17
QA Manager - Carl Degner

Approved By: _____ Date: 2/16/2017
Laboratory Director - Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date

TABLE OF CONTENTS

SUBSAMPLING AND COMPOSITING OF SAMPLES

1. SCOPE AND APPLICATION

1.1. This standard operating procedure describes procedures for obtaining subsamples used for laboratory analysis. The procedure also describes general practices for making composite samples from multiple individual samples. Procedures are given for aqueous, soil, sediment, vegetation and miscellaneous matrices. The SOP does not apply to tissue samples. Procedures for tissue samples are described in the GEN-TISP and MET-TDIG SOPs.

1.2. The SOP describes routine, or default, procedures for samples that do not require VOC analyses. Handling of VOC samples is described in SOP VOC-5035. Program or project-specific requirements may differ from those described in the SOP. Samples analyzed by EPA CLP procedures are specifically excluded from this procedure, and will be handled according to the applicable SOW.

1.3. Multi-increment samples require special handling and subsampling procedures. In addition to routine procedures, this SOP also includes instructions for handling and sampling from multi-increment samples submitted to the laboratory.

1.4. This procedure does not apply to situations where the entire sample (container) is used for the analysis.

2. METHOD SUMMARY

2.1. Obtaining a representative analytical subsample from the field sample submitted is essential to providing meaningful data. The subsample must be taken to most closely reflect the predominant composition of the sample. For aqueous and liquid samples, this is usually accomplished by shaking or inverting the sample. For soil, sediment, powders, and other solids the procedures are more involved. Procedures for subsampling are based on the information given in the references listed.

2.2. Some projects may employ multi-increment (MI) sampling in the field. The primary objective of MI sampling is to control the certain statistical errors associated with discrete sampling. Some studies have shown that MI sampling, using 30+ sample increments within a decision unit (a defined field sampling area) may provide a more representative view of contaminant concentrations than traditional discrete sampling approaches. References listed provide additional background on MI sampling. When this approach is taken it is important that laboratory procedures are consistent with field procedures when taking samples.

2.3. Unique sample matrices such as vegetation, wood and wood chips, mechanical parts and filters, etc. pose additional challenges to obtaining representative samples. For these samples the laboratory staff should consult with the Project Manager to determine the subsampling strategy. These special situations will be handled on a case-by-case basis. Service requests should list any specific sample preparation required.

3. DEFINITIONS

3.1. Sample – A portion of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity (ASTM).

3.2. Subsample – A portion of a sample taken for the purpose of estimating properties or composition of the whole sample (ASTM).

3.3. Composite sample – A mixture of multiple samples or subsamples produced to result in one sample representative of multiple field samples.

3.4. Representative subsample – A subsample collected in such a manner that it reflects one or more characteristics of interest (a defined by the project objectives) of the laboratory sample from which it was collected (ASTM).

3.5. Multilayered sample – A sample consisting of two or more clearly differentiated components (ASTM).

3.6. Multi-increment sample (MIS) – A field sample consisting of multiple bulk containers from one decision unit (defined in a MIS sampling plan) submitted to the lab for subsampling into a representative sample for analysis. Also known as Incremental Sampling Methodology (ISM).

4. INTERFERENCES

4.1. When obtaining subsamples it is important to minimize any chances for sample contamination or cross-contamination between samples. Work should be performed in an organized and neat manner. Spilling of samples (from overfilled containers, etc.) should be minimized and spills cleaned up. Equipment and laboratory tools used with samples should be cleaned between samples to prevent cross-contamination.

4.2. Analysis-specific interferences are described in the applicable analytical SOP.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Refer to the analytical SOP for sample collection preservation and storage of samples. Subsamples and composite samples held for later analysis should be preserved and stored in the same manner as specified for field samples.

6.2. MIS Projects

6.2.1. Projects for MI samples may include additional instructions not found in the analytical SOP. The analyst should consult with the Project Manager, or refer to the Project Manager's instructions, prior to working with these samples.

6.2.2. LIMS test codes are used to specify which MIS-analytical tests are needed (e.g. ISM-PAH). These test codes will have holding times associated with them that will ensure the completion of the MIS work before the initial analytical holding times (e.g. sample extraction) lapse.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Dichloromethane, acetone, methanol, and acetonitrile may be used during the noted procedures for cleaning and decontamination of equipment.

8. APPARATUS AND EQUIPMENT

8.1. Laboratory balance capable of weighing the desired sample mass. There are various makes and models of balances available for use, with each department having balances appropriate for its use. For weighing solids and non-aqueous liquids (wastes), use a top-loader balance. Ensure that the mass (sample + container) to be placed on the pan is within the calibration-verified range of the balance.

8.2. Wiley laboratory mill, Model 4. Operate the Wiley mill following the manufacturer's recommendations.

8.3. Sieve shakers.

8.4. Shatter box.

8.5. Mechanical mixer and/or shaker.

8.6. Stainless steel or Glass mixing bowl.

8.7. Metal or disposable spoons and spatulas.

8.8. Aluminum foil.

8.9. Weighing boats, plastic or aluminum

8.10. Clean sample containers and lids (various sizes) as specified in the applicable test SOP.

8.11. Common laboratory glassware/apparatus (beakers, flasks, pipets, syringes, etc.).

8.12. Multi-Increment Samples

8.12.1. Flat spatula, modified to create sides perpendicular to the flat surface used to scoop.

8.12.2. Flat stainless steel masons trowel

8.12.3. Volatile sample containers.

8.12.3.1. 250-500 milliliter (mL) narrow mouth, amber bottles (recommended)

8.12.3.2. 4-8 ounce (oz.) amber jars with Teflon lined septum lids

8.12.4. Large stainless steel spoon or scoop

8.12.5. Large clean containers (a large stainless steel or glass bowl, Ziploc bags, or 5 gallon bucket)

8.12.6. #10 (2 mm) sieve

8.12.7. Stainless steel cookie sheet or other tray.

9. PREVENTIVE MAINTENANCE

9.1. No preventive maintenance is required other than normal glassware and apparatus cleaning.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *ALS-Kelso Training Procedure* (ADM-TRAIN).

11. PROCEDURE

11.1. Aqueous samples - Subsampling

11.1.1. Examine the sample. Thoroughly mix all samples by vigorous shaking. Immediately open the container and obtain the subsample. Additional filtering of the subsample may be required by the analytical SOP.

11.1.2. If the sample is multi-layered (a water layer with a sand/sediment layer that cannot be mixed or non-aqueous liquid layer) the Project Manager should be consulted on how to proceed with the sample. Additional analyses or sample preparations may be necessary depending on the client's data needs. Document the condition of the sample and decision made on subsampling.

11.2. Aqueous samples - Compositing

11.2.1. The customer may require compositing based on flow rates to create a flow proportional composite. The compositing instructions are included with the Form V or other project specification. Equal volume compositing is assumed if there are no specific instructions provided for compositing ratios.

11.2.2. Setup the necessary glassware and/or sample container receiving the composite sample. Ensure that proper measuring glassware is used, typically a graduated cylinder or volumetric flask for larger volumes and pipet or syringe for smaller volumes.

11.2.3. Working quickly, mix the individual samples (as described above), open the container(s) and obtain the composite aliquot. Add each aliquot to the composite container and cap between samples.

11.2.4. Once all composite aliquots are obtained, cap and mix the composite sample. Label the container appropriately. Complete all documentation necessary to describe the compositing procedure, including samples used, aliquot taken, etc.

11.3. General considerations – Non-liquid samples

11.3.1. The analyst must first understand what the sample matrix of interest is. The project information should be consulted. If the sample appears to be homogeneous (other than extraneous materials described below) particle size reduction is not necessary. Particle size reduction should be performed only when required by the project QAPP, project specifications, or client request. If particle size reduction is required, use the appropriate apparatus (Wiley mill, shatter box, etc.) to perform crushing, grinding, milling, or sieving, and document. Refer to ASTM D6323 for guidelines on performing particle size reduction.

11.3.2. Once the matrix of interest is known, examine the sample for presence of extraneous material. The default procedure is to remove these items, or not include in the representative subsample. However, the presence of these materials should be documented in lab records and the Project Manager should be consulted prior to subsampling. Some examples are given below.

- Soil, solid, and sediment samples may include such material as larger rocks, sticks, leaves, pieces of metal, man-made materials, etc.
- Wood or bark samples may include chunks of soil, mud, rocks, etc.
- Vegetation samples may include chunks of soil, mud, rocks, sticks (not of the sample type, etc.).
- Sediment samples may include rocks, twigs, vegetation, organisms, etc.
- Sediment/marine projects, organisms are typically analyzed under separate sampling and analysis plans.
- Mechanical parts, filters, etc., may include chunks of soil, mud, rocks, sticks, etc.

11.3.3. Examine soil samples to determine if the sample contains significant amounts of water. If the amount of water is greater than approximately 30%, treat the sample as a sediment sample.

11.3.4. Samples which are especially heterogeneous, as well as various special matrices, may require additional preparation. These will be handled on a case-by-case basis after consultation with the appropriate supervisors and Project Manager. Unique matrices for TCLP and other leaching procedures should be handled according to the applicable SOP or reference method.

11.4. Soil/solid Samples

11.4.1. Subsampling samples in jars

11.4.1.1. Using a spatula or other utensil made of an inert material, thoroughly mix and homogenize the sample, making sure to loosen sample from the sides of the container, and continue mixing the entire contents, breaking up soil clumps, etc., until there is no visible segregation of the sample by layer, grain size, color, etc. The sample should appear uniform in color and texture.

11.4.1.2. Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.4.2. Subsampling samples in sleeves (core samples) and large bulk containers.

11.4.2.1. Empty samples in sleeves into a metal or glass homogenizing container and thoroughly stir using a spatula or other utensil. When homogenized the appropriate sample portions are placed in jars. Perform additional drying and grinding only when specified for the project. Client specifications for drying and grinding will be communicated by the Project Manager.

11.4.2.2. When working with sleeves and resulting homogenized samples or subsamples, always double-check the sample ID on the sleeve against the sample numbers on the samples.

11.4.3. Compositing soil/solid samples

11.4.3.1. Thoroughly mix each individual sample as described above.

11.4.3.2. Combine equal masses from each of the individual samples into a clean stainless steel mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations using the Composite Data benchsheet (Figure 2).

11.4.3.3. Thoroughly homogenize the sample using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification, dated, and initialed.

11.4.3.4. Return the composite sample and remaining individual samples to storage.

11.5. Sediment Samples - Subsampling

11.5.1. Standard procedure calls for mixing overlying water into the sample. EPA SW-846 methods for organic extractions specify to decant and discard overlying water. However, the Puget Sound Protocols and others have options for decanting and discarding this water, decanting and performing a separate water analysis, or mixing the water into the sample. The analyst should confirm which option is to be used on the sample. For projects not within the scope of the Puget Sound Protocols or similar

project plans, the overlying water should be decanted and discarded for organics analysis. For metals and inorganics, mix the overlying water into the sample.

Note: If water is decanted and discarded and percent solids is to be applied or determined, a separate solids determination must be made on the decanted sample.

11.5.2. Thoroughly mix and homogenize the sample, making sure to mix the entire contents of the jar. Additional steps may be needed to homogenize the sample (break up soil clumps, etc.). The sample should be mixed so there is a uniform color and texture. See section 11.4.1.1.

Note: Sediment samples may contain considerable amounts of organics matter. Ensure that samples and thoroughly mixed. Document the presence of substantial organic matter, shells, etc.

11.5.3. Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.5.4. The subsample is transferred to an appropriate, labeled container. The sample container is stored in the appropriate refrigerator in sample receiving and any empty sleeve can be stored at room temperature.

11.6. Sediment Samples - Compositing

11.6.1. Thoroughly mix each individual sample as described above.

11.6.2. Combine equal masses from each of the individual samples into a clean stainless steel or glass mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations using th4e Composite Data benchsheet (Figure 2).

Note: Equal masses are used unless otherwise instructed. It may be required to use the entire jar or other measure.

11.6.3. The sample is thoroughly homogenized using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification, dated, and initialed.

11.6.4. The composite sample and remaining individual samples are returned to storage.

11.6.5. Samples should be received prepared from the field as sample increments. Although unlikely, in cases where proper preparation of increments from large bulk samples does not occur in the field, the following steps will be taken.

11.6.5.1. When obtaining sample increments from a large bulk container (bucket, large jar, large bag, etc.) be sure to sample from the center and remove the soil 1-2 inches deep. Using the large spoon or scoop, collect the sample increment according to the work plan. Scoop approximately 30-60 grams into a large, clean container and move on to the next sample increment location. Be cautious of oversize material, which means more mass may need to be

taken from each increment to end with the 30–50 g sub-sample after sieving (a 5 Kg field sample may not be uncommon). Increments can be sieved directly into the bucket, or they can be bagged and sieved later.

11.7. Multi-Incremental Sampling (or Incremental Sampling Methodology (ISM)) – When laboratory subsampling using MIS/ISM is to be used to produce the analytical subsample(s), the following procedures are used.

NOTE: Section 11.7.1 lists the default procedure that is to be used when no other client or project specifications or modifications are given. This section refers to two tables – one specifying default increment amounts for analytical and one listing a "large mass" option that is to be used only when project specified. Section 11.7.2 describes the procedures to be used when the State of Hawaii DOH protocol is specified. Section 11.7.3 describes procedures for analysis method 8330B.

If, after reviewing the project and Service Request information, the analyst has any uncertainty of the MIS approach to take, they must confirm with the Project Manager the protocol to be used.

11.7.1. Default procedure

11.7.1.1. After the 30-50 sample increments have been field collected into a container (a 5 Kg field sample may not be uncommon) air dry the entire sample (all received containers) in aluminum pans pre-rinsed 3 times with DCM (dichloromethane/methylene chloride). Note, if Aluminum is a target analyte of interest then substitute the aluminum pans for glass or stainless steel. Air drying may take 2-4 days with occasional stirring.

11.7.1.2. The intent of air drying is to convert the sample to a more manageable form prior to sieving. The sample is considered air-dried when the material appears dry enough to enable disaggregation and sieving. Due to high variability of laboratory samples, sample dryness should be confirmed by a senior analyst or supervisor prior to going further with the procedure. Constant weight data will be recorded on the Constant Weight Data sheet (Figure 3).

11.7.1.3. Rinse all utensils and equipment with DCM three times prior to use (stainless steel tray, mortar & pestle, 2 mm sieve & catch pan, trowel, ISM spatula).

11.7.1.4. Lightly grind the air dried sample with a mortar & pestle in order to break up dirt and clay chunks (do not size reduce rocks or vegetation) and pass sample through a 2 mm sieve.

11.7.1.5. Weigh the remaining +2 mm fraction in an appropriate sized jar and record the weight on the Air Dried Sieve Data benchsheet (Figure 1). Describe the +2mm fraction on the bench sheet (size of rocks, type of any vegetation, etc.).

11.7.1.6. Weigh and record the weight of the -2 mm fraction on the Air Dried Sieve Data benchsheet (Figure 1).

11.7.1.7.Mix the sample, dump on a DCM-rinsed stainless steel pan, and spread the sample out with a trowel, forming a rectangle no more than 1cm deep.

11.7.1.8.Divide the sample into a minimum of 30 equal sections (30 to 50 sections is recommended) using the trowel blade. Note that the entire sample should be included in the grid and amount of sample 'outside' the grid outer edges minimized (however, do not overly manipulate the sample in an attempt to create a perfect grid).

11.7.1.8.1.Collect an equal (approximate) amount of sample from each of the sections based on the applicable table (Table 1 or Table 2) and place into a labeled container (see Tables 1 and 2). Scrape the modified flat spatula along the bottom of the tray and pull straight up to make sure all depths and particle sizes are represented in the collection area. Avoid collecting portions from the edge of gridlines (where the slab has been disturbed). Record the exact final weight of sample for each test on the ISM bench sheet and on the jar. Metals tests should be weighed on an analytical balance. All larger amounts can be done on a 2 place balance.

11.7.1.8.2.Since the each laboratory area must analyze the entire contents of the prepared (or submitted) jar, the subsampling process must be repeated for each separate analysis to be performed on the sample. The subsampling process must be performed for each individual QC sample as well. The entire mass in the jar will be analyzed (TOC is the exception). The results may be less defensible if only a subsample or fraction of the jar contents is analyzed.

11.7.1.8.3.If sample amount is sufficient, it is recommended to repeat the process to obtain a backup sample in the event that re-analysis is required. This 'As Received' backup is placed back in the original sample jar and returned to sample management/custody.

11.7.1.9.Labeling and storage

11.7.1.9.1.Refer to Table 3 for default storage conditions, which are based on how the MIS sample was prepared and on the stability/volatility of target analytes.

11.7.1.9.2. MIS subsamples do not need to be returned to SMO for barcode labeling. Label the sub-aliquots with LIMS sample labels and deliver them to the designated storage areas for each lab section performing analysis. Document the internal custody transfer in a logbook, on the benchsheet, or similar fashion. .

11.7.1.9.3.Place any remaining -2mm sample into jars labeled as "-2 mm archive." If there are multiple jars, label them as "1 of 3", "2 of 3", etc. All remaining bulk sample jars must be returned to SMO for barcode labeling and storage.

Usually, the -2 mm archive and test archive (back-up samples) jars are placed in a freezer, while the +2 mm archive and test jars (with QC) are placed on the room temperature shelves.

11.7.2. Procedure for ISM following State of Hawaii DOH Protocol (see references)

11.7.2.1. Samples requesting the Hawaii DOH procedure require wet and/or dry sieving depending on the test/analytes for which subsamples are being prepared. Refer to a copy of the Hawaii DOH procedure and/or the Project Manager for details before beginning.

11.7.2.2. Obtain instructions from the Project Manager or Service Request for increment amounts and test subsample amounts. Also refer to the *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, November 12, 2008, Section 4.2.2 for guidance on increment/sample amounts.

11.7.2.3. Subsample bulk MI samples to be tested for SVOCs, including TPH-D, some PAHs, and Mercury, unstable pesticides, should be subsampled without drying or sieving in order to minimize chemical loss or alteration and meet holding times for analysis. Refer to Table 2a. of *Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations* , March 2011, State of Hawaii, Department of Health, Reference document number 2011-143-RB.

11.7.2.4. If both SVOC and non-volatile PAHs are targeted contaminants of interest then include testing for both in laboratory subsamples collected from the multi-Increment sample prior to drying and sieving.

11.7.2.5. For wet ISM aliquots, organic tests (SVG/SVM) require a larger aliquot size to accommodate for the extra water content. In most cases, low-level organic tests will require a 40 g wet aliquot (max weight capacity for most tests) and normal level tests will require a 20 g wet aliquot (double the target dry weight).

11.7.2.6. Use a separate sample from the wet material and test for soil moisture in order to convert analytical results to dry-weight basis.

11.7.2.7. Not all samples from Hawaii require the State of Hawaii DOH procedure. See service request and/or verify with the Project Manager.

11.7.3. Procedure for ISM on 8330B Explosives

11.7.3.1. Samples from Ammunition Depots and anywhere except Firing Ranges (not DOD)

11.7.3.1.1. Follow the basic ISM procedure, except all utensils/pans need rinsed 3 times with Acetonitrile (instead of DCM). Collect a 10.00 g aliquot and place in a 4 oz amber jar (explosives are sunlight sensitive).

11.7.3.2. Samples from Firing Ranges

11.7.3.2.1.Grinding: For firing ranges, the entire -2 mm portion collected from the sieving procedure must be ground to a powder in the shatter box.

11.7.3.3.Method 8330B DOD samples

11.7.3.3.1.Grinding: For DOD work, the entire -2 mm portion collected from the sieving procedure must be ground to a powder in the shatter box prior to proceeding. Note: high-speed milling, such as in the shatter box, can elevate sample temperature due to friction. The thermal stability of the target analytes should be considered when performing this grinding procedure. Method 8330B specifies a 2 minute (or longer) cool down period between five 60 second grinding intervals to maintain acceptable temperatures and minimize loss of volatile energetic contaminants.

11.7.3.3.2. An SRM (supplied by the Organic LC instrument lab) must be taken through the grinding and ISM procedure (already dry so doesn't need to be air dried or sieved). Shatter box 50 - 100 g of the well-mixed SRM, and then make a 10 g aliquot after grinding. Place the aliquot in 4 oz amber jar. Archive the remaining SRM in an amber jar.

11.7.3.3.3.Grinding Blank: Matrix sand blanks (use baked sand) must be ground in the shatter box between each sample and aliquoted following the ISM procedure. The blanks can be ground in equal portions and then recombined at the end to make one sample requiring one ISM aliquot procedure. (Example: To ISM a 200 g portion for use in making the final 10 g aliquot, divide 200 g by the number of samples needing shatter box and grind that amount of matrix sand between each sample. Recombine all ground matrix sand at the end and ISM one 10 g aliquot from the 200 g of ground matrix sand.) Archive the remaining matrix sand in an amber jar.

11.8. Analyte-Specific Considerations

11.8.1. Metals

11.8.1.1.It has been proven that grinding can greatly improve the reproducibility for metals analyses. However, erosion of the metals surfaces used in grinding may contribute to a high bias in the samples. It is recommended that the tungsten carbide grinding mill is used when grinding soils in the shatter box thereby limiting the amount of potential bias in the prepared samples.

11.8.1.2.When grinding soil samples that may potentially contain ores of malleable metals (e.g. Lead, Copper, Tin) be aware that the malleable particles may tend to smear during grinding, and may be lost from the samples to equipment surfaces. This anomaly may bias sample results low, decontamination of equipment surfaces may be difficult and could result in high bias in subsequent samples from carry over.

11.8.1.3. Reproducibility for Lead analyses in unground, incrementally sampled (IS) samples from small arms firing ranges may have an unacceptable large variability. The large variability for Lead may be due to single particles of Lead between one and two millimeters in diameter being present in only some of the replicate splits. If the end data is to assess risk of accidental ingestion of Lead, precision for the concentration of lead contained in larger particles may be of less interest then the Lead contained in the finer, less than 0.25 mm, fraction. Using a finer mesh sieve (0.25 mm rather than 2 mm) may improve precision and reproducibility. However, sieving unground samples through sieves finer than two millimeters is not appropriate if analyzing for high explosives or propellants. Typical mass sizes for energetic analytes are in particles sizes greater than 0.59 millimeters.

11.8.1.4. MI samples collected for Arsenic analyses that contain greater than 20 mg/Kg total Arsenic should be tested for bioaccessible Arsenic. This should be discussed with the project manager. If deemed appropriate, the entire <2 mm fraction of the respective samples should be sieved to a ≤0.25 mm, representatively sub-sampled and analyzed for bioaccessible Arsenic using SBRC methodology, 1-2 grams are required.

11.8.2. Polycyclic Aromatic Hydrocarbons (PAHs)

Currently there is little information in published procedures specific to the laboratory processing of ISM samples for PAHs. The default procedure above is used, but the 8330B procedure is an acceptable option if specified.

11.8.3. Perchlorate

11.8.3.1. Currently there is little information in published procedures specific to the laboratory processing of ISM samples for Perchlorate. Laboratory processing of samples per EPA Method 8330B as described in Section 11.7.3 is recommended. A 10 gram sample is required for propellants and explosives. It is recommended that a 10 gram ISM sample should be extracted with 100 mL of DI water for Perchlorate analysis by EPA Method 314.0.

11.9. Vegetation samples

Since vegetation samples often are not amenable to standard mixing and homogenization techniques, or because specific sections of the vegetation are targeted, these are handled on a case-by-case basis with instructions from the Project Manager. The PM will obtain sample-specific instructions from the client, and then communicate the specifications to the lab personnel using the ALS Form V or similar project specification document for the project. If the client makes reference to specific procedures, methods, or technical references, the PM will make the document(s) available to the laboratory personnel.

11.10. Paperboard samples

11.10.1. In general, prepare paperboard samples as described below. Project-specific instructions may replace these.

11.10.2. Review the Service Request and determine the jars you will need. In general, the jars needed are as follows:

Metals = 8 oz. jar.
VOA = 8 oz jar.
Dioxins = 8 oz jar.
SVG = 32 oz jar.
SVM = 32 oz jar.
PHC (8315) = 8 oz jar.
Gen Chem (not Biology) = 8 oz jar.

11.10.3. Make sample labels according to test and put on appropriate jar.

11.10.4. If FDA Ext is on the Service Request for PHC you will need a 16 oz jar per sample. Do Not Composite into one sample. Each sample is a separate sample.

11.10.5. Prepare the FDA Ext first.

- Cut the sheet of paper into one 10" x 10" square.
- Cut the 10" x 10" into strips at the cut lines 7 ½, 5, and 2 ½.
- Cut the strips at the cut lines 7 ½, 5, and 2 ½. This will make 16 2" squares.
- Put each sample into its own jar and label accordingly. i.e. (1, 2 3, etc.); PHC will composite in the lab.

11.10.6. Put one sheet of paper into shredder, run the shredder back and forth to get the entire sample out. Use tongs to remove any remaining sample in bottom of shredder (make sure to turn off before you do this)

11.10.7. Shred equal amounts of each sample (1 or more sheets) to create the composite sample. Homogenize sample thoroughly and aliquot into each jar needed for analysis. Put sample storage on lid of jar.

11.10.8. Dioxins are sent out to Houston. Label the lid "Out".

11.10.9. Take all composites to Sample Management for ALS labeling and shelving.

11.10.10. Update composites as being done….Open Starlims, double click on Ad Hoc by Test (Under Results entry), highlight samples composited and click the Update to Done button at the top of page. Do not add jars when asked. Just click the X on the right hand corner.

12. QA/QC REQUIREMENTS

12.1. Ongoing QC Samples required for each sample batch (20 or fewer samples) are described in the SOP for Sample Batches and in the determinative SOPs.

13. DATA REDUCTION AND REPORTING

13.1. All compositing and subsampling data must be recorded into the bench records by the analyst. In addition to sample volumes and masses, sample identifications, etc., this should include descriptions of unique samples or sample components. Figure 1 shows the current MIS benchsheet template used to record MIS subsampling. Other project-specific benchsheets may apply.

13.2. It is the supervisor's responsibility to ensure that analytical data is reviewed and to ensure that all quality control requirements have been met.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for corrective action procedures. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example. Table 4 lists typical actions taken.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. Not applicable.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

16.2. It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

16.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

16.4. This method uses Dichloromethane and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

17. TRAINING

17.1. Training outline – Training Plan

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of time. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.2. Training is documented following the SOP *ALS-Kelso Training Procedure* (ADM-TRAIN).

17.2.1. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. Not applicable.

19. REFERENCES

19.1. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples, U.S. Environmental Protection Agency, EPA/600/R-03/027, November 2003.

19.2. Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities, ASTM D 6323, Annual Book of ASTM Standards, 1999.

19.3. Test Methods for Evaluating Solid Waste, EPA SW-846, Final Update III, December 1996.

19.4. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, January, 1996.

19.5. Draft Guidance on Multi-Increment Soil Sampling State of Alaska, Department of Environmental Conservation, March 2007.

19.6. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, November 12, 2008.

19.7. Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations, March 2011, State of Hawaii, Department of Health, 2011-143-RB.

19.8. Standard operating Procedure, In Vitro Method for Determination of Lead and Arsenic Bioavailability; Solubility/Bioavailability Research Consortium, Document 8601-102.011-0601-1099-RN01.

19.9. Figure 1: Multi Incremental Sampling Worksheet.

20. CHANGES SINCE THE LAST REVISION

20.1. New SOP.

TABLE 1
Default Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container	QC Requirement
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar	DUP per 10
200.7 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 10
6010 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 20
200.8 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 10
6020 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube	DUP/MS per 20
Mercury	Air Dried	0.5000 g	0.0167 g	Mercury digestion cup	DUP/MS per 20
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	None
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar	N/A

* For DOD projects refer to the DOD 8330B protocols.
** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 2
"Large Mass" Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container	QC Requirement
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar	DUP per 10
200.7 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 10
6010 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 20
200.8 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 10
6020 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube	DUP/MS per 20
Mercury	Air Dried	5.00 g	0.167 g	Mercury digestion cup or 2 oz. soil jar	DUP/MS per 20
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar	MS/DMS per 20
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	MS/DMS per 20
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar	MS/DMS per 20
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar	MS/DMS per 20
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar	None
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar	N/A

* For DOD projects refer to the DOD 8330B protocols.
** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 3
Storage of Multi-Incremental Subsamples

Test	Storage
Total Solids	Room Temperature
200.7 Metals	Room Temperature
6010 Metals	Room Temperature
200.8 Metals	Room Temperature
6020 Metals	Room Temperature
Mercury	Room Temperature
8081 PEST	4 ± 2˚C
8081 PEST-LL	4 ± 2˚C
8082 PCB	Room Temperature
8082 PCB-LL	Room Temperature
8151	4 ± 2˚C
8270	4 ± 2˚C
8270 LL	4 ± 2˚C
PAH	4 ± 2˚C
PAH ULL	4 ± 2˚C
8290/Dioxin	Room Temperature
8330B*	4 ± 2˚C
Diesel or Residual Range Organics (DRO, RRO)*	4 ± 2˚C
TOC	Room Temperature
Backup Sample	4 ± 2˚C

* For DOD projects refer to the DOD 8330B protocols.

FIGURE 1
Air Dried Sieve Data Benchsheet Template

ALS Inc.

Service Request Number(s):

Air Dried Sieve Data

Service Request #	Sample Weight (g)	Weight of Passing Fraction(g)	Weight of Retainied Fraction (g)	Sieve Size
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			

Balance ID:	
Analyst:	Date:
Reviewed:	Date:

R:\ICP\misc\digforms\Air Dried Sieve Bench Sheet-Compatible

FIGURE 2
Composite Data Template

ALS Inc.

Service Request Number(s):

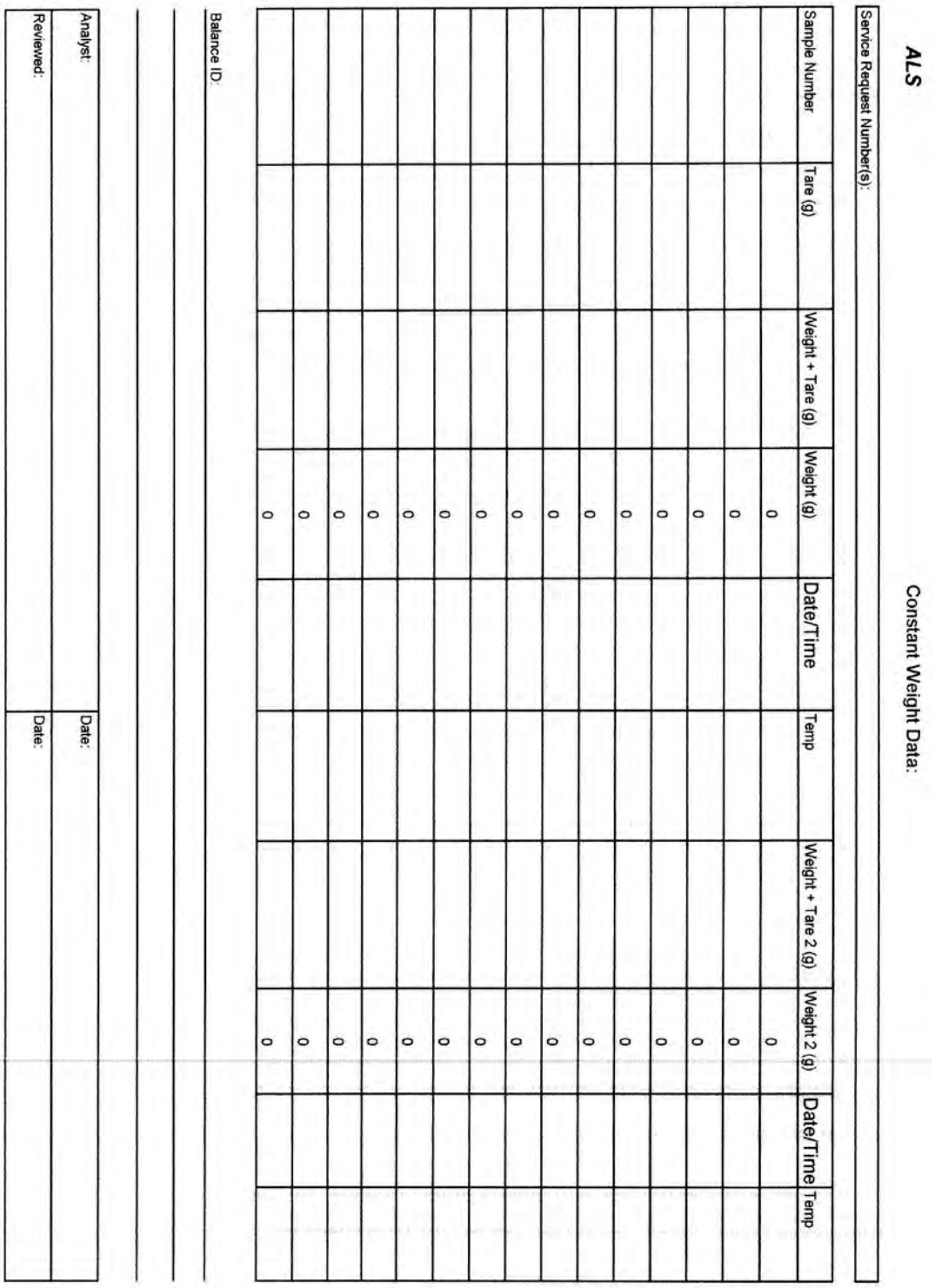
COMPOSITE DATA

Service Request #	Sub Sample Wt. (g)	Total Composite Wt. (g)	FDA Squares	Anthraquinone Sub Sample Wt. (g)	Total Anthraquinone Sub Sample Wt. (g)	
		0			0	

Balance ID:	
Analyst:	Date:
Reviewed:	Date:

R:\ICP\misc\digforms\Composite Data Sheet

FIGURE 3
Constant Weight Data Template



ALS

Constant Weight Data:

Service Request Number(s):

Sample Number	Tare (g)	Weight + Tare (g)	Weight (g)	Date/Time	Temp	Weight + Tare 2 (g)	Weight 2 (g)	Date/Time	Temp
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		
			0				0		

Balance ID:

Analyst: Date:

Reviewed: Date:

STANDARD OPERATING PROCEDURE SOP-5

SAMPLE LABELING

Scope and Applicability

This standard operating procedure (SOP) describes the general procedures for completing sample labels that will be used on the Soil Amendment Technology Evaluation Study (SATES) program. The project-specific work plan or field sampling plan should be consulted regarding the rationale behind the sampling labeling protocol.

Equipment and Materials

- Sample labels
- Indelible marker
- Work Plan Section 7.4.3

Sample Identifier Labels

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., replicates) to ensure proper data analysis and interpretation; 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples; and 3) to track individual sample containers to ensure that the laboratory receives all of the material associated with a single sample. Note that sample labels with some data pre-printed onto the labels, such as sampler name and analyses, are acceptable for use. The codes and uses are described below for soil samples collected during the initial screening and characterization efforts.

Initial Screening Soil Samples

Each discrete sampling location during the initial screening will be assigned a unique identifier (ID) based on location and date collected.

For the initial screening program, a grid at 10-foot vertical (X) and horizontal (Y) intervals will be established across each test plot from a fixed and recorded plot corner. Each row will be designated alphabetically ranging from A to J, and each column numerically from from 1 to 10. One soil sample will be collected from each grid square during the initial screening process, and will be designated with the following information:

- Test plot number;
- Y interval (row letter);
- X interval (column number); and
- 6-digit date.

The test plot number will include the Decision Unit number and, if more than one test plot is present in a DU, a sequential numerical identifier (i.e., 1, 2, or 3) preceded by a dash. An example sample identifier for a soil sample collected on July 22, 2017 from row C, column 7 from test plot 258-2 would be "258-2-C7-072217".

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-10.

Characterization Soil Samples

Each discrete or incremental composite (IC) soil sample collected during the test plot characterization effort will be assigned a unique ID based on the type of sample, location, and date collected.

For the test plot soil characterization program, each test plot sub-plot will be designated alphabetically (A, B, C, and D). Soil samples collected from each sub-plot will be designated with the following information:

- Sample type (IC ["IC"] or discrete ["D]);
- Test plot number;
- Sub-plot letter (capital letters);
- 6-digit date; and
- Depth interval in inches (discrete samples only).

For example, an IC soil sample collected on August 17, 2017 from subplot "A" in test plot 258-2 would be designated "IC-258-2A-081717". Similarly, a discrete sample collected on that date from a depth of 4 to 6 inches in a test pit completed at that subplot would be designated "D-258-2A-081717-4-6".

This 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-10.

STANDARD OPERATING PROCEDURE SOP-6

DISCRETE SOIL SAMPLE COLLECTION

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of discrete soil samples for the Soil Amendment Technology Evaluation Study (SATES) program. The SATES work plan describes the sampling rationale behind the sampling program at each test plot. The work plan also indicates the soil sample to be collected 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

Accurate, representative samples should be collected with this procedure, which requires vigilant care and precision by each sample team member. Collection of discrete soil samples from surface soil will be accomplished with a stainless steel sample coring device or stainless steel trowel only. Tools plated with chrome or other materials should not be used[1].

The following is a list of equipment and materials needed by the sampling team:

- Global positioning system (GPS) receiver
- Tape measure
- Survey stakes or flags
- Maps
- Camera and film or digital card
- Field logbook
- Pens and pencils
- Chain of Custody records and custody seals
- Field data sheets
- Sample labels
- Appropriate sample containers

[1] Note that plating is common with garden instruments such as potting trowels.

- Re-sealable plastic bags
- Cooler(s)
- Wet ice
- Canvas or plastic sheet on which to work with collected samples
- Stainless steel homogenization bucket, bowl or pan, and stainless steel mixing spoon
- Stainless steel sampling punch(es) and trowel(s)
- Stainless steel or acetate sample liners (characterization phase only)
- Stainless steel ruler
- Disposable nitrile gloves for handling soil samples
- Radios (for communication)
- Knife
- Project-specific work plan and health and safety plan (HSP)

Equipment and materials needed for decontamination are:

- Plastic bucket (e.g., 5 gallon bucket)
- Tap water or site water (i.e., potable water)
- Carboy filled with distilled/deionized water (analyte-free; received from testing laboratory or other reliable source)
- Properly labeled squirt bottles
- Funnels
- Liqui-Nox®, or equivalent industrial non-phosphate detergent (e.g., Alconox®)
- Long handled, hard-bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Paper towels
- Polyethylene or polypropylene tub (to collect solvent rinsate)
- Baking soda (if required)
- Disposable nitrile gloves
- Safety glasses or goggles.

Procedures for Discrete Soil Sample Collection

1. For the initial screening, plot the sample grid in GIS to obtain spatial coordinates prior to mobilizing into the field. The GIS generated predetermined sample location grid should be adjusted to the plot datum once it has been selected in the

field. For test plot characterization, establish sample locations in a GIS format prior to mobilizing into the field using the geolocation data from the initial screening sampling. .

2. Transport field personnel and sampling equipment to the DU selected for sampling.

3. Locate each sample point using a GPS, mark each point with a pin flag, and convey sampling equipment/personnel to this location. Field location procedures are described in the SOP-7 Positioning at Sample Collection Areas.

4. Document the vegetation and any anthropogenic features in the vicinity of the sample point in the field notebook. Take digital photographs of the sample locations (record in the photo log). Note that multiple soil sample locations can be included in a single photograph.

5. Select the point to collect the soil sample within 0.5 m of the GPS sample locations based on the test plot map in work plan Figure 8. The actual discrete sample point may be shifted from the planned GPS location by no more than 2 feet to target available soil and avoid obstacles such as woody vegetation or rocks.

6. At each sampling point, clear vegetation and surface debris (e.g., woody debris, undecomposed leaves and pine needles, and surficial rocks) from the sample point (resulting surface is considered the 0-inch depth). Retain surficial materials for replacement after sampling.

7. For test pit sample collection, excavate a test pit to approximately 18 inches in depth using hand tools. Collect shallow driven soil samples from the test pit location prior to excavating through the target depth intervals. Collect deeper driven samples from the base of the test pit after clearing slough from the bottom. Retain surficial material and mineral soils separately for backfilling and restoration of the test pit excavation.

8. Using a soil punch (or similar sampling tool) decontaminated using the methods described in SOP-8, collect the sample(s) from each sample point (see work plan Table 8) using a decontaminated soil punch or equivalent sampling device.

   - Surface samples for laboratory analysis will be collected using a 2-inch-diameter soil punch (or similar sampling tool) from the 0 to 3 inch depth interval.
   - Depth-discrete interval samples from test pits will be collected By driving a 2-inch-diameter split spoon coring device (or similar sampling tool) vertically into the ground, and then segmenting the resulting soil core at each target depth interval

(0-2″, 2-4″, 4-6″, 6-8″, 8-10″, and 10-12″) using a stainless steel sampling knife or trowel. If there is insufficient recovery in the driven sample, then depth-discrete samples may be collected directly from the test pit wall using a square-sided stainless steel sampling scoop or similar.

- At each test pit, an additional soil sample for potential future supplemental analysis or evaluation will be collected from 18 to 24 inches bgs by driving a 2-inch-diameter soil punch (or similar sampling tool) equipped with an acetate or stainless steel sampling sleeve vertically into the ground.
- Test pit mineraological samples will be collected using a 2-inch-diameter soil punch (or similar sampling tool) from the 0 to 3 inches bgs interval. Undisturbed soil samples for in situ permeability analysis will be collected in a 2-inch-diameter acetate or stainless steel sampling sleeve pushed vertically from 0 to 6 inches at the location of each test pit *prior to* test pit excavation.
- For locations where duplicate samples will be collected, the duplicate samples should be collected as close as possible to the planned original sample point and the samples should be collected in close proximity (<0.1 m) to one another.
- Place the samples for laboratory analysis into appropriate containers (4-ounce glass jars for metals analysis), or cap the sampling sleeve with a Teflon sheet and tight-fitting polymer cap (undisturbed samples only).
- Allow the cultural resource representative to inspect the sample before the sample is transferred from the sampling device to the sample container, or prior to capping the ends of the *in situ* permeability sample.
- If the sample passes the cultural resources review, continue sampling procedures.
- If the sample does not pass the cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.

9. Measure the pH of the soil at a depth of 1 inch bgs in each increment location with a portable pH probe.

10. Complete field documentation for this soil sample point as outlined in SOP-1 Field Documentation.

11. For vertical samples, fill the sampling hole to 0.5 inches below the ground surface with wooden dowel or branch segment with saw-cut ends as a marker to prevent future re-sampling of each point. Wood used must not be treated. Place previously removed vegetation/plant debris or local soil over top of plug. For the

test pit area, backfill the hole with excavated materials and place a semi-permanent marker (metal rod with plastic or brass cap) at the location.

12. Fully decontaminate sample collection equipment prior to collection of each discrete soil sample point as described in SOP 8.

13. Discard disposal sample-dedicated equipment such as gloves.

14. Soil samples will be maintained in sample coolers and stored on ice at 4±2°C.

15. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation following the requirements of SOP-9 Sample Custody and SOP-10 Sample Storage and Packaging. The sample-filled collection cooler(s) will also be packed with sufficient ice to ensure samples arrive at the analytical laboratory at 4±2°C.

STANDARD OPERATING PROCEDURE SOP-7

POSITIONING AT SOIL SAMPLE COLLECTION AREAS

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe procedures used for locating soil sampling stations across the UCR Site. 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 should be usable for any submeter accuratehandheld global positioning system (GPS); however, the owner's manual for any GPS unit used should be consulted and used to support this SOP.

Equipment and Materials

The following is a list of equipment and materials needed by the field sampling team:

- High-precision 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 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 requires no calibration because 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 should 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 photos, 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 noticed during the reconnaissance visit to sampling sites prior to the field sampling event. In the event a pre-selected location cannot be sampled, any alternate or additional locations sampled will be entered into the GPS 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 each sampling station will be visited. The station locations then will be selected one at a time from the pre-selected station locations that have been entered into the GPS. Upon selection of a target station, the positioning data of the sample location will be displayed on the hand-held unit to assist the field team in proceeding to the station. A confirmed position will be recorded electronically at each sample collection location. Ancillary information will be recorded in the field logbook, and may include personnel operating the GPS system, elevation, and time samples were collected.

A brief summary of handheld GPS procedures to locate a specific soil sampling station follow:

- Turn on the unit
- Wait for it to acquire the location of satellites
- Select desired soil sampling or other point location
- Follow GPS directions to desired location
- Document the soil sampling or point elevation on the field data form
- Save the soil sampling or point location into the GPS memory, as well as note the site coordinates in the field log book
- Charge 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-selected sampling locations and actual sampling locations will be mapped and described with any supporting documentation in the field sampling report.

STANDARD OPERATING PROCEDURE SOP-8

DECONTAMINATION OF SOIL SAMPLING EQUIPMENT

Scope and Applicability

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 soil sampling and processing equipment will be decontaminated before each use. Reusable sampling equipment includes the stainless steel trowels, soil sample punches, bowls, spoons, etc. Decontaminated equipment will be stored away from areas that may cause recontamination. 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. Two general types of decontamination will be used during the field program – dry decontamination and full decontamination, depending on the nature of the samples collected.

Equipment and Materials

Equipment and materials needed for decontamination are:

- Plastic bucket(s) (e.g., 5 gallon bucket)
- Tap water or site water (i.e., potable water)
- Potable water
- Properly labeled squirt bottles (or large spray bottles if needed)
- Funnels
- Liqui-Nox®, Alconox®, or equivalent industrial non‐phosphate detergent
- Long handled, hard‐bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Paper towels
- Polyethylene or polypropylene tub (to collect rinsate)
- Disposable nitrile gloves
- Safety glasses or goggles.

Dry Decontamination Procedures

Dry decontamination will be used only between soil increment samples collected for a single incremental composite (IC) sample for laboratory analysis. Full decontamination procedures will be used between samples submitted for analysis under separate sample identifiers. The specific procedures for dry decontamination of soil sampling and processing equipment used to collect soil samples are as follows:

1. If needed, use a non-metallic brush to remove larger soil particles adhered to the equipment.
2. Wipe visible soil and residue from the equipment using a clean cloth or paper towel.
3. After decontaminating the sampling equipment, solid wastes such as soil residue, gloves, and cloths/paper towels will be placed in garbage bags and disposed in a solid waste landfill.

Full Decontamination Procedures

Full decontamination will be completed on reusable equipment prior to collection of each discrete sample and between separate IC samples. Always follow the procedures listed in the site‐specific HSP when decontaminating sampling equipment (e.g., wear appropriate gloves and safety glasses or goggles). Containerize all decontamination fluids for proper disposal following procedures listed in this SOP.

The specific procedures for full decontamination of soil sampling equipment are as follows:

1. Rinse the equipment thoroughly with tap or site water to remove visible soil. This step should be performed on-site for all equipment. After removing visible solids, sampling equipment that does not need to be used again that day may be set aside and thoroughly cleaned in the field laboratory at the end of the day.
2. Pour a small amount of concentrated laboratory detergent into a bucket (i.e., about 1 to 2 tablespoons 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. Be sure to clean the outside of the compositing bowls and other pieces that may be covered with soil.
4. Rinse the equipment with potable water twice and set on a stable surface to drain. Do not allow any surface that will come in contact with the sample to touch any

potentially-contaminated surface. Equipment does not need to be dried before the next use.

5. If the decontaminated sampling equipment is not to be used immediately, wrap small stainless steel items in aluminum foil (dull side facing the cleaned area) for cleaning at the field laboratory.
6. If the sample collection or processing equipment is cleaned at the field laboratory and transported to the sampling 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.
7. After decontaminating all of the sampling equipment, the disposable gloves and used foil will be placed in garbage bags and disposed of in a solid waste landfill. Water generated during equipment decontamination will be containerized, temporarily stored at a designated staging area in 55-gallon drums or portable tanks, and disposed appropriately based on analytical results.

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 Soil Amendment Technology Evaluation Study (SATES). The procedure outlined herein will be used in conjunction with SOP-5, which covers sample labeling; SOP-1, which covers field documentation; 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 of designated personnel's custody unless the samples have been transferred to a secure area (i.e., locked up and custody sealed) or transferred to the 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: these 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 soil sample identifiers 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.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express (FedEx) or United Parcel Service (UPS), the name of the carrier should be recorded on the COC form. Any tracking numbers supplied by the carrier should be also entered on the COC form. The time of transfer should be as close to the actual drop-off time as possible. After 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.
5. If errors are found after the shipment has left the custody of sampling personnel, a corrected version of the forms must be made and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.
6. Upon completion of the field sampling event, the field supervisor will be responsible for submitting all 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.

Shipping Air Bills

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., Federal Express, 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 it is 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 pack and ship environmental samples include the following:

- Work plan for the Soil Amendment Technology Evaluation Study (SATES) Phase I
- Project-specific field logbook(s)
- Resealable airtight bags (assorted sizes)
- Wet ice in doubled, sealable bags or frozen Blue 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 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
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 inch] thick) for cooler lining
- Paper towels
- "Fragile," "This End Up," or "Handle With Care" labels
- Mailing labels
- Airbills for overnight shipment.

Procedure

In some cases, samples may be transferred from the field to a 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 utilize a commercial courier or shipping service. If a courier service is used, then field personnel should 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 "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±2°C until they are packaged for shipping to the offsite analytical laboratory.

Sample Preparation

The following steps should 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-5.
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 (i.e., 4±2°C) throughout the sampling day because the samples have a required storage temperature.
5. Store all sample containers in coolers on wet ice until ready for shipping.

To prepare samples and coolers for shipping

1. Choose the appropriate size cooler(s) and make sure that the outside and inside of the cooler is clean of gross contamination. If the cooler has an external drain, the drain should be capped and thoroughly taped shut with duct tape to ensure no leakage will occur.
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 glass container (which at the sample collection site had already been placed in an individual sealable plastic bag) in bubble wrap using either tape or a rubber band to hold the bubble wrap in place. Ensure IC sample bags are placed inside an additional sealable plastic bag. Place the wrapped samples into the large plastic bag in the cooler, leaving sufficient room for ice to keep the samples cold (i.e., 4±2°C).
4. While the samples are being placed in the shipping cooler(s), the field supervisor will fill out COC form with sample IDs and laboratory analyses to be performed (see example blank and filled out COC forms in Appendix B of the work plan).
5. Make sure all applicable laboratory quality control sample designations have been made on the COC forms. Samples that will be archived for possible future analysis should be clearly identified on the COC form and should be also be labeled as "Do Not Analyze: Hold and archive for possible future analysis" as 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±2°C) because the samples have a required storage temperature. Always overestimate the amount of ice that may be required. Place the ice in sealable plastic bags and then place each bag into 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 project files. Place the signed COC form in a resealable clear plastic bag and tape the bag containing the form to the inside of the cooler lid. Each cooler should contain

an individual (or multiple) COC form(s) for the samples contained in that particular cooler only.

8. 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.

9. Apply one COC seal 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.

10. Notify the analytical 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 task manager and analytical 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 task manager and analytical 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," "Perishable,"and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the 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 laboratory contact and the task analytical chemistry QA/QC coordinator that samples will be shipped and the estimated arrival date and time. All environmental samples are shipped at 4±2°C, and will be shipped overnight for next morning delivery. The field supervisor will provide copies of all COC forms to the task manager the analytical chemistry laboratory coordinator upon completion of the study.

STANDARD OPERATING PROCEDURE SOP-11

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 3 inches below ground surface) using incremental composite sampling for the Soil Amendment Technology Evaluation Study (SATES) program. The study work plan describes the sampling rationale behind each of the test plot areas to be sampled, and lists each the analytical analyses to be performed for each sample. 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 2 to 3 inches in diameter and 3 inches 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
- Disposable nitrile gloves for handling samples
- Radios (for communication)
- Project-specific work plan 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. The field team will establish IC sample locations in a GIS format prior to mobilizing into the field using the geolocation data from the initial screening sampling.

2. Transport field personnel and sampling equipment to the DU selected for sampling.

3. Locate each increment location (predetermined prior to the field event) using a handheld GPS, mark each location with a pin flag, and convey sampling equipment/personnel to this location. Field location procedures are described in the SOP Positioning at Sample Collection Areas (SOP-7) in Appendix C.

4. Document the vegetation and any anthropogenic features in the vicinity of the increment location in the field notebook. Take digital photographs of the increment locations (record in the photo log). Note that multiple soil sample locations can be included in a single photograph.

5. Select a location to collect the soil sample within 2 feet of the GPS increment locations based on the subplot map in Figure 11 and the increment location plan outlined in work plan Table 8. Note that incremental composite samples will not be collected from the sub-plot areas within 4 feet of adjacent sub-plots because of potential overspill of planned future remedy materials between sub-plots. 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. The sample relocation should be a minimum distance required to avoid the obstacle, and should not exceed 2 feet from the original sample location.

6. Clear vegetation and large surface debris (e.g., woody debris, undecomposed leaves and pine needles, and surficial rocks) from the increment location (resulting surface is considered the 0-inch depth). Retain surficial materials for replacement after sampling.

7. Collect the increment(s) from each increment location (see work plan Table 8) using a decontaminated soil punch or equivalent sampling device.

- Increment samples for laboratory analysis will be collected using a 3-inch-diameter soil punch from the 0 to 3 inch depth interval.
- For locations where multiple increment samples will be collected, all increments collected at an increment location should be collected as close as possible to the planned GIS location and in close proximity (<4 inches) to one another. The first duplicate sample should be collected 2 inches west of each original sample location, and the second 2 inches east of each original sample.
- Place the increment for laboratory analysis into a quart-sized zipper closure plastic bag dedicated to the IC sample
- Allow the cultural resource representative to inspect the increment in the quart-sized bag(s).
- If the increment passes the cultural resources review, continue sampling procedures.
- If the increment does not pass the cultural resources review, STOP SAMPLE COLLECTION. Notify the field supervisor for management-of-change procedures.

8. Transfer the increment for laboratory analysis from the quart-sized inspection bag into a gallon-sized zipper closure bag containing previously collected increments dedicated that that specific incremental composite sample.
9. Complete field documentation for this increment location.
10. Fill sampling hole with 2.5-inch-long, wooden dowel or branch segment with saw-cut ends as a marker to prevent future re-sampling of location. Place previously removed vegetation/plant debris or local soil over top of plug.
11. Dry decontaminate (brush off) sample collection equipment between increment locations within each sub-plot. Fully decontaminate sampling equipment between sub-plots as described in SOP-8.
12. Discard dedicated sampling equipment such as gloves, quart-sized inspection bags, and aluminum pans.
13. ICS samples will be maintained in sample coolers and stored on ice at 4±2°C.
14. Ship sample-filled collection cooler(s) to the analytical laboratory along with all appropriate documentation following the requirements of the SOP-9 Sample Custody and SOP-10 Sample Storage and Packaging. The sample-filled collection cooler(s) will also be packed with sufficient ice to ensure samples arrive at the analytical laboratory at 4±2°C.

APPENDIX D

CULTURAL RESOURCE COORDINATION PLAN

CONTENTS

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
ARPA	Archaeological Resources Protection Act of 1979
bgs	below ground surface
CCT	Confederated Tribes of the Colville Reservation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CRCP	cultural resources coordination plan
DAHP	Washington State Department of Archaeology & Historic Preservation
DU	decision unit
EPA	U.S. Environmental Protection Agency
FE	fundamental error
FOIA	Freedom of Information Act
FSP	field sampling plan
HHRA	human health risk assessment
IC	incremental composite
Lake Roosevelt	Franklin D. Roosevelt Lake
MOA	Memorandum of Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
QAPP	quality assurance project plan

RCW	Revised Code of Washington
RI/FS	remedial investigation and feasibility study
RM	river mile
SATES	Soil Amendment Treatability Evaluation Study
SHPO	State Historic Preservation Officer
Site	Upper Columbia River site
STI	Spokane Tribe of Indians
TAI	Teck American Incorporated
THPO	Tribal Historic Preservation Officer
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation
WAC	Washington Administrative Code

UNITS OF MEASURE

cm	centimeter(s)
g	gram(s)
in.	inch(es)
μm	micron(s)
mm	millimeter(s)
ppm	part per million

1 INTRODUCTION

This document presents the cultural resources coordination plan (CRCP) for the Upper Columbia River (UCR) site (herein the 'Site') remedial investigation and feasibility study (RI/FS). Emphasis is placed on sampling activities associated with the 2017 Phase I Soil Amendment Treatability Evaluation Study (SATES) to be conducted within the UCR Study Area, as defined by the *Work Plan for the Soil Amendment Technology Evaluation Study, Phase 1: Test Plot Characterization and Initial Amendment Alternatives Evaluation* (Ramboll Environ 2017).

1.1 BACKGROUND

As specified in the Statement of Work associated with the June 2, 2006 Settlement Agreement (USEPA 2006), "For all RI/FS activities at the Site involving sediment collection or ground penetration/disturbance, the Company shall work with the potentially affected parties to assess the effects of the planned work and seek ways to avoid, minimize or mitigate any adverse effects on historic properties." The purpose of this CRCP is to describe known or likely physical impacts of proposed sediment/soil sampling, provide relevant background information, define measures for protecting resources, and define procedures for consulting with the appropriate state, federal, and tribal parties with interests in the cultural resources of the Site and surrounding areas for this study.

The Site is located wholly within the state of Washington and includes approximately 150 river miles of the Columbia River extending from the U.S.-Canada border to the Grand Coulee Dam and those areas in proximity to such contamination necessary for implementation of the response actions described in the 2006 Settlement Agreement. The Colville Indian Reservation borders the UCR from approximately river mile (RM) 690 to the Grand Coulee Dam. The Spokane Indian Reservation borders the UCR to the east from approximately RM 650 to RM 640. Franklin D. Roosevelt Lake (Lake Roosevelt) and associated lands are administered by the U.S. Bureau of Reclamation (USBR) and the National Park Service (NPS) of the U.S. Department of the Interior.

The U.S. Environmental Protection Agency (EPA) has responsibilities under the National Historic Preservation Act (NHPA) to consider how its undertakings would affect historic properties. As defined in the NHPA, "historic properties" include archaeological resources, historic-period buildings and structures, and traditional cultural places listed in or determined eligible for listing in the National Register of Historic Places (National Register). To meet the NHPA requirements, EPA must ensure that sampling and other activities would avoid, minimize, or mitigate any adverse effects on any historic properties.

The CRCP is organized into six sections, as follows: 1) this introductory section, which includes summary information on the archaeology, prehistory, Native peoples, and Euroamerican historical development of the project area; 2) an overview of the relevant federal, state, and tribal laws and regulations, and other appropriate procedures and requirements; 3) a description of the proposed sampling program; 4) a plan for coordination and consultation with all affected parties to address known and likely impacts on cultural resources in implementing the proposed work; 5) a list of references; and 6) a glossary of terms.

1.2 CULTURAL SETTING

The broader context of the cultural development of the upper Columbia region provides the critical framework for understanding the importance of cultural resources in the area. Archaeological and historical resources reflect broad patterns of cultural use and development, just as ongoing traditional use of areas and natural resources represents cultural continuity that can be important to individual and social identities. This section of the CRCP serves as a brief introduction to the cultural history of the upper Columbia region. The primary source of information on the prehistory of the area is Goodal et al. (2004); for Native peoples, the source is Kennedy and Bouchard (1998); and for Euroamerican history, McKay and Renk (2002).

Archaeological research contributes significantly to our understanding of the prehistoric past. In the upper Columbia region, systematic archaeological research began in the late 1930s and has continued to the present. Almost 500 archaeological resources have been recorded in and along Lake Roosevelt, representing prehistoric, protohistoric, ethnohistoric, and historic-period human use and occupation. Research at some of these resources has provided the outlines of prehistoric cultural development in the upper Columbia region. Human presence in the region extends back at least 11,000 years. These first humans lived in small groups and were mobile foragers, hunting and gathering plants. The presence of the Columbia River led to an early focus on the abundance of riverine sources. Beginning about 8,000 years ago, populations appear to have increased and led to a gradual trend to less mobility and more permanent settlements. The growing population also led to use of a greater diversity of resources and increasing reliance on fish.

Permanent settlements increased in size and became concentrated in the river valleys beginning about 6,000 years ago, probably in response to continued population growth. Use of resources in upland areas expanded to meet the needs of the burgeoning populations and settlements. These trends continued until about 1,000 years ago, when there is evidence for a decline in population size. There were fewer settlements, villages were smaller, and there was less use of upland areas.

Cultural patterns of the late prehistoric period were reflected in the lives of the Native peoples at the time of Euroamerican contact. At the time of contact, the UCR was the homeland of the Lakes, Colville, Spokane, and Sanpoil peoples. The Lakes people occupied the Columbia River valley from the vicinity of modern Northport, WA, north into the Arrow Lakes area of modern British Columbia. The Colville lived along the river downstream of the Lakes as far as around the mouth of the Spokane River. Downriver of the Colville were the Spokane, in the Spokane River drainage, and the Sanpoil, who lived along the Columbia River from around the mouth of the Spokane River to near the modern location of the Grand Coulee Dam.

All of these groups spoke Interior Salish languages and shared many cultural features. Their cultural differences largely reflected differences in the local environments in which they lived. The social, political, and economic foundation of these groups was historically the winter village. The villages were concentrated in the river valleys, and each village was politically independent. Residents of the villages relied on provisions gathered, dried, and stored during the summer to survive through the winter. With the coming of spring, families began moving out of the winter village and shifting among the warm-season camps near resource locations. Gathering of plants and hunting game in upland areas were important subsistence activities during this season, but salmon constituted the most important food staple. Kettle Falls was a major aboriginal fishery, attracting people from throughout the region.

Native life began to change with the introduction of elements of Euroamerican culture. Horses reached the region in the 1700s and significantly changed Native travel and transportation. European diseases such as smallpox appeared in the late 1700s and had disastrous consequences for Native groups. Populations may have declined as much as 80 percent between the 1780s and 1840s. Direct contact with Euroamericans came in the early 1800s, when fur-trade posts were established on the Spokane River and at Kettle Falls.

When American settlement began in the 1840s, it bypassed the upper Columbia region. The discovery of gold in the region in the 1850s led to a major influx of Americans and growing conflict between the new settlers and Indian groups. A series of treaties with Indian groups were signed in 1855 but did not include the peoples of the upper Columbia region. As American settlement continued, the federal government responded by Presidential Executive Order creating the Colville Reservation in 1872 for the Colville, Spokane, Methow, Okanogan, Sanpoil, Lakes, Calispel, Coeur d'Alene, and scattering bands. Separate reservations were later set aside for the Spokane, Calispel, and Coeur d'Alene Tribes. Both the Colville and Spokane reservations have subsequently lost lands to the allotment process in the late 1800s and early 1900s and inundation from the waters of Lake Roosevelt. The Colville Reservation is now home to the 12 tribes that comprise the

Confederated Tribes of the Colville Reservation (CCT); the Spokane Reservation is the home of the Spokane Tribe of Indians (STI).

As already noted, the direct Euroamerican presence in the upper Columbia region began with the establishment of fur-trade posts on the Spokane River and at Kettle Falls. These posts were constructed between 1810 and 1825. The fur traders were followed by Christian missionaries in the 1830s and 1840s. A more substantial Euroamerican presence in the region developed in the 1850s, with the discovery of gold near Fort Colville. Conflicts between miners and Indians led to a military campaign in the Spokane River valley in 1858 and the establishment of an army post (Fort Colville) near Kettle Falls in 1859.

American settlement in the UCR drainage accelerated in the 1860s, initially spurred by mining. Farmers eventually followed the miners, but agricultural activity was limited until the construction of the Spokane Falls and Northern Railway through the region in 1890. With improved access to markets, farming—especially orchard crops—developed as one of the economic mainstays of the area, although mining has continued to play an important role.

The growing demands for agriculture led to plans to construct a dam at Grand Coulee. The dam would provide water for irrigation and inexpensive hydroelectric power. Construction of the dam began in 1934 and was completed in 1942. More than 82,000 acres above the dam was flooded, resulting in the relocation of 11 towns and about 3,000 residents. Since its creation, Lake Roosevelt has provided a growing number of recreational and tourist activities, which have become increasingly important to local economies.

2 OVERVIEW OF LAWS AND REGULATIONS

Implementation of the SATES sampling plan will require activities on privately owned lands and tribal allotments. This overview therefore includes a brief description of relevant federal and state law, executive orders, and tribal laws and regulations.

2.1 FEDERAL LEGISLATION AND REGULATIONS

An overview of federal legislation and regulations is provided below. There are three key laws relevant to Site RI/FS activities. The NHPA guides all federal agency actions that could affect cultural resources. Implementation of the RI/FS constitutes an "undertaking" as defined in the NHPA; therefore, complying with the NHPA requirements is the responsibility of EPA. The Archaeological Resources Protection Act (ARPA) of 1979 and the Native American Graves Protection and Repatriation Act (NAGPRA) apply to activities that could affect archaeological resources and Indian burials on federal and tribal lands. These laws and their implementing regulations would therefore apply to RI/FS activities conducted on federal and tribal lands.

2.1.1 National Historic Preservation Act of 1966, as Amended through 1992 (16 USC 470-470w)

The NHPA is the centerpiece of federal legislation protecting cultural resources. In the Act, Congress states that the federal government will "provide leadership in the preservation of the prehistoric and historic resources of the U.S.," including resources that are federally owned, administered, or controlled. For federal agencies, Sections 106 and 110 of the Act provide the foundation for how federal agencies are to manage cultural resources, but other sections provide further guidance. The implementing regulations for the NHPA are in 36 Code of Federal Regulations (CFR) Part 800. These regulations are summarized below.

Section 106

Similar to the National Environmental Policy Act of 1969 (NEPA), Section 106 of the NHPA requires federal agencies to take into account the effects of their actions or programs, specifically on historic and archaeological properties, prior to implementation. This is accomplished through consultation with the State Historic Preservation Officer (SHPO) and/or the Advisory Council on Historic Preservation (ACHP). On lands held by a tribe with a Tribal Historic Preservation Officer (THPO), the THPO has the same duties and responsibilities as the SHPO. If an undertaking on federal lands may affect properties having historic value to a federally recognized Indian tribe, such tribe shall be afforded the opportunity to participate as interested persons during the consultation process defined in

36 CFR 800. Compliance can also be accomplished using agreed-upon streamlined methods and agreement documents such as programmatic agreements.

The Section 106 process is designed to identify possible conflicts between historic preservation objectives and the proposed activity, and to resolve those conflicts in the public's interest through consultation. Neither the NHPA nor the ACHP's regulations require that all historic properties be preserved. Rather, they only require the agency proposing the undertaking to consider the effects of the proposed undertaking prior to implementation.

Failure to take into account the effects of an undertaking on historic or cultural properties can result in formal notification from the ACHP to the head of the federal agency of foreclosure of the ACHP's opportunity to comment on the undertaking pursuant to NHPA. A notice of foreclosure can be used by litigants against the federal agency in a manner that can halt or delay critical activities or programs.

The process for compliance with Section 106 consists of the following steps:

1. **Identification of Historic Properties**—Identification of historic properties located within the area of potential effects (APE) is accomplished through review of existing documentation and/or field surveys.
2. **Property Evaluation**—Evaluation of the identified historic properties using National Register criteria (36 CFR Part 63) in consultation with the SHPO and, if necessary, the ACHP. Properties that meet the criteria will be considered "Eligible" for listing in the National Register, and will be subject to further review under Section 106. Properties that do not meet the criteria will be considered "Not Eligible" for listing in the National Register, and will not be subject to further Section 106 review.
3. **Determination of Effect**—An assessment is made of the effects of the proposed project on properties that were determined to meet the National Register criteria, in consultation with the SHPO and, if necessary, the ACHP. One of the following effect findings will be made:
    - No Historic Properties Affected—If no historic properties are found or no effects on historic properties are found, the agency official provides appropriate documentation to the SHPO/THPO and notifies consulting parties. However, the federal agency must proceed to the assessment of adverse effects when it finds that historic properties may be affected or the SHPO/THPO or Council objects to a "No Historic Properties Affected" finding. The agency must notify all consulting parties and invite their views.

- No Historic Properties Adversely Affected—When the Criteria of Adverse Effect are applied (36 CFR 800.5(a)), and it is found that historic properties will not be adversely affected by the undertaking, the agency may make a finding of "No Historic Properties Adversely Affected." This finding is submitted to the SHPO for concurrence. Typically, the Council will not review "No Adverse Effect" determinations. However, the Council will intervene and review "No Historic Properties Adversely Affected" determinations if it deems it appropriate, or if the SHPO/THPO or another consulting party and the federal agency disagree on the finding and the agency cannot resolve the disagreement. If Indian tribes disagree with the finding, they can request the Council's review directly, but this must be done within the 30-day review period. Agencies must retain records of their findings of "No Historic Properties Adversely Affected" and make them available to the public. The public should be given access to the information when they so request, subject to Freedom of Information Act (FOIA) and other statutory limits on disclosure, including the confidentiality provisions in Section 304 of the NHPA. Failure of the agency to carry out the undertaking in accordance with the finding requires the agency official to reopen the Section 106 process and determine whether the altered course of action constitutes an adverse effect.
- Historic Properties Adversely Affected—Adverse effects occur when an undertaking may directly or indirectly alter characteristics of a historic property that qualify it for inclusion in the National Register. Reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative also need to be considered. The finding of "Historic Properties Adversely Affected" is submitted to the SHPO for concurrence. The SHPO/THPO may suggest changes in a project or impose conditions so that adverse effects can be avoided and thus result in a "No Historic Properties Adversely Affected" determination.

4. **Resolution of Adverse Effects/Mitigation**—When adverse effects are found, the consultation must continue among the federal agency, SHPO/THPO, and consulting parties to attempt to resolve them. The agency official must notify the Council when adverse effects are found and should invite the Council to participate in the consultation when circumstances as outlined within 36 CFR 15 800.6(a)(1)(i)(A)-(C) exist. A consulting party may also request the Council to join the consultation.

When resolving adverse effects without the Council, the agency official consults with the SHPO/THPO and other consulting parties to develop a Memorandum of Agreement (MOA). The MOA will outline the steps or actions to be taken prior to implementation of the project, in order to mitigate the adverse effects on the historic property. Stipulations included in an MOA may include (but are not limited to) documentation, modification of the project to lessen the adverse effects on the property, efforts to sell or relocate the resource, or step-by-step consultation with interested parties throughout the process to ensure it is carried out according to plan.

The MOA is executed between the agency official and the SHPO/THPO and filed with required documentation with the Council. This filing is the formal conclusion of the Section 106 process and must occur before the undertaking is approved.

In some cases, streamlining of the Section 106 process can be accomplished through the use of programmatic agreements. The ACHP and the agency official may negotiate a programmatic agreement to govern the implementation of a particular program or the resolution of effects from complex projects or multiple undertakings. Programmatic agreements are particularly useful when programs or projects affecting historic properties are similar and repetitive, and have known effects, such as routine maintenance or a series of similar rehabilitation projects.

Section 101(d)(2)

This section of the NHPA provides for the assumption by federally recognized Indian tribes of all or any part of the functions of a SHPO with respect to tribal lands (e.g., all lands within the exterior boundaries of any Indian reservation and all dependent Indian communities). Section 101(d)(2) requires federal agencies, in carrying out their Section 106 responsibilities, to consult with federally recognized Indian tribes that attach religious or cultural significance to a historic property. The agency will consult with federally recognized Indian tribes in the Section 106 process to identify, evaluate, and treat historic properties that have religious or cultural importance to those groups.

Section 110

Section 110 of the NHPA is intended to ensure that historic preservation is integrated into the ongoing programs of federal agencies. This section of the Act requires agencies to identify, evaluate, and nominate for listing in the National Register, historic properties owned or controlled by the agency; use historic properties to the maximum extent feasible; ensure documentation of historic properties that are to be altered or damaged; carry out programs and projects that further the purpose of the Act; and undertake such planning

and actions as may be necessary to minimize harm to any formally designated National Historic Landmark properties.

Section 111

Section 111 of the NHPA requires agency officials, to the extent practicable, to establish and implement alternatives for historic properties, including adaptive use, that are not needed for current or projected agency uses or requirements. Further, Section 111 allows the proceeds from any lease to be retained by the agency to defray the cost of administration, maintenance, repair, and related expenses of historic properties.

Section 112

Section 112 of the NHPA requires that agency officials who are responsible for protection of historic properties pursuant to the NHPA ensure that all actions taken by employees or contractors meet professional historic preservation standards established by the Secretary of the Interior (Professional Qualifications Standards of the Secretary of the Interior's Standards and Guidelines in Archaeology and Historic Preservation [NPS 1983]).

Section 304

Section 304 of the NHPA requires that information about the location, character, or ownership of a historic property be withheld from public disclosure when the federal agency head or other public official determines that disclosure may cause a significant invasion of privacy, risk and/or harm to the historic property, or impede the use of a traditional religious site by practitioners.

CERCLA and the NHPA

EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements (USEPA 1989) outlines how "substantive compliance" with the NHPA is to be achieved in CERCLA actions. The initial step is determining if cultural resources are known or are likely to be present "in or near the area under study in the RI." This step may require conducting a survey of both the location of the proposed remedial action and any associated actions that would occur off-site. The CERCLA manual referenced above defines three stages of a survey: Stage IA, literature search and sensitivity study; Stage IB, field investigation; and Stage II, site definition and evaluation. All studies should include Stage IA but implementation of Stage IB is contingent on the results of Stage IA, and the need for Stage II is contingent on the results of Stage IB. If results of the survey identify significant cultural resources (i.e., resources listed or considered eligible for listing on the National Register), effects of the proposed

remedial action and associated actions to the significant resources must be evaluated. Adverse effects on significant resources must be either avoided or mitigated. Any proposed mitigation measures must be incorporated into the remedial design process.

2.1.2 Archaeological Resources Protection Act of 1979 (16 USC 470aa-470ll)

ARPA is essentially an update to the 1906 Antiquities Act. It expands and strengthens the activities prohibited under the Antiquities Act, increases the criminal penalties for violation, establishes civil penalties, and provides further guidelines for the issuance of permits. This Act continues to apply only to federal and Indian lands (the definition of "Indian lands" in ARPA differs very slightly from the definition of "tribal lands" in the NHPA). Most archaeological excavations and collection of artifacts on these lands are allowed only with an ARPA permit. Trafficking in illegally obtained archaeological resources from federal and Indian lands is also prohibited. Individuals convicted of violating the Act are liable for the value of the archaeological resource itself, and the cost of restoration or repair of the damage caused by illegal excavation or collection.

The implementing regulations are 43 CFR Part 7 (Department of the Interior), which applies to federal lands that are not within military reservations or national forests. The regulations include detailed definitions of "archaeological resource" and "Indian lands" (lands held in trust by the United States on behalf of a federally recognized tribe or individual members of a federally recognized tribe).

2.1.3 Native American Graves Protection and Repatriation Act (25 USC 3001-3013)

NAGPRA establishes that Native American human remains and associated funerary objects found on federal or tribal lands belong to the lineal descendants of the Native American. When the lineal descendants cannot be determined, the remains belong to the tribe on whose land the remains were found (when found on tribal lands), or to the Indian tribe with the "closest cultural affiliation." This latter rule also applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony (all defined in the Act); NAGPRA applies to both human remains intentionally excavated (which would require an ARPA permit) and those accidentally discovered.

NAGPRA also requires all federal agencies and museums to inventory their holdings of Native American human remains and funerary objects. Once the inventories are completed, the agencies and museums are to notify the appropriate tribes of the remains and other objects in their collections. The remains and associated funerary objects are to be returned (repatriated) at the request of the lineal descendant(s) or tribe. The same requirement applies to unassociated funerary objects, sacred objects, and objects of cultural patrimony for which a cultural affiliation can be demonstrated. Exceptions to the repatriation

requirement are objects that are "indispensable for completion of a specific scientific study, the outcome of which would be of major benefit to the U.S."

The implementing regulations are 43 CFR Part 10, which largely expand on the elements of the statute. The regulations detail: 1) the process of consultation with Indian tribes to address either intentional excavation of human remains or inadvertent discovery of human remains; 2) how agencies and museums are to inventory their collections; and 3) the repatriation process. When human remains, funerary objects, sacred objects, and objects of cultural patrimony are inadvertently discovered on federal lands, the following steps are to be followed: 1) ongoing activity in the area of the find must cease and a reasonable effort made to protect the find; and 2) the federal land agency (i.e., the federal agency on whose lands the remains or objects have been found) must be immediately notified by telephone, with written confirmation. The federal land agency must then notify the appropriate tribe(s) and further secure and protect the discovery. The activity may be halted for up to days while an appropriate response to the find is negotiated by the federal agency and the appropriate tribe(s).

2.1.4 American Indian Religious Freedom Act (42 USC 1996)

This Act states that it is the policy of the United States to protect and preserve the rights of American Indians to practice traditional religions. That policy includes rights of access to sacred sites and to the use and possession of sacred objects. There are no implementing regulations.

2.2 PRESIDENTIAL EXECUTIVE ORDERS

Presidential executive orders define policies and procedures for federal agencies to facilitate their execution of laws passed by the Congress or clarify how specific laws are to be implemented. Presidential executive orders can be considered instructions or directives from the President to federal agencies on how to carry out specific laws. The executive orders listed below are either directly related to cultural resources or define relationships between federal agencies and tribes.

2.2.1 Executive Order 11593. Protection and Enhancement of the Cultural Environment

Issued in 1971, Executive Order 11593 states that the federal government would provide leadership in "preserving, restoring, and maintaining the historic and cultural environment of the Nation." Federal agencies were directed to inventory cultural resources under their jurisdiction and nominate National Register-eligible properties to the National Register. Properties that have been determined eligible are not to be transferred, sold, demolished,

or altered without providing the ACHP on Historic Preservation with an opportunity to comment. Properties to be demolished or substantially altered were to be documented prior to demolition or alteration. National Register properties or National Register-eligible properties under federal control were to be maintained following standards set by the Secretary of the Interior. Executive Order 11593 also assigns specific responsibilities to the Secretary of the Interior, including managing the National Register and assisting and advising other federal agencies in the management of cultural resources.

2.2.2 Executive Order 13007. Indian Sacred Sites

Issued in 1996, Executive Order 13007 directs federal agencies to provide access and ceremonial use of Indian sacred sites, where practicable, legal, and not inconsistent with essential agency functions. Agencies are also directed to avoid adversely affecting sacred sites and maintain the confidentiality of such sites. A "sacred site" as defined by this executive order is a specific location that is sacred because of its religious significance to or ceremonial use in an Indian religion.

2.2.3 Executive Order 13175. Consultation and Coordination with Indian Tribal Governments

Issued in 2000, Executive Order 13175 directs federal agencies to consult with tribal officials in the development of policies and regulations that have "tribal implications" or that preempt tribal law. Executive Order 13175 also emphasizes the importance of government-to-government relationships between the United States government and tribes. Agencies must designate an official responsible for implementing the executive order and must document tribal consultation in the development of the relevant policies and regulations.

2.3 TRIBAL LEGISLATION AND REGULATIONS

Tribal laws and regulations addressing cultural resources would apply to lands on the reservations and off-reservation trust lands. The SATES field program is entirely on Colville Tribal allotment lands, therefore the CCT is the tribe 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. The CCT has a THPO that has the same authority and responsibilities as the SHPO.

2.3.1 Confederated Tribes of the Colville Reservation. Colville Tribal Law and Order Code Chapter 4-4, Cultural Resources Protection

This Colville Tribal Code establishes the Colville Cultural Resources Board, which has the responsibility of developing policies and procedures to protect cultural resources of interest and concern to the Colville Tribes, both on and off the Colville Reservation. The Board reviews proposed federal agency actions off the reservation and is responsible for reviewing all proposed on-reservation actions that could affect significant cultural resources. The code also establishes a Colville Register of Historic and Archaeological Properties for listing of historic properties on the Colville Reservation.

This code defines the roles and responsibilities of the Colville History and Archaeology Department, which include identifying significant cultural resources on the reservation, nominating properties to the National Register and the Colville Register, and promoting efforts to protect cultural resources on the reservation.

Chapter 4-4 of Colville Tribal Code prohibits the excavation, disturbance, or other adverse effects to archaeological resources and historic properties on the reservation without a permit issued by the History and Archaeology Department. The code defines the procedure for the issuance of permits and the duties of permittees.

2.4 STATE LEGISLATION AND REGULATIONS

Washington state laws and regulations regarding archaeological and historical resources, as well as the law protecting Indian graves, are not applicable on federal lands or on tribal trust lands. These laws would apply, however, to any RI/FS-related activities that would affect private lands, non-federal lands, or non-tribal public lands.

2.4.1 Revised Code of Washington (RCW) Chapter 27.44, Indian Graves and Records

This legislation prohibits the removal or other disturbance of Indian burials, cairns, and "glyptic or painted records." "Burials" and "graves" are not defined in the statute. Excavation or removal of burials is permitted only under provisions of a permit issued by the Washington Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in Washington Administrative Code (WAC) Chapter 25-48.

2.4.2 RCW Chapter 27.53, Archaeological Sites and Resources

This legislation prohibits the excavation or disturbance of archaeological sites on public and private lands in Washington except under provisions of a permit issued by the Washington

Department of Archaeology and Historic Preservation. Procedures for obtaining permits are defined in WAC Chapter 25-48.

2.4.3 RCW Chapter 68.60, Abandoned and Historic Cemeteries and Historic Graves

This legislation prohibits the destruction, alteration, or other disturbance of historical land, abandoned cemeteries, and historic graves (Indian graves and burials are protected in RCW Chapter 27.44). A historic cemetery is defined in the statute as one established before November 1889. A historic grave is a grave or graves outside of a cemetery placed prior to June 1990.

2.4.4 RCW Chapter 43.21C, State Environmental Policy Act

This legislation directs state and local agencies in Washington to address environmental impacts of proposed projects. The implementing rules (WAC Chapter 197-11) require that impacts on historic and cultural resources are to be addressed in the State Environmental Policy Act process.

3 PROPOSED SAMPLING PROGRAM

Three decision units (DUs) from tribal allotments in the Columbia River valley just south of China Bend, WA and extending south of the U.S.-Canada border are the focus of this study (see Figures D1 and D2). Properties to be sampled were identified based on the results of residential soil sampling led by USEPA in 2014.

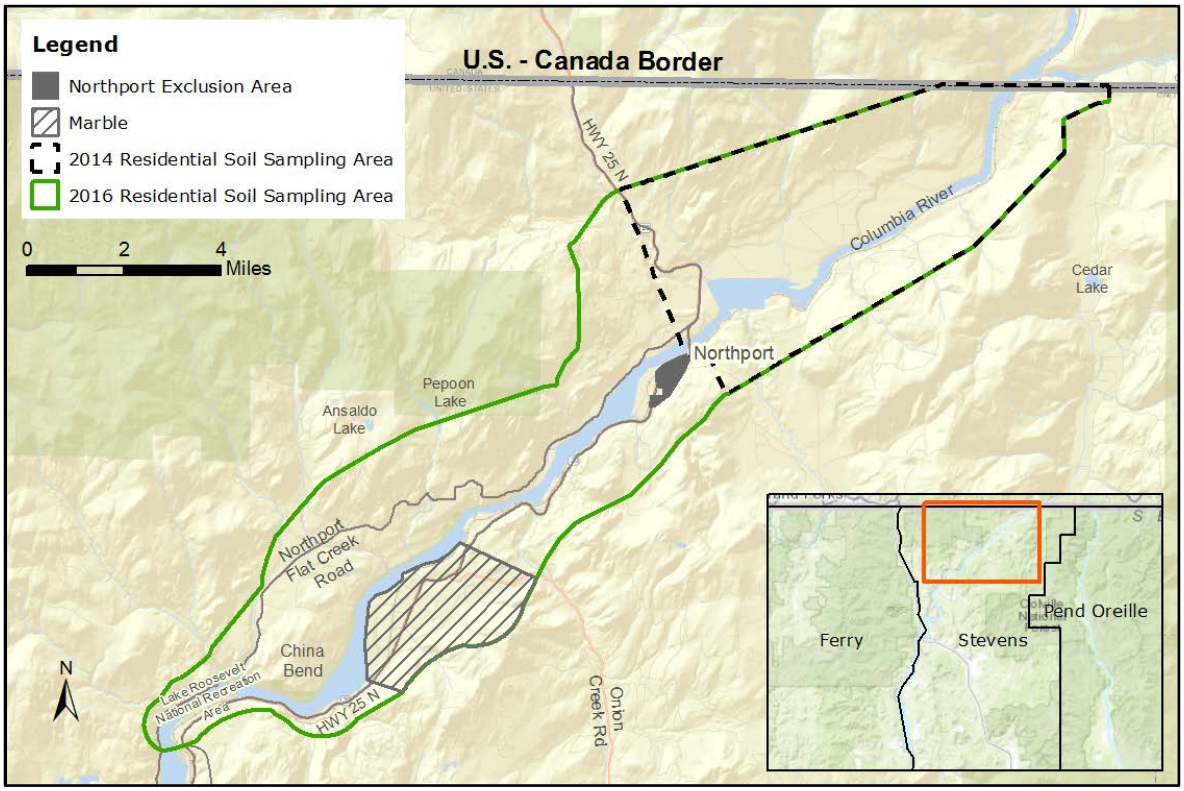


Figure D1. UCR Residential Soil Study Area

Figure D2. SATES Test Plot Decision Units

Most of the soil samples will be collected using an incremental composite (IC) sampling design (see Figure D3). IC sampling entails the collection of multiple individual volumes of soil (termed "increments") from a target area (i.e., a decision unit [DU]) that are composited and subsampled according to a detailed standard operating procedure prior to laboratory analysis (ITRC 2012). In addition, discrete core samples will be collected between 0 and 12 inches below ground surface (bgs). At several locations, soil will be excavated from small test pits of approximate dimensions of 2 feet long by 2 feet wide by 1.5 feet deep for observation of soil conditions and collection of additional discrete samples.

3.1 METHOD FOR COLLECTING INCREMENT SOIL SAMPLES

Individual soil increments will be collected using a cylindrical or core-shaped sampler to ensure that each increment contains a proportionate amount of soil particles over the entire depth of interest, with an equal volume of soil particles from the top of the sample as the bottom. The diameter of the cylindrical or core-shaped sampler will be between 2 to 3 inches but will remain constant within a DU.

Care will be taken to collect an IC sample that contains the same amount of soil particles from the top of the sample as the bottom. This will be achieved by scraping the length of the core using a decontaminated trowel or disposable scoop to remove the increment sample from the corer into a plastic bag for cultural monitor observation. Each increment across a DU will be collected in this manner, with the increments for one IC sample placed

in the same plastic bag or large bucket following visual inspection by the cultural monitor, taking care to ensure that equal volumes of soil are collected from each increment location.

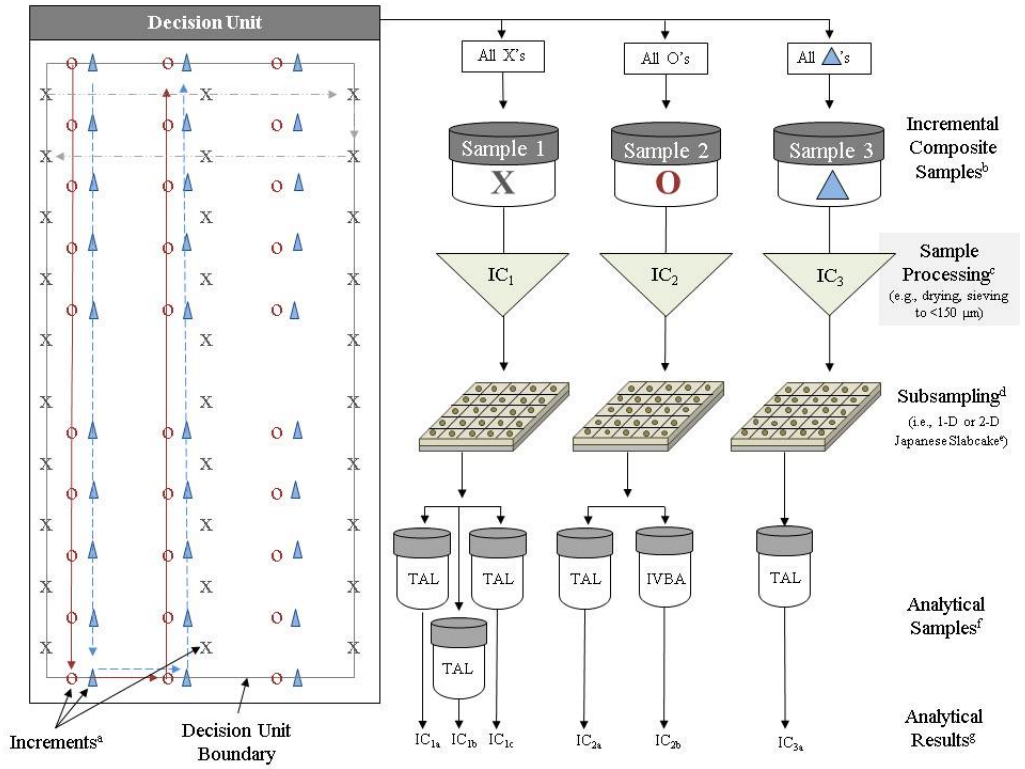


Figure adapted from ITRC (2012) and Hathaway et al. (2008).

Figure D3. Overview of the IC Sampling Design for Use in the 2017 SATES Program[1]

[a] Increments will be located by using systematic random sampling and a square grid.

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

[c] Sample processing will take place in the laboratory, by pre-sieving the sample to 2 mm and then passing the entire IC sample through a 150 µm (see SATES Phase I Draft Work Plan for additional information on laboratory procedures).

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

[e] As described in ITRC (2012).

[f] Analyses to be performed on the IC samples are summarized in Table 7 of the SATES Phase I Draft Work Plan.

[g] At a frequency not exceeding one per every four IC samples, IC samples will include the preparation and analysis of three laboratory replicate subsamples for the purpose of estimating variance due to bias and contaminant heterogeneity.

[1] This overview example pertains to DUs where triplicate IC samples are collected and there is a single replicate IC sample that is also submitted for analysis of lead and arsenic bioaccessibility in soil.

3.2 METHOD FOR COLLECTING DISCRETE SOIL SAMPLES

Individual discrete core soil samples will be collected using a cylindrical or core-shaped sampler to ensure that each sample contains a proportionate amount of soil particles over the entire depth of interest, with an equal volume of soil particles from the top of the sample as the bottom. The diameter of the cylindrical or core-shaped sampler will be between 2 to 3 in. but will remain constant within a DU.

Care will be taken to collect a discrete core sample that contains the same amount of soil particles from the top of the sample as the bottom. This will be achieved by scraping the length of the core using a decontaminated trowel or disposable scoop to remove the sample from the corer into a laboratory-supplied sample bottle.

3.3 METHOD FOR COMPLETING TEST PITS

Test pits will be completed using hand tools to excavate soils from the ground surface to a depth of approximately 18 inches over a 2-foot by 2-foot area. Prior to excavation commencing, discrete core samples will be collected from between 0 and 12 in. bgs and 0 to 6 in. bgs using a cylindrical or core-shaped sampler between 2 to 3 in. in diameter. At a depth of 12 inches bgs, the sampler will be driven to again to collect a soil sample from 12 to 24 in. bgs.

3.4 SAMPLE DEPTH

The sampling depth will depend on the sample type. Sample depths will range from 0 to 3 in. bgs, 0 to 6 in. bgs, 0 to 12 in. bgs., and 12 to 24 in. bgs.

4 COORDINATION PLAN

The objective of the CRCP is to ensure that implementation of the SATES program and associated sampling activities does not adversely affect any cultural resources. The plan therefore defines a general process and more specific procedures to meet this objective.

Few of the surveys conducted prior to about 1975 are likely to have met current regulatory and professional standards. In addition, many of the previous surveys focused on archaeological resources to the exclusion of other types of cultural resources (and older archaeological surveys documented only evidence of prehistoric use or occupation). Finally, it is likely that there are some locations previously surveyed at which burials or buried archaeological resources are present but not evident and therefore not recorded at the time of the survey (many surveys both in the past and in the present rely entirely or primarily on surface evidence of archaeological resources or burials).

This plan therefore defines procedures that address sampling at known locations of cultural resources and locations where no cultural resources are currently recorded. EPA is the lead federal agency for cultural resources coordination for the Site. The SATES field work will be conducted entirely on Colville Tribal allotments. Therefore, any issues or concerns related to cultural resources during the planning or implementation of Site work shall be brought to the attention of EPA for consultation with the CCT, as appropriate.

4.1 GENERAL CONSULTATION FRAMEWORK

Successful implementation of the SATES program and of this CRCP, given the issues defined above, will require ongoing consultation and coordination with the CCT. Other consulting parties (STI and the Washington State Department of Archeology and Historic Preservation [DAHP]) may be recognized in the future whose participation would be important for general consultation or coordination in the SATES 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 SATES and RI/FS processes.

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.

As each of the SATES target DUs are on Colville Tribal allotments, a tribal cultural resources (archeological) monitor and tribal representative will be present on-site to monitor sampling. The protocol for this monitoring is defined below.

4.2.1 Archaeological Monitoring in the Sampling Program

To ensure compliance with the NHPA and the applicable requirements, procedures, and standards of the CCT, 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.

Archaeologist and Tribal Representative On-Site

An archaeological monitor and tribal representative will be present on-site when ground-disturbing sampling or sampling-related activity occurs. The archaeological monitor 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 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 will document their observations on a daily basis, including field notes and photographs that record the location and character of the sampling or other ground-disturbing activity, any archaeological discoveries made, and any decisions made within the provisions of this plan by the archaeological monitor and tribal representative in response to any archaeological discoveries. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

All archaeological monitors and tribal representatives will be required to have read the applicable health and safety plan and to have complete understanding of the archaeological monitoring provisions of this plan. The archaeological monitors and tribal representatives will also be required to meet requirements for personal protective equipment. In addition, all on-site personnel are subject to the directions of the task field supervisor at all times.

Discoveries—Archaeological Monitors Present

At the discretion of the archaeological monitor or tribal representative, ground-disturbing sampling or associated activity may be slowed or halted at any time that a suspected archaeological object or archaeological resource is encountered. The objective of this

slowing or halting of ground-disturbing activity is to allow the archaeologist to confirm and/or make a preliminary assessment of the discovery. At the discretion of the archaeological monitor or tribal representative, a specific sample may be relocated from the location of the discovery but at the sampling location. Such relocation will be coordinated with the on-site sampling manager or supervisor.

At the request of the archaeological monitor or tribal representative, the sampling personnel will either:

- Assist in securing access to the location of the discovery and take appropriate measures to protect the location of the discovery from rain, storm water, and other possible disturbances, or
- Assist in moving the artifacts to a protected and secure area of the site away from the immediate sampling area. Removal of artifacts from the discovery location will be undertaken only if leaving the artifacts in place would jeopardize their integrity due to erosion or collection by unauthorized individuals.

The archaeological monitor, tribal representative, or a member of the TAI field sampling team will remain on-site to ensure the security of the find until more extensive efforts can be made to secure the site from further disturbance or a more extensive evaluation and documentation of the discovery can be made.

Notification of any archaeological discoveries must be provided to EPA for further coordination with consulting parties within 24 hours of the discovery. EPA contact information is provided in Attachment D1. All telephone notification of discoveries must be promptly followed by notification in writing (via email or conventional mail).

Discovery of Human Remains

Native peoples in the UCR Study Area consider the graves of their ancestors to be important in both their cultural identity and in defining their relationship with the land. These graves are therefore considered sacred and should be left undisturbed. Should inadvertent disturbance occur, the remains and associated materials ("funerary objects") must be treated with respect and honor. All appropriate federal, tribal, and state laws, regulations, and procedures regarding burials should be rigorously enforced. In the event that likely or confirmed human remains are encountered, all further sampling or other ground-disturbing activity will cease immediately.

Upon such discovery, the TAI field sampling team and/or CCT cultural monitor will notify EPA for further coordination with consulting parties (consisting minimally of the STI, and the DAHP). The field sampling team will assist the archaeological monitor and tribal representative in securing the location of the discovery.

If no archaeological monitor or tribal representative is present, the TAI field sampling team will secure the location of the discovery in such a manner that both maintains the physical integrity of the remains and any associated objects and precludes further disturbance, or a member of the TAI field sampling team will remain on-site until an archaeologist or tribal representative can arrive to assess the find.

Other conditions for responses to discoveries of archaeological materials may be defined in the permit(s) issued for the sampling program. Responses to any discoveries of burials must comply with provisions of NAGPRA and its implementing regulations (in addition to those referenced above), as well as the existing protocols of the CCT (these protocols are provided in Attachment D2).

4.2.2 Curation

Artifacts and other cultural materials that may be recovered during the sampling program (with the exception of human remains and associated items subject to NAGPRA) will be curated at a facility that meets the standards of 36 CFR 79. The appropriate tribe will designate the curation facility for cultural materials recovered from tribal lands.

4.2.3 Reporting

Within 150 days of completion of each sampling activity that is covered under this plan, the CCT archaeologist will prepare a confidential written report that presents the results of the archaeological monitoring and responses to any discoveries of archaeological resources or burials. The report will include: 1) copies of field notes, descriptions, and maps of all locations at which sampling-related archaeological monitoring was conducted; 2) descriptions of any discoveries made during such monitoring and the outcome of the discoveries (including the rationale for the decisions for the disposition of any finds); 3) descriptions and maps of all non-monitored locations at which inadvertent discoveries were made and the outcome of those discoveries; and 4) recommendations for any changes in the monitoring protocol or coordination plan that may be appropriate to address results of the monitoring or how well existing coordination procedures worked. A standardized archaeological monitoring form may be substituted for the field notes referenced above.

The draft report will be provided to EPA for review.

4.3 CONFIDENTIALITY

The TAI field sampling team shall make its best efforts, in accordance with state and federal law, to ensure that its employees and contractors keep the discovery of any found or suspected human remains, other cultural items, and potential historic properties confidential. Pertinent TAI employees and contractors will be required to read and sign a

confidentiality statement that specifies procedures to be followed in response to media and public contacts regarding archaeological and other cultural resources. To the extent permitted by law, prior to any release of information, EPA, TAI, and the other consulting parties shall concur on the amount of information, if any, to be released to the public, any third party, and the media and the procedures for such a release.

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6 GLOSSARY OF TERMS

Burial—A burial is defined in NAGPRA as "[a]ny natural or prepared physical location, whether originally below, on, or above the surface of the earth, into which as part of the death rite or ceremony of a culture, individual human remains are deposited."

Curation—Long-term storage and preservation of archaeological collections. Archaeological collections from federal lands must be curated at facilities that meet the standards of 36 CFR 79.

Ethnohistoric—Information on Native peoples gathered from historical accounts.

Historic, historic-period, historical—The NHPA uses the term "historic" to refer to properties that are listed or have been determined eligible for listing on the National Register of Historic Places. To avoid confusion with this definition of "historic," "historic-period" or "historical" are used to reference resources, places, events, and people associated with the period since the appearance of Euroamericans and the beginning of written accounts (ca. 1780–1810 in the Pacific Northwest).

Protohistoric—The period of time transitional from prehistory to history. In the Pacific Northwest, the protohistoric can be generally defined as from the late 1600s until late 1700s.

ATTACHMENT D1

USEPA CONTACT INFORMATION

USEPA CONTACT INFORMATION

Monica Tonel is the primary contact for the EPA. Ms. Tonel's telephone number is (206) 553-0323 (office) and email is Tonel.Monica@epa.gov. Ms. Tonel will have a cell phone number that will be provided to the sampling team(s), tribes, and state, prior to field sampling activities commencing.

If Ms. Tonel cannot be reached, then Laura Buelow is the alternate EPA contact at (509) 376-5466 (office) or (509) 420-0435 (cell) and at Buelow.Laura@epa.gov.

In the event that either Ms. Tonel or Ms. Buelow cannot be contacted, then Kira Lynch will be contacted at (206) 553-2144 (office) and at lynch.kira@epa.gov.

ATTACHMENT D2

PROTOCOLS FOR INADVERTENT DISCOVERIES

Federal Columbia River Power System (FCRPS) Grand Coulee Dam Project and Lake Roosevelt National Recreation Area Inadvertent Discovery of Human Remains Protocol

Treatment of Human Remains Found on Federal or Tribal Lands

This protocol covers human remains and/or other cultural objects that are subject to the Native American Graves Protection and Repatriation Act (NAGPRA) that are discovered inadvertently on Federal or tribal lands after November 16, 1990. In this document, Federal lands are defined as: within the boundaries of lands managed by the National Park Service (NPS), Bureau of Reclamation (Reclamation), the Confederated Tribes of the Colville Reservation (CCT), or the Spokane Tribe of Indians (STI). If remains that are potentially human or other NAGPRA items are encountered, any activity in the vicinity of the discovery will cease. All reasonable efforts will be made to protect the remains and any associated cultural items.

1. Secure the area and take protective measures to assure that the remains are not in danger of further depredation or disturbance. The burial or location will not be disturbed. All human remains and associated artifacts will be treated in a respectful manner.
2. In cases where a potential crime scene exists, *personnel except those necessary to protect the location will leave the immediate vicinity in order to prevent unintentional destruction of crime scene information.* The appropriate law enforcement office (Tribal within the boundaries of the Reservation Zone, NPS within the boundaries of the Recreation Zone, and Reclamation within the boundaries of the Reclamation Zone) will be immediately notified, however, site specific information should not be included in radio transmissions to maintain site security.
3. The Tribal Historic Preservation Officer (THPO) (CCT or STI), if applicable, and the archaeologists working for the appropriate tribe or agency will also be contacted immediately after law enforcement (contact phone numbers are provided below). For NAGPRA discoveries associated with the Lake Roosevelt shoreline, Reclamation's Grand Coulee Power Office (GCPO) Archaeologist will be notified. For inadvertent discoveries in the Reservation Zone, the NPS archaeologist does not need to be contacted. Live phone contact is required; backup staff is 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.

4. Law enforcement, in consultation with a professional archaeologist (if needed), trained in human osteology, will determine if the remains are human, whether it is of recent origin, and if it is part of a crime scene. These initial investigations conducted by law enforcement will be conducted carefully and with a mind toward minimizing damage to potential human remains and burial features

5. A professional archaeologist will also assist law enforcement in determining if the human remains are archaeological in origin and if they should be classified as NAGPRA items. If they are determined to be NAGPRA items yet there is an ARPA-related crime scene (i.e., there is evidence for intentional disturbance or looting of archaeological materials), the archaeologist will assist law enforcement as needed in the collection of archeological data to support the ARPA case. In order to document the crime scene, law enforcement officers and assisting archaeologists may take photographs of human remains and collect other relevant evidence.

6. If law enforcement determines that the find is human and not of law enforcement concern, they will release the site to the appropriate federal or tribal archaeologist. It is then the responsibility of that archaeologist to contact the appropriate Tribal representatives and the Reclamation archaeologist if contact has yet to be made about the Inadvertent Discovery. Live phone contact is required; backup staff are identified if the primary contacts are unavailable. Phone contact will be followed up by written confirmation.

7. As soon as the remains have been determined to be human, then efforts will be made in the field to determine whether they are Native American. The basis of this determination will be documented in writing. If the items are determined to be Native American, go to Item 10. All NAGPRA procedures and protocols for Inadvertent Discoveries on Federal Lands After November 16, 1990 will be followed.

8. If the remains are determined **not** to be Native American, then Washington State burial laws apply and will be followed (Title 68, Chapter 68.50 RCW HUMAN REMAINS).

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 or the STI, the NPS, and Reclamation will coordinate regarding the types of non-destructive analysis to be conducted.

10. On lands managed by the Tribes, NPS, or Reclamation, it will be assumed that the human remains fall under the coverage of ARPA. No further investigations by non-agency or non-tribal personnel will be conducted until an ARPA permit is in place. For the purposes of advancing the process, and out of caution and respect for the concerns of local tribes, it will be assumed that the remains are

Native American and affiliated with the local tribes. A Written Plan of Action will be prepared in consultation with the affected tribe. Provenience information will be collected as specified by the Written Plan of Action and ARPA permit, if applicable. 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 (following the methods shown in Appendix C).
12. If it is possible to rebury or cap the NAGPRA items in place, then that decision will be documented in the Written Plan of Action in agreement with the Tribes.
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 will 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, the STI, or the US government, an ARPA permit will be required from the NPS or Reclamation. The Written Plans of Action for individual discoveries will detail exact procedures for further implementation of NAGPRA.
14. NAGPRA items will be removed using standard professional archaeological practices in compliance with the ARPA permit issued for the removal, if applicable, and in a culturally sensitive manner at the direction of a Tribal representative. Because each burial is unique and recoveries need to be suited to different situations (e.g., position of the burial on the landform, weather, fluctuating reservoir levels). If work is contracted beyond the reservoir group, the Contractor will brief the appropriate federal and/or tribal archaeologist about their plan for the recovery and seek their concurrence. Because of the sensitivity of the local tribes regarding photographs of human remains, no such photographs will be taken. The only possible exception would be a photograph used for initial identification of remains as human versus non-human. Instead, those removing the remains will create a sketch showing the position of the human remains in the burial feature. After excavations have been completed, a photograph will be taken showing the stratigraphic position of the burial feature so that its association to other potential cultural features is documented.

15. Inadvertent discoveries that result from activities requiring easements or other non-ARPA permits (such as access, construction, etc.) will 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. Inadvertent discoveries have to be protected. This is primarily the job of the enforcement officers with jurisdiction with the various Lake Roosevelt zones. Additional assistance may be provided as follows: if the find occurred on the Mainstem then the CCT will assist to 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. If the find occurs on the Spokane Arm, the STI will fill this role (see below for the STI contact).

17. Contact Information

    a. 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 is (509) 634-2695, FAX (509) 634-2694, and the internet address is guy.moura@colvilletribes.com. After work hours, Mr. Moura can generally be reached at (509) 633-8361 (home) or (509) 631-1705 (cell). If Mr. Moura cannot be reached, then Brent Martinez is the alternate contact: phone (509) 634-2648 (work) or (509) 631-1177 (cell); email brent.martinez@colvilletribes.com . Additional contacts include Brenda Covington 634-2699 and Jackie Cook 634-2635.

    b. Randy Abrahamson, STI THPO, is the primary contact for the STI. Mr. Abrahamson's phone number at the Department is (509) 258-4315, FAX (509) 258-6965, and his e-mail address is randya@spokanetribe.com. After work hours, Mr. Abrahamson can generally be reached at (509) 951-0524 (cell). If Mr. Abrahamson cannot be reached, Mr. John Matt shall be contacted at (509) 258-4060 (work), (509) 258-8945 (home), or (509) 993-1921 (cell).

    c. Justin Eichelberger, Park Archeologist for the Lake Roosevelt National Recreation Area, is the primary contact for the NPS. Mr. Justin Eichelberger's phone number is (509) 738-6266, ext. 114, FAX (509) 633-3862, and internet address is justin_eichelberger@nps.gov." The NPS will issue an ARPA permit for burial recoveries in the Recreation Zone. If Mr. Eichelberger cannot be contacted in person, the District Ranger can be contacted at (509) 738-6266, ext. 109.

    d. Derek Beery, Grand Coulee Power Office Archaeologist, is Reclamation's primary contact for NAGPRA on Lake Roosevelt. His phone number is (509) 633-9233, and internet address is dbeery@usbr.gov. His work cell phone is (509) 237-4477 and his home phone is (360) 477-5058. If Mr. Beery is not available, then Dr. Sean Hess, Regional Archaeologist, is Reclamation's

alternate contact. His phone number is (208) 378-5316, Cell (509) 631-0581, and internet address is "shess@pn.usbr.gov." In the event that neither Mr. Beery nor Dr. Hess is available, Reclamation's Contracting Officer will be contacted directly at (208) 378-5364.

e. Gregory Anderson, FCRPS Cultural Resource Project Manager/Archaeologist, is the primary contact for Bonneville Power Administration. Mr. Anderson's phone number is are: (503) 230-4721, gmanderson@bpa.gov.

Upon completion of the above steps, the appropriate land manager, or its consultant, will prepare a written report of the discovery. The report will include a description of the contents of the discovery, a summary of consultation, and a description of the treatment or mitigation measures. The DAHP and THPO will have 30 days to review and submit comments on the report. The appropriate land manager will then revise the document and file final copies with the appropriate THPO and DAHP if the find occurred outside either reservation.

Treatment of Human Remains Found on Private or State Lands under Washington Law

In the event that human remains are encountered during construction, maintenance, or operation of the Project on private or state lands, the following procedures are to be followed to ensure compliance with RCW 68.60: *Abandoned and Historic Cemeteries and Historic Graves*, and RCW 27.44: *Indian Graves and Records*.

1. Pursuant to RCW 68.60.(050), if a member of the project work force or an archaeologist believes that he/she has encountered human skeletal remains, he/she must immediately stop work and inform the Construction Supervisor or site manager, if applicable. The Construction Supervisor will be responsible for stopping all excavation work adjacent to the discovery in an area large enough to provide for the security and integrity of the remains. The Construction Supervisor will be responsible for taking appropriate steps to protect the remains by installing a physical barrier (i.e., exclusionary fencing) and prohibiting machinery, other vehicles, and unauthorized individuals from coming within at least 100 ft (30 meters) of the discovery site.
2. The Construction Supervisor or other project staff will promptly contact the appropriate local law enforcement, County Coroner, and the landowner. The remains should not be touched, moved, or further disturbed, and will remain secured until law enforcement arrives. They will also notify law enforcement that the treatment of all Native American human remains and associated objects should be respectful and confidential, until the origin of the remains can be determined.

3. The County Coroner will assume jurisdiction over the human skeletal remains and make a determination of whether the remains are forensic or non-forensic. If the Coroner determines the remains are non-forensic, he/she will report that determination to the DAHP who will then take jurisdiction over the remains and report the discovery to the appropriate County cemeteries and affected Indian tribes. The State Physical Anthropologist will determine whether the remains are Native American or non-Native American and will report that finding to the appropriate parties. The State Physical Anthropologist will also establish an appropriate buffer zone around the discovery site within which no work may proceed while investigations proceed. The DAHP will then handle all consultation with the appropriate Indian tribes and parties as to the preservation, excavation, and disposition of the remains.
4. If the human remains are Indian, all subsequent proceedings, including any visits to the discovery site by affected tribes that have been authorized by the DAHP, will be conducted with dignity and respect by all employees and contractors. The State Physical Anthropologist will assess whether a buffer zone larger than 100 ft (30 meters) is needed to accommodate any excavation work, tribal visits or ceremonies, etc.
5. Construction activities will not resume within the established buffer zone of the discovery site until authorized disposition of the human remains has been completed and permission from the appropriate authority to resume work in the buffer zone has been received. In the case of Indian human remains, written permission to resume work must be obtained from the DAHP.

APPENDIX E

HEALTH AND SAFETY PLAN ADDENDUM

CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
COPC	chemical of potential concern
HAZWOPER	hazardous waste operations and emergency response
OSHA	Occupational Safety and Health Administration
PFD	personal flotation device
PPE	personal protective equipment
RI/FS	remedial investigation and feasibility study
SHSP	site health and safety plan
Site	Upper Columbia River site
SATES	Soil Amendment Treatability Evaluation Study
TAI	Teck American Incorporated
UCR	Upper Columbia River
WISHA	Washington Industrial Safety and Health Act

SITE HEALTH AND SAFETY PLAN ADDENDUM APPROVAL

This addendum to the general site health and safety plan (SHSP) has been reviewed and approved by Teck American Incorporated's (TAI) lead technical consultant Ramboll Environ for the 2017 Soil Amendment Treatability Evaluation Study at the Upper Columbia River (UCR) site (Site) in support of the remedial investigation and feasibility study (RI/FS) for the Site.

Ramboll Environ Task Manager Date

Ramboll Environ Corporate Health and Safety Officer Date

SITE HEALTH AND SAFETY PLAN ADDENDUM ACKNOWLEDGEMENT

This addendum to the general SHSP (TCAI 2009) is approved for use at the Site. The general SHSP and addendum are the minimum health and safety standard for the Site and will be strictly enforced for all personnel conducting sediment sampling activities at the Site. Subcontracted personnel may request to adopt a subcontractor-specific plan in lieu of this addendum to the general SHSP, but must obtain prior written approval from TAI and provide written concurrence from the subcontractor that the subcontractor will assume direct responsibility and liability for administering the plan to its employees.

I have reviewed this addendum to the general SHSP for the study. I have had an opportunity to ask any questions I may have and have been provided with satisfactory responses. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines.

Employee signature	Company	Date
Employee signature	Company	Date
Employee signature	Company	Date
Employee signature	Company	Date
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1 INTRODUCTION

This addendum to the general site health and safety plan (SHSP) for the Upper Columbia River (UCR) site (Site) remedial investigation and feasibility study (RI/FS) provides specific Site information and health and safety provisions to protect workers from potential hazards during sediment and soil sampling at locations along the UCR.

Site background information and general health and safety provisions to protect workers from potential hazards during work at the Site are presented in the general SHSP (TCAI 2009).

Subcontractors that are contracted to perform field work associated with the RI/FS may adopt this SHSP or develop and follow their own SHSPs. However, subcontractor SHSPs must be consistent with the provisions outlined in this addendum and the general SHSP, and any discrepancies will follow the most protective practices.

It is Ramboll Environ's policy to provide a safe and healthful work environment. No aspect of the work is more important than protecting the health and safety of all workers.

Ramboll Environ cannot guarantee the health or safety of any person entering the Site. Because of the potentially hazardous nature of the Site and the activity occurring thereon, it is not possible to regulate personal diligence or to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the Site. The health and safety guidelines in this plan were prepared specifically for the Site and should not be used on any other site without prior evaluation by trained health and safety personnel.

A copy of this addendum and the general SHSP must be in the custody of the field team during field activities. All individuals performing field work must read, understand, and comply with this plan before undertaking field activities. Once the information has been read and understood, the individual must sign the Site Health and Safety Acknowledgment Form provided with this addendum to the general plan. Any changes to the plan will be written in the plan and initialed by all potentially affected field personnel. The signed form and any initialed changes will become part of Ramboll Environ's project file. A copy of the form will be provided to Teck American Incorporated (TAI).

This addendum may be modified at any time based on the judgment of the site safety officer in consultation with the corporate health and safety officer and project manager or designee.

Any modification will be presented to the on-site team during a safety briefing and will be recorded in the field logbook.

1.1 ORGANIZATION

Task-specific safety procedures associated with soil sampling are presented in this addendum to the general SHSP. In addition, this addendum provides detailed field site and hospital location maps, air monitoring requirements, specific requirements for personal protective equipment (PPE), work zone definitions, and key emergency contact information.

The general SHSP (TCAI 2009) provides background site information and general health and safety provisions to protect workers from potential hazards during field activities. The information includes general safety guidelines for physical hazards, a chemical hazard evaluation, health and safety training requirements, general PPE requirements, emergency planning, general decontamination procedures, vehicle safety, and spill containment.

1.2 SCOPE OF WORK

Soil samples will be collected from tribal allotment properties previously sampled within the 2014 residential soil study area (see Site map, Attachment E-1).

1.3 DEFINITIONS

Contamination reduction zone:	Area between the exclusion and support zones that provides a transition between contaminated and clean zones
Exclusion zone:	Any area of the Site where hazardous substances are present, or are reasonably suspected to be present, and pose an exposure hazard to personnel
HAZWOPER:	Hazardous Waste Operations and Emergency Response standard, as described in 29 Code of Federal Regulations (CFR) Part 1910.120
OSHA:	Occupational Safety and Health Administration
Support zone:	Any area of the Site, so designated, that is outside the exclusion and contamination reduction zones
WISHA:	Washington Industrial Safety and Health Act, as described in Chapter 49.17 Revised Code of Washington

2 SAFETY GUIDELINES FOR PHYSICAL HAZARDS

All work will be done using the buddy system. Depending upon the time of year and the location of work, biting insects may be an issue when accessing any of the sampling locations during the sampling event. Table E-2-1 summarizes potential physical hazards posed by proposed Site activities. Table E-2-2 presents potential physical hazards that are expected to be present during sediment sampling activities.

Table E-2-1. Summary of Activities and Potential Hazards

Activity	Potential Hazard
Soil Sampling	Water hazards, slippery walking surfaces, cold/hypothermia (depending on sampling event), heat stress (depending on sampling event), material handling, adverse weather, work in remote areas

Table E-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 E-2); potential for cold/hypothermia will depend on season.
Heat stress	X		Drink water frequently in hot weather; take work breaks; follow the heat-related illness information (Attachment E-3); potential for heat stress will depend on season.
Material handling	X		Lift properly; seek assistance if necessary; do not overfill coolers or boxes.
Adverse weather	X		Seek shelter during storms; work in adverse weather conditions only with proper training, clothing, and equipment.
Drowning		X	Wear personal flotation devices (PFDs) at all times when working over water. Inspect the PFDs prior to use and do not use defective PFDs. Keep sampling equipment on boats organized at all times. Boats are required to be equipped with a throwable life ring, fire extinguisher, and warning horn, and each field member will be briefed on their storage location.
Work in remote areas	X		Use the buddy system; carry radio and/or cellular phone; bring sufficient equipment in case of accident or injury (first aid kit, shelter if appropriate).
Biting insects	X		Use repellents, as needed.

3 CHEMICAL HAZARD EVALUATION

A chemical hazard evaluation is presented in the general SHSP (TCAI 2009) and incorporated herein by reference.

4 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

The following sections address PPE and safety equipment required for completing the sediment sampling activities.

4.1 PERSONAL PROTECTIVE EQUIPMENT

Based on chemical and physical hazards associated with the soil sampling activities, Tables E-4-1 and E-4-2 identify the PPE required for sampling.

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

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

[a] See Table E-4-2 for definitions

[b] Based on unexpected change in Site conditions

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

Protection Level	Required	Personal Protective Equipment
Level D	X	Long pants and shirt or work coveralls; safety glasses or goggles (as appropriate); and nitrile, neoprene, or Barrier® 5 layer laminate gloves (as appropriate). Hard hat and hearing protection as needed.
Level MD	X	Same as Level D with modification (M) of addition of rain gear and PFD, as needed.

Is there potential for a respirator to be donned during field work? Yes _____ No X

4.2 SAFETY EQUIPMENT

The following safety equipment will be on site during the proposed field activities.

Air Monitoring (Check the items required for this project)

- ☐ Photoionization Detector
- ☐ Lower Explosive Limit/Oxygen meter
- ☐ Hydrogen sulfide meter
- ☐ Detector pump and tubes
- ☐ Air sampling pumps
- ☐ Miniram
- ☐ Radiation meter
- ☐ Other _____

First Aid Kit (mandatory, including adhesive band-aids, gauze, tape, gloves, cardiopulmonary resuscitation shield, triangle bandage)

[X]	Emergency blanket	[X]	Sunscreen
[X]	Insect repellent	[ ]	Other _____

Other (Check the items required for this project)

[X]	Eyewash	[ ]	Fit test supplies
[X]	Drinking water	[X]	Fire extinguisher (boat)
[ ]	Stop watch for monitoring heart rate	[ ]	Windsock
[ ]	Thermoscan® thermometer (or equivalent) for heat stress monitoring	[X]	Cellular phone
		[ ]	Radio sets
[X]	Survival kit	[X]	Global positioning system
[ ]	Personal flotation device	[X]	Other: Satellite phone
[ ]	Cool vests		

5 AIR MONITORING

The principal chemicals of potential concern (COPCs) at the Site are not volatile (i.e., metals). There is a small chance for the COPCs to become airborne in dust form if the sediment is dry, although the sediments are unlikely to contain a significant amount of fine particles. In addition, the chemical hazard evaluation presented in the general SHSP (TCAI 2009) concluded that, based on previous evaluations, none of the sediment or soil chemicals is expected to pose a threat to field personnel during soil sampling activities. If windblown dust becomes problematic to the field crew, operations may be suspended. Tables E-5-1 and E-5-2 provide air monitoring requirements and action levels to be used during sampling activities.

Table E-5-1. Site-specific Air Monitoring Requirements

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

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

Table E-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
Site phone	Field cellular phone. Cellular phone coverage is spotty in the vicinity of the sampling areas. If cellular phone coverage is lost due to a mountain or hill,	(503) 320-1796	NA

Local Resources	Name	Telephone	Notified Prior to Work (Yes/No)?
	drive a little farther to get coverage. If cellular phone coverage is available, the 911 system will work. A satellite phone may be necessary for areas with limited cellular phone coverage.		
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 E-1)		

In case of serious injuries, death, or other emergency, the TAI Project Coordinator and TAI Principal Investigator must be notified immediately. Contact numbers are listed in Table E-6-2.

Table E-6-2. Corporate Emergency Telephone Numbers

Corporate Resources	Name	Work/Cellular Telephone
TAI Project Coordinator	Kris McCaig	Work: (509) 623-4501 Cellular: (509) 434-8542
TAI Principal Investigator	Dina Johnson	Work: (206) 336-1662 Cellular: (425) 765-1218

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

Table E-6-3. Project Area Hospital Information

Facility Name	Hours of Operation	Phone Number	Address	City
Coulee Community Hospital	24 hours/ emergency	509-633-1753	411 Fortuyn Road	Grand Coulee
Ferry County Memorial Hospital	24 hours/ emergency	509-775-3333	36 Klondike Road	Republic
Lincoln Hospital	24 hours/ emergency	509-725-7101	10 Nichols Street	Davenport
St Joseph's Hospital	24 hours/ emergency	509-935-8211	500 East Webster Street	Chewelah
Mount Carmel Hospital	24 hours/ emergency	509-684-2561	982 East Columbia Street	Colville
Deer Park Hospital	24 hours/ emergency	509-276-5061	East 1015 'D' Street	Deer Park
Deaconess Medical Center-Spokane	24 hours/ emergency	509-473-7178	West Fifth Avenue	Spokane
Holy Family Hospital	Dependent on case	509-482-0111	North 5633 Lidgerwood Avenue	Spokane

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

Facility Name	Hours of Operation	Phone Number	Address	City
Sacred Heart Medical Center	24 hours/ emergency	509-474-3131	West 101 Eighth Avenue	Spokane
Veterans Affairs Medical Center	7:30 am to 4:00 pm	509-434-7032	North 4815 Assembly Street	Spokane

In the event any health or safety issue arises, after the victim(s) receive appropriate medical treatment, the relevant field crew member(s) will be interviewed to formally document the incident by, at a minimum, the field supervisor and TAI Project Coordinator. All incidents will be documented in the field logbook. If applicable, a corrective action record form will be filled out (see Appendix B to the Draft Phase I Work Plan) to ensure future health and safety issues are addressed.

7 WORK ZONES

The following work zones are defined for the sediment and soil sampling activities.

Exclusion zone. The area immediately around the sampling activities will be designated as the exclusion zone. Traffic cones and/or caution tape will be used to delineate the specific area(s).

Contamination reduction zone. Not applicable. All sampling activities will occur within the exclusion zone.

Support zone. Not applicable. All sampling activities will occur within the exclusion zone.

Controls to be used to prevent entry by unauthorized persons. Sampling staff will remain cognizant of people approaching the exclusion zone. All unauthorized persons will be instructed to remain outside of the sampling area.

8 DECONTAMINATION

The field team will decontaminate all sampling equipment that comes into contact with soil prior to the commencement of sampling at each location and upon completion of the study. This will include equipment such as trowels, mixing bowls, and utensils. The decontamination will consist of thoroughly rinsing all of the equipment with potable water, then with soap (i.e., Alconox®) and rinsed with potable water after each use.

Clean gloves will be worn at each sampling location to avoid transfer of potential contaminants among samples. Otherwise, decontamination procedures will follow those presented in the general SHSP (TCAI 2009) and are incorporated herein.

9 VEHICLE SAFETY, SPILL CONTAINMENT, AND SHIPPING INSTRUCTIONS

Vehicle safety, spill containment, and shipping instructions are presented in the general SHSP (TCAI 2009) and are incorporated herein.

10 TASK-SPECIFIC SAFETY PROCEDURES

Slips, trips, and falls are anticipated to be the greatest hazards to field personnel during the soil sampling event, as well as unexpected contact with the sampling equipment. Always move about the shore or upland area with caution. Wear properly fitting shoes or boots with non-slip soles and good ankle support. Be aware of the location and movement of the grab sampler at all times.

The Site is located in a remote region with limited cellular phone coverage. All field crews will have a satellite phone to maintain communication with the field supervisor. The field crews will coordinate departure and expected return times for all field activities with the field supervisor. Field crews will provide the field supervisor with status updates at least every 4 hours while performing field collection activities.

The areas that will be sampled are accessible to the public. Always be aware of your surroundings. Use the buddy system and keep in line-of-sight contact with other sampling personnel at all times. Do not leave samples or sampling equipment unattended. If you feel threatened, or if the situation feels unpredictable, leave the area immediately.

Always wear nitrile gloves and safety glasses or goggles when handling sampling equipment, samples, or preservative chemicals (if required). Keep a 1-L eye wash bottle accessible during all field work. Avoid getting preservatives on your skin or clothes. If any preservatives are spilled or splashed on your skin or clothes, immediately rinse the affected area with potable water and get medical attention, if warranted. If any preservative is splashed in the eye, flush the eye with the eye wash solution and get immediate medical attention.

11 REFERENCE

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