August 5, 2015

Guy Barrett
Washington Department of Ecology
Southwest Regional Office Toxics Cleanup Program,
P.O. Box 47775
Olympia, WA 98504-7775

Subject: Agreed Order No. DE 10483- Former Columbia Gorge Aluminum Smelter
Final Remedial Investigation Work Plan

Pursuant to Section VII in Agreed Order No. DE 10483 and Task 1 of the Statement of Work, this transmits the two hard copies and two electronic (CD-ROM) copies of the Final Remedial Investigation (RI) Work Plan for the Goldendale facility.

The Agreed Order requires two phases of RI work plan preparation (Phase 1 and Phase 2) that have been prepared as two separate volumes of the Final RI Work Plan: Volume 1 is the Phase 1 Work Plan and Volume 2 is the Phase 2 Work Plan.

The Final Phase 1 Work Plan (Volume 1) and Final Phase 2 Work Plan (Volume 2) incorporate responses to the January 25, 2015 and July 6, 2015 Ecology and Yakama Nation comments on the draft plans.

We look forward to obtaining Ecology's approval of the Final RI Work Plan.

Very Truly Yours,

Bill Bath

Bill Bath
Lockheed Martin Corporation
2550 North Hollywood Way, Suite 406
Burbank, CA 91505-5047

Peter Trabusiner

Peter Trabusiner
Blue Mountain Consulting
1500 Adair Drive
Richland, WA 99352-9419
For
NSC Smelter LLC
3313 West Second Street
The Dalles, OR 97058

FINAL
REMEDIAL INVESTIGATION WORK PLAN

VOLUME 2: PHASE 2 WORK PLAN

Columbia Gorge Aluminum Smelter Site

Revision 0
Goldendale, WA
Facility Site ID #95415874

Agreed Order DE 10483

August 5, 2015

On behalf of:

Lockheed Martin Corporation
6801 Rockledge Drive
Bethesda MD 20817

NSC Smelter LLC
3313 West Second Street
The Dalles OR 97058

Prepared by:

Tetra Tech, Inc.
19803 North Creek Parkway
Bothell WA 98011

Blue Mountain Environmental Consulting Inc.
125 Main Street
Waitsburg WA 99361

Plateau Geoscience Group LLC
P. O. Box 1020
Battle Ground WA 98604

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Acronyms

Aleris	Aleris International Limited
AOC	Area of Concern
AST	Aboveground Storage Tank
BAL	Basalt Aquifer – Lower Zone
BAU	Basalt Aquifer – Upper Zone
BAZ	Biological Active Zone
bgs	Below ground surface
BMEC	Blue Mountain Environmental Consultants, Inc.
BPA	Bonneville Power Administration
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
CB	Catch Basin
CLARC	Ecology Cleanup Level and Risk Calculation database
CoC	Chain-of-Custody
COPC	Chemicals of Potential Concern
cPAHs	Carcinogenic Polycyclic Aromatic Hydrocarbons
CRMP	Cultural Resources Monitoring Protocol
DAHP	Washington State Department of Archaeology and Historic Preservation
DGPS	Differential Global Positioning System
DOT	U.S. Department of Transportation
DQOs	Data Quality Objectives
EBs	Equipment Blanks
Ecology	Washington Department of Ecology
EELF	East End Landfill
EESH	Lockheed Martin Energy, Environment, Safety, & Health
EHW	Extremely Hazardous Waste
EIMS	Environmental Information Management System
EP	Electrostatic Precipitator
EPA	U.S. Environmental Protection Agency
ESI	East Surface Impoundment
FERC	Federal Energy Regulatory Commission
FS	Feasibility Study
GIS	Geographic Information System
GPR	Ground-Penetrating Radar

GPS	Global Positioning System
HASP	Health and Safety Plan
HEAF	High Efficiency Air Filtration
HEAST	Health Effects Assessment Summary Table
IRIS	Integrated Risk Information System database
JARPA	Joint Aquatic Resources Permit Application
KPUD	Klickitat County Public Utility District
Lockheed Martin	Lockheed Martin Corporation
MCLs	Maximum Contaminant Levels
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTCA	Model Toxics Control Act
NCEA	National Center for Environmental Assessment database
NESI	North of the East Surface Impoundment
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NSC	NSC Smelter, LLC
NTUs	Nephelometric Turbidity Units
OCBs	Oil Circuit Breakers
OMM	Operations, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PE	Professional Engineer
PGG	Plateau Geoscience Group, LLC
PID	Photoionization Detector
PPE	Personal Protective Equipment
PSEP	Puget Sound Estuary Program
QAPP	Quality Assurance Program Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RQD	Rock Quality Designation
SAP	Sampling and Analysis Plan

SCUM II	Ecology's Sediment Cleanup User's Manual
SMS	Washington State Sediment Management Standards
SPL	Spent Pot Liner
SPLP	Synthetic Precipitation Leaching Procedure
SWMU	Solid Waste Management Unit
SVOCs	Semivolatile Organic Compounds
TCLP	Toxic Characteristic Leaching Procedure
TDS	Total Dissolved Solids
Tetra Tech	Tetra Tech, Inc.
TFAS	Treaty Fishing Access Site
TPH	Total Petroleum Hydrocarbons
TPH-DX	Total Petroleum Hydrocarbons – Diesel extended range
TPH-Gx	Total Petroleum Hydrocarbons – Gasoline extended range
TSS	Total Suspended Solids
TTEC	Total Toxicity Equivalent Concentrations
μg/kg	Micrograms per Kilogram
μg/L	Micrograms per Liter
UA	Unconsolidated Aquifer
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
WAAS	Wide Area Augmentation System
WAC	Washington Administrative Code
WELF	West End Landfill
WESP	Wet Electrostatic Precipitator
WISAASRD	Washington Information System for Architectural and Archaeological Records Data database
WSI	West Surface Impoundment

Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)
(Agreed Order No. DE 10483)

Solid Waste Management Units (SWMUs)

NPDES Ponds (SWMU #1)
East Surface Impoundment (ESI) (SWMU #2)
Intermittent Sludge Disposal Ponds (SWMU #3)
West Surface Impoundment (SWMU #4)
Line A Secondary Scrubber Recycle Station (SWMU #5)
Line B, C, D Secondary Scrubber Recycle Stations (SWMU #6)
Decommissioned Air Pollution Control Equipment (SWMU #7)
Tertiary Treatment Plant (SWMU #8)
Paste Plant Recycle Water System (SWMU #9)
North Pot Liner Soaking Station (SWMU #10)
South Pot Liner Soaking Station (SWMU #11)
East SPL Storage Area (SWMU #12)
West SPL Storage Area (SWMU #13)
North SPL Storage Containment Building (SWMU #14)
South SPL Storage Building (SWMU #15)
SPL Handling Containment Building (SWMU #16)
East End Landfill (SWMU #17)
West End Landfill (SWMU #18)
Plant Construction Landfill (SWMU #19)
Drum Storage Area (SWMU #20)
Construction Rubble Storage Area (SWMU #21)
Wood Pallet Storage Area (SWMU #22)
Reduction Cell Skirt Storage Area (SWMU #23)
Carbon Waste Roll-off Area (SWMU #24)
Solid Waste Collection Bin and Dumpsters (SWMU #25)
HEAF Filter Roll-Off Bin (SWMU #26)
Tire and Wheel Storage Area (SWMU #27)
90-Day Drum Storage Area (SWMU #28)
Caustic Spill (SWMU #29)

Paste Plant Spill (SWMU #30)
Smelter Sign Area (SWMU #31)
Stormwater pond and appurtenant facilities (SWMU #32)

Areas of Concern (AOCs)

Columbia River Sediments
Groundwater in the Uppermost Aquifer at the Facility
Wetlands
Rectifier Yard
Plant Area

Section 1
Introduction

This section provides an introduction and overview of the project including project objectives, scope, involved parties, and plan organization. This Phase 2 Work Plan has been prepared to address the requirements of the 2014 Agreed Order No. DE 10483 issued by Washington Department of Ecology (Ecology) and dated May 1, 2014. The Agreed Order requires two phases of Remedial Investigation (RI) work plan preparation (Phase 1 and Phase 2) that have been prepared as two separate volumes of the RI Work Plan.

The Final Phase 1 Work Plan (included as Volume 1) summarizes available information and data regarding each Solid Waste Management Unit (SWMU) and area of concern (AOC) identified in the Agreed Order, screens each SWMU and AOC to determine if they require further investigation, and if so, identifies data gaps and data needs for each SWMU and AOC. The Draft Phase 1 Work Plan was submitted to Ecology on November 25, 2014 (Tetra Tech et al. 2014). Ecology and Yakama nation comments on the Draft Phase 1 Work Plan were received on January 25, 2015 (Ecology 2015b). Some of the comments were related to specific investigation and evaluation activities for SWMUs and AOCs, which is the objective of the Phase 2 Work Plan. The Draft Phase 2 Work Plan (Tetra Tech et al. 2015), which was submitted to Ecology on May 8, 2015, addressed those comments and specified investigation methods for the SWMUs and AOCs that were retained. Ecology and Yakama Nation comments on the Draft Phase 2 Work Plan were received on July 6, 2015 (Ecology 2015 d). The Final Phase 1 Work Plan (Volume 1) and Final Phase 2 Work Plan (Volume 2) incorporate responses to the January 25, 2015 and July 6, 2015 comments.

This Final Phase 2 Work Plan (Volume 2) defines the specific investigation and evaluation activities for each SWMU and AOC that requires further investigation to characterize the nature and extent of contamination. It includes a sampling and analysis plan (SAP) and quality assurance project plan (QAPP) as individual sections. A site-specific health and safety plan (HASP; Appendix A), cultural resources monitoring protocol (CRMP; Appendix B), Joint Aquatic Resources Permit Application

Form (JARPA Form; Appendix C), and a Potliner Waste Definition and Recognition Memorandum (Appendix D) are provided as appendices.

The plans will guide the investigation of the SWMUs and AOCs to complete characterization of the nature and extent of contamination and to obtain the information necessary to identify, define, and evaluate remedial action alternatives in the Feasibility Study (FS). The Phase 2 RI Work Plan includes an overall description of the RI activities and clearly describes the project management strategy for implementing and reporting on RI activities.

1.1 PROJECT OBJECTIVES

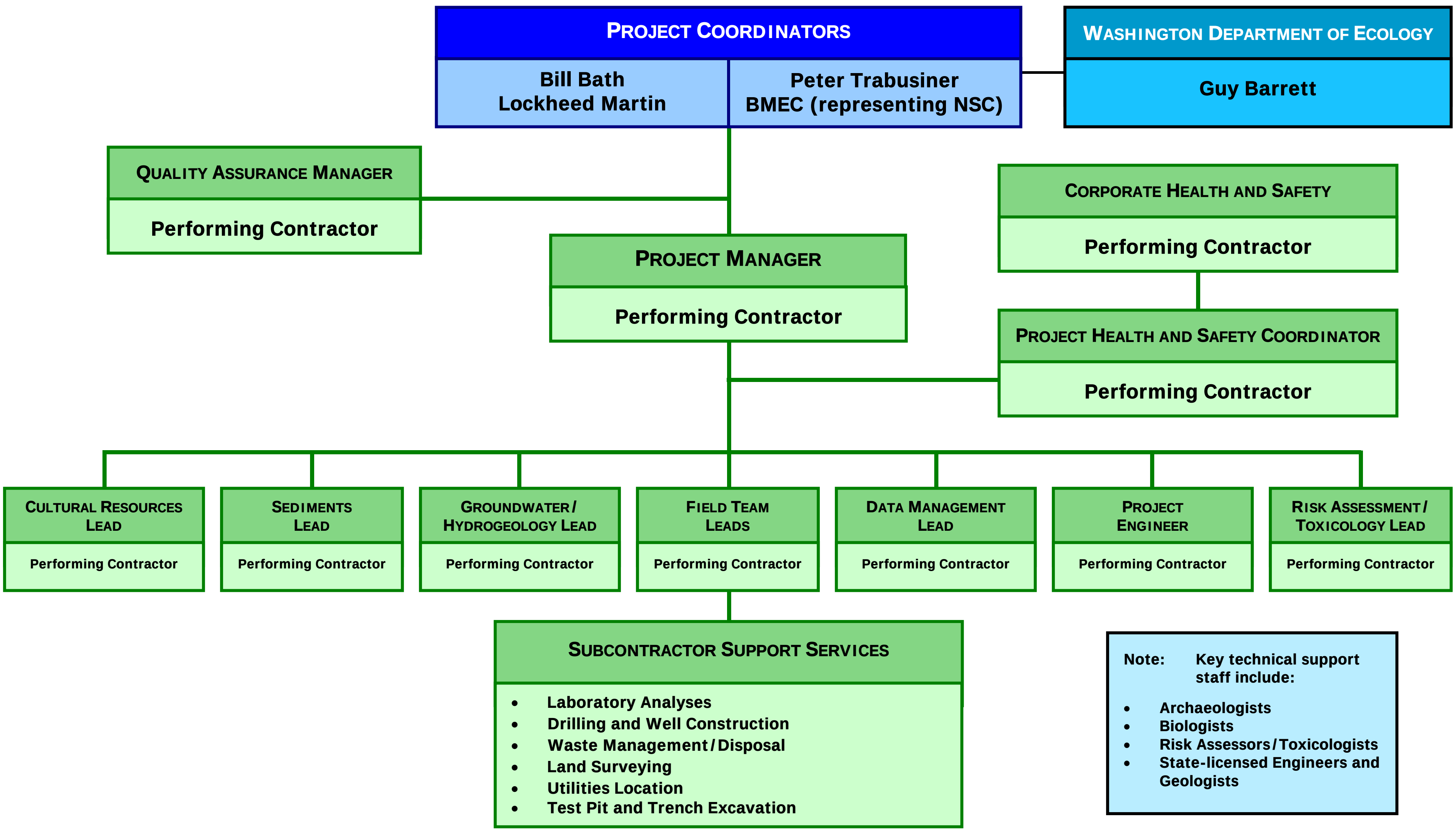
The overall objective of the Agreed Order is to provide for a remedial action plan where there has been a release or threatened release of hazardous substances (Ecology 2014). The scope of work for the Agreed Order includes preparation of an RI Work Plan, a Remedial Investigation and Feasibility Study (RI/FS) at 32 SWMUs and 5 AOCs, as well as preparation of a draft Cleanup Action Plan that summarizes the proposed remedial actions necessary to address contamination at each of the SWMUs and AOCs. The objective of the RI/FS under the Washington State Model Toxics Control Act (MTCA) is to collect, develop, and evaluate sufficient information and data to select remedial actions consistent with MTCA requirements.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The following section describes the organization for the project and describes roles and responsibilities. Specific staffing for the project roles are not described because the procurement process for the contractor conducting the work (the Performing Contractor) has not been completed. The project roles and organization are summarized in Figure 1-1. Project roles are described as follows:

- **Project Coordinators.** Lockheed Martin and NSC Smelter LLC are responsible for conducting the RI/FS in accordance with the requirements of the Agreed Order. Mr. Bill Bath is the Lockheed Martin Corporation (Lockheed Martin) Project Lead and designated project coordinator. Mr. Peter Trabusiner of Blue Mountain Environmental Consulting (BMEC) is the project coordinator for NSC Smelter LLC (NSC).

FIGURE 1-1. PROJECT ORGANIZATION
REMEDIAL INVESTIGATION AT FORMER COLUMBIA GORGE ALUMINUM SITE
GOLDENDALE, WASHINGTON



- **Washington Department of Ecology** is the lead regulatory agency for oversight of this project under the Agreed Order. Mr. Guy Barrett is the Ecology representative for this project.

- **Performing Contractor Project Manager** is responsible to ensure that the fieldwork and reporting are performed according to this Plan and local, state, and federal requirements. The Project Manager is also responsible for ensuring quality control (QC) activities are implemented consistent with corporate practices, and this Plan. The project manager will also monitor, document, and report progress, costs, and schedule with assistance from the Field Manager. The Project Manager will ensure that client comments, questions, and concerns are addressed during the field investigation and reporting. The project manager, with support of the Site Health and Safety Officer and Field Leads is responsible for ensuring that the procedures and requirements of the project site-specific health and safety plan are implemented. The Project Manager is also responsible to ensure effective and appropriate communication between the various discipline leads, Field Leads, and other staff involved in the project.

- **Performing Contractor Site Health and Safety Officer** is responsible for ensuring that site health and safety requirements and procedures are implemented at the Site in accordance with the project site-specific health and safety plan. The Site Health and Safety Officer reports to the Corporate Health and Safety Manager and Project Manager.

- **Performing Contractor Field Leads** are responsible for ensuring that the field work is being performed consistent with the requirements of this Plan as well as local, state, and federal requirements. The Field Team Leads are also responsible for ensuring that site health and safety requirements and procedures are implemented consistent with the project site-specific health and safety plan and under the direction of the Site Health and Safety Officer. The project coordinators may elect to split the site characterization fieldwork between different performing contractors. If so, each performing contractor team will have its own field manager who reports to the project manager.

- **Performing Contractor Groundwater/Hydrogeology Lead.** The groundwater lead is a licensed hydrogeologist in Washington and is responsible for leading, reviewing, and approving hydrogeological interpretations and ensuring that the hydrogeologic and geologic work is being performed consistent with generally accepted hydrogeological practices as well as state and federal requirements. The Hydrogeology Lead is the Task Lead for the Groundwater in the Uppermost Aquifer AOC and will work with the other project leads and the Project Manager to ensure that all groundwater-related issues are resolved.

- **Performing Contractor Sediments Lead.** The Sediments Lead will have a background in biology with environmental site characterization and remediation experience in freshwater settings and will be responsible for leading, reviewing, and approving work related to sediments. The Sediments Lead will be the Task Lead for the Sediment AOC including sediment characterization, application of federal and state sediment criteria and guidelines including the Washington State Sediment Management Standards (SMS), interpretation of benthic community data should benthic community analysis become necessary. The Sediments Lead will also be responsible for evaluation of potential human health and ecological risk related to sediments with support of the Risk Assessment/Toxicology Lead and Project Manager, and potential evaluation of remedial alternatives for sediment with support of the Engineering Lead and Project Manager.

- **Risk Assessment/Toxicology Lead.** The Risk Assessment/Toxicology Lead is a toxicologist or biologist responsible for the evaluation potential ecological and human health risk issues, particularly as they relate to sediment, wetlands, terrestrial ecological evaluations, and groundwater.

- **Engineering Lead/Project Engineer.** The Project Engineer is a Licensed Washington State Professional Engineer (PE) with experience in remedial alternative development, remedy selection, and associated costing under MTCA. The Project Engineer will also support engineering review of existing remedial systems (e.g., caps) as appropriate. The Project Engineer will be responsible for leading the feasibility study with support of the other project leads and the project manager.

- **Cultural Resources Lead.** The Cultural Resources Lead is a professional archaeologist that will be responsible for ensuring that the requirements of the CRMP are followed. The Cultural Resources Lead will also be responsible for coordinating cultural resources-related information and activities with the Yakama Nation.

- **Performing Contractor Data Management Lead**. The Data Management Coordinator will be responsible for coordination with the analytical laboratory and with field staff. The Data Management Coordinator will coordinate shipments of glassware, supplies, and samples as well as coordinate completion and storage of chain-of-custody (CoC) forms. The Data Management Coordinator will also coordinate the computer storage of field instrument data as well as storage of completed Field Forms. The Data Management Coordinator is responsible for the coordination and completion of third-party data validation activities specified in the QAPP that will be used for assessing and ensuring analytical data quality. The Data Management Coordinator will be responsible for ensuring that the project data is uploaded to the Ecology Environmental Information Management System (EIMS) database as required by the Agreed Order.

- **Performing Contractor Project Quality Assurance Manager**. The Project Quality Assurance Manager represents a senior-level technical staff that is familiar with program goals and requirements. The Project Quality Assurance Manager will help ensure that the overall quality of the work meets the expectations of the client(s). The Project Quality Assurance Manager for this project will provide senior-level quality control review of project deliverables.

Subcontractor support services will include the analytical laboratory, driller(s), excavation contractor, waste management and disposal contractors, surveyors, and private utility locators. These subcontractors will be under the direct supervision of the performing contractor(s) and in accordance with subcontract agreements, specifications, and the procedures of this Phase 2 Work Plan.

1.3 PLAN ORGANIZATION

The Phase 2 Work Plan has been organized into the following major sections:

Section 1.0 **Introduction –** Provides a summary of the project objectives, scope, project organization, and report organization.

Section 2.0 **Background** – Summarizes basic background information about the site including facility description, environmental setting, Agreed Order and Phase 1 Work Plan, and current and future land use.

Section 3.0 **Identified Data Needs –** Summarizes the data needs and data gaps for the SWMUs and AOC identified in the Phase 1 Work Plan.

Section 4.0 **Risk Pathway Evaluation Approach –** Summarizes the evaluation approach for: development of soil screening levels for protection of groundwater, terrestrial ecologic evaluation for soils, development of risk-based screening levels for selected chemicals, human health evaluation of Columbia River Sediments, and evaluation of the groundwater to surface water and groundwater to sediment transport pathways.

Section 5.0 **Field Sampling Plan –** Summarizes the investigation objectives, scope of work and rationale for each SWMU and AOC, and describes field methods and procedures and quality control for the field program.

Section 6.0 **Quality Assurance Project Plan –** Defines data quality objectives, analytical program, accuracy and precision criteria, sample custody and data management procedures.

Section 7.0 **Project Schedule –** Summarizes the project schedule for the RI including major milestones.

Section 8.0 **References –** Summarizes the cited reference in the Phase 2 Work Plan.

Appendices include the HASP (Appendix A), CRMP (Appendix B), JARPA Form (to be completed as necessary for some types of work in wetland areas; Appendix C), and Potliner Waste Definition and Recognition Memorandum (Appendix D).

Section 2
Background

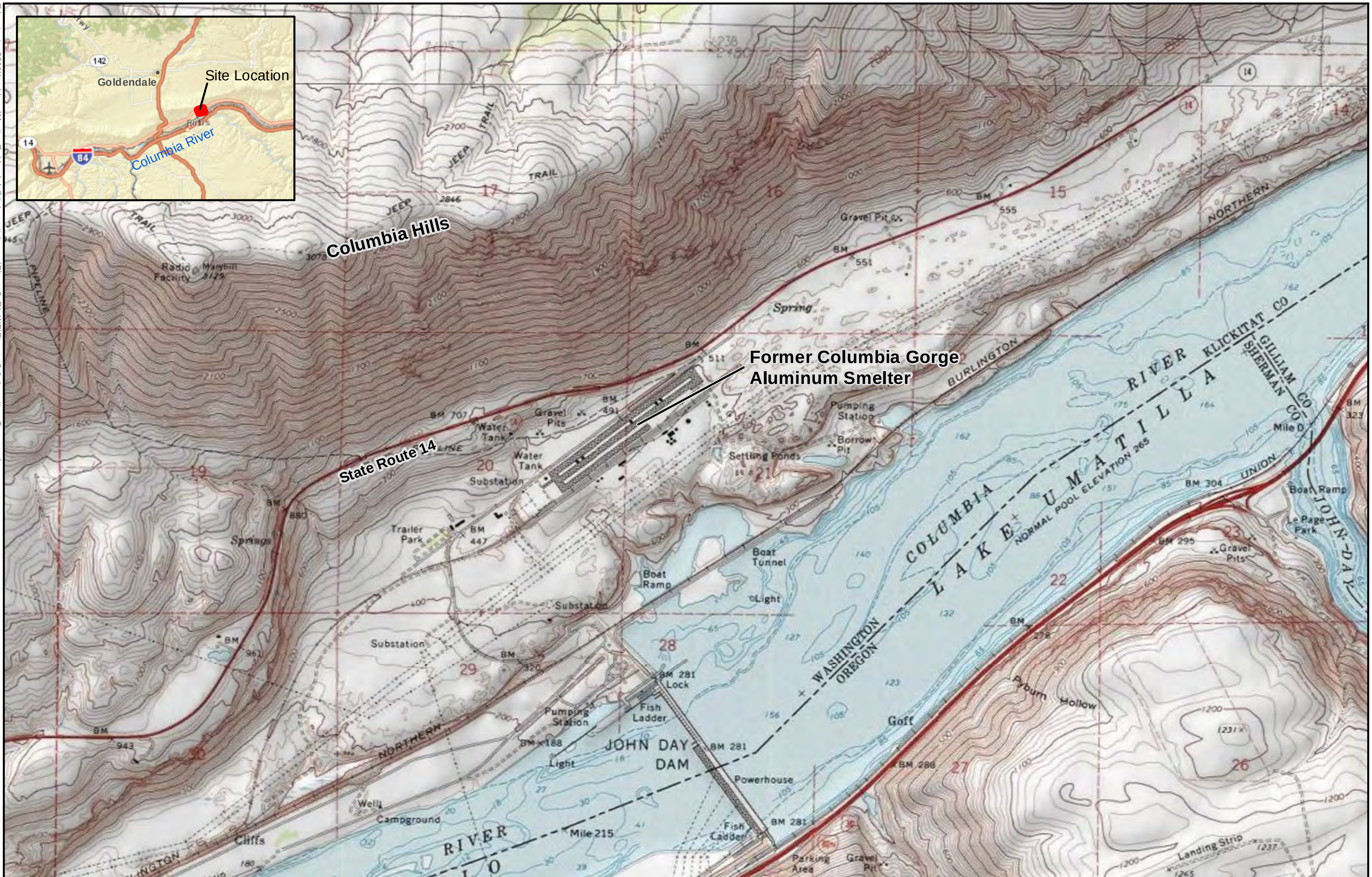
This section summarized background information regarding the facility including facility description and history, environmental setting, and previous investigations.

2.1 FACILITY DESCRIPTION

The former Columbia Gorge Aluminum Smelter (site) is located at 85 John Day Dam Road, Goldendale, Washington. It incorporates an area of approximately 350 acres associated with the former plant operations within a 7,000 acre parcel of land currently under the same ownership. The site is located adjacent to the Columbia River approximately 9 miles southeast of the City of Goldendale in Klickitat County (Figure 2-1). The site includes portions of Sections 20 and 21 in T3N, R17E, Willamette Meridian.

The facility was operated nearly continuously as a primary aluminum smelter from its completion of construction in the early 1970s until 2003 when aluminum smelter operations were permanently suspended. The current owner (NSC) plans to redevelop the site for commercial and industrial purposes. Figure 2-2 shows the main features of the former smelter and surrounding area.

When the aluminum reduction facility was in operation, there were a total of 525 electrolytic reduction cells in which aluminum metal was produced. At full capacity, the smelter produced about 176,000 tons of aluminum and aluminum alloys per year and required a work force of 650 employees. During peak operation, the smelter facilities included a carbon plant, four reduction cell lines (Landau 1995), a cast house, rectifier building and electrical substations, a laboratory, administrative offices, stormwater and groundwater collection systems, and a sewage treatment plant. In April 2003, the plant was shut down. Demolition of all buildings directly associated with the smelter operations, including the reduction cell lines, began in 2011 and was completed in spring 2013.



Topographic Map Data Source: USGS 24k Topographic Quadrangles, 1973.

N W E S

0 0.25 0.5 1

Miles

Figure 2-1
Project Location Topographic Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Legend

Wetlands

N W E S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 2-2
Primary Site and Vicinity Features Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

2.2 ENVIRONMENTAL SETTING

The environmental setting is described in detail in the Phase 1 Work Plan (Volume 1). The site is located in the semi-arid eastern portion of the Columbia River Gorge. The former smelter is located on a topographic bench about 450 to 540 feet in elevation about 0.5 miles from the Columbia River (see Figure 2-1). South of the former smelter, the bench generally terminates in a line of cliffs above the Columbia River. North of the former smelter, the Columbia Hills form a steep ridge with about 2,500 feet of relief with a talus slope extending down slope onto the site. Three natural seasonal drainages are present to the south of the former smelter and north of the Columbia River. One of these drainages was modified during initial plant construction into a series of settling ponds called the National Pollutant Discharge Elimination System (NPDES) Ponds A through D (Figure 2-2).

The site is located on the Columbia River Plateau where the bedrock is composed of the Miocene Columbia River Basalt Group. The bench area represents an erosional feature formed by scour during the Pleistocene Missoula Floods. Unconsolidated deposits in the site vicinity consist of glacial fluvial sediments, alluvium, colluvium shed from the ridge to the north, potential localized eolian deposits, and man-made fill associated with highway construction, dam construction, and smelter construction and operations. These unconsolidated deposits are present as either a discrete stratigraphic unit ranging from a few feet to over 60 feet thick or localized areas within flood-scoured depressions on the basalt bench surface. Conceptually, the aquifer system can be seen as an unconsolidated alluvial/colluvial aquifer underlain by a series of basalt bedrock aquifer zones that represent the more permeable zones within the basalts. Three production wells are present near the former smelter and range in depth from 504 to 1,128 feet deep.

2.3 CURRENT AND FUTURE LAND USE

Demolition of most buildings associated with the former Columbia Gorge Aluminum Smelter operations was completed in Spring 2013. The only development near the project site is the John Day Hydroelectric Dam, located on the Columbia River approximately 0.5 miles to the southwest (refer to Figure 2-1). Land use surrounding the site has been limited to livestock grazing, including primarily cattle in the sagebrush/grassland habitat.

The subject property is zoned industrial, with the current owner (NSC) planning to sell its land (and other assets) for commercial and industrial purposes. Although there are no current/active facility operations, the subject site is periodically accessed to perform routine environmental monitoring, including groundwater sampling and stormwater discharge monitoring. In addition, ongoing environmental investigation and cleanup is being conducted in accordance with the 2014 Agreed Order (Ecology 2014).

The site is located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation. The upland North Shore Treaty Fishing Access Site (TFAS) is located adjacent to the Columbia River immediately upstream of the John Day Dam (Ecology 2014) (refer to Figure 2-2). Enrolled Yakama tribal members exercise treaty reserved fishing rights for ceremonial, subsistence, and commercial purposes from numerous traditional platforms on the Washington shore of the Columbia River within a mile of the site (Ecology 2014).

A public day-use park (Railroad Island Park) that includes a boat launch is located immediately upstream of the John Day Dam, and about 0.5 miles from the former smelter. This land is owned by the U.S. Army Corps of Engineers (USACE) (refer to Figure 2-2).

The largest water rights in the vicinity were associated with the former aluminum smelter operation and included rights for both groundwater and surface water. The groundwater and surface water rights have been transferred to Klickitat County Public Utility District (KPUD) and the water use designations have been recently changed to municipal use (refer to Volume 1).

As described in the Phase 1 Work Plan, a notice of intent (NOI) and a Pre-Application Document for a hydroelectric project (John Day Pool Pumped Storage Hydroelectric Project) has recently been submitted to the Federal Energy Regulatory Commission (FERC), and a portion of the proposed hydroelectric project footprint is located on the former Columbia Gorge Aluminum Smelter Site (KPUD 2014). The timing and funding for this project are currently unclear, but the construction (if it occurs) is at least 10 years from completion. The proposed John Day Pool Pumped Storage Hydroelectric Project represents a closed-loop Pumped Storage Hydropower facility proposed by the Public Utility No. 1 KPUD. The project would provide necessary ancillary services and energy storage to allow for more reliable management and integration of renewable energy sources into the power grid (KPUD 2014). The proposed project consists of a 1,200 megawatt closed-loop pumped storage hydropower facility including: 1) two Upper Reservoirs and associated rock fill embankment dams, 2) a Lower Reservoir and associated rock fill embankment dam, 3) two waterways, 4) a pit-style powerhouse, 5) a transmission line, and associated facilities including access roads and a water supply pipeline. Power from the proposed storage hydroelectric project would be routed to the existing Bonneville Power Administration substation that was formerly associated with smelter, which then ties into nearby transmission lines. The project represents a closed loop system and would use the Columbia River for initial fill and periodic make-up water.

Of the proposed facilities, the location of the Lower Reservoir is directly in the area of SWMUs and AOCs being investigated as part of the RI (KPUD 2014). Ecology (2015d) comments on the Draft Phase 2 Work Plan state that while Ecology is supportive of future economic development, the RI/FS is not part of any current or future land use proposal for the Columbia Gorge Aluminum Smelter site, and that the RI/FS will consider potential exposure risks and cleanup requirements within the context of future industrial uses.

Section 3
Identified Data Needs

This section summarizes the SWMU and AOC and associated data needs. The data gaps and data needs for the RI/FS were originally identified in the Draft Phase 1 Work Plan (Tetra Tech et al. 2014). Some additional data needs have been identified by Ecology and the Yakama Nation in the Phase 1 Work Plan comments (Ecology 2015b) that have been included in this section.

3.1 SWMU AND AOC SUMMARY

Historical information and past environmental data regarding each SWMU and AOC are summarized in detail in the Phase 1 Work Plan (Volume 1). The locations of the 32 SWMUs listed in the Agreed Order are shown in Figure 3-1. Table 3-1 provides a brief summary of the SWMUs including an operational description from the Agreed Order and overview of the environmental investigation status.

The AOCs include: Columbia River Sediments, Groundwater in the Uppermost Aquifer, Wetlands, Rectifier Yard, and the Plant Area. The Plant Area AOC was not specified in the Agreed Order, but was subsequently added during the preparation of the Phase 1 Work Plan to address an area in the vicinity of the Paste Plant, Production Buildings, Cast House and ancillary features where materials containing site chemicals of potential concern (COPC) including polycyclic aromatic hydrocarbons (PAHs) that were present in the carbon anodes as a binder material, as well as fluoride that was present in the cryolite used as bath material within the reduction cells were used, routinely handled, and temporarily stored. This area could also have been impacted by dust and fugitive emissions from the plant air pollution control systems as well as temporary storage and handling operations (e.g., trucking). Note that the features in the Plant Area AOC do not appear to meet the definition of a RCRA SWMU under the regulations and guidance at the time of plant operations (or presently), but represent features that need further evaluation to complete the RI/FS.

Legend

SWMU Investigation Areas

Wetlands

1 Solid Waste Management Unit

W N E S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 3-1

Solid Waste Management Units and Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\Investig\maps\Phase2_RI_WP\Figure_3-1_SWMU_and_Investigation_Areas.mxd

Table 3-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 5)

SWMU No.	Site Name	Description and Notes	Environmental Investigation Status
1	NPDES Ponds	Four settling ponds (Ponds A through D) were operated under a wastewater permit since construction of the plant. The ponds received wastewater from facility air pollution scrubbers during plant operation as well as stormwater from the stormwater detention pond. A stormwater bypass around the ponds was constructed during 2010.	Characterization of the pond deposits during 2008 showed that some of the sludges contained PAHs above the one percent total carcinogenic Extremely Hazardous Waste (EHW) limit. Pond sediments were characterized in 2008 (ARCADIS 2008a,b). In 2012, a voluntary soil removal action was performed with remediation of the pond sediments meeting MTCA Method B Soil Cleanup Levels (ARCADIS 2011a).
2	East Surface Impoundment (ESI)	The ESI is located in a natural depression east of the production area. The ESI was operated from 1973 to 1985 as an unlined surface impoundment for disposal of NPDES pond sludge and blow down from the North SO2 scrubber. In 1985, it was taken out service. The ESI unit was closed under RCRA in 1987. The engineered impermeable RCRA cap consists of a one-foot sand cover, 30-mil PVC liner, and a 0.05-inch geotextile fabric, one foot of transitional material, and one foot of rip-rap.	Groundwater monitoring program and the cap operations, maintenance and monitoring (OMM) program is ongoing as part of the post-closure plan. The most recent groundwater monitoring data was collected during 2010 (ARCADIS 2011b).
3	Intermittent Sludge Disposal Ponds	Following closure of the ESI, additional areas east of the smelter were discovered that had been used for the disposal of sludge from the NPDES ponds. Thirteen small deposits of sludge with no standing water were found. This site has accordingly also been called the East Surface Deposits.	This SWMU was investigated in 2006 and an independent soil removal action performed during 2007 (URS 2008b). The remaining soils at the SWMU meet MTCA Method A Industrial Soil Cleanup Levels.
4	West Surface Impoundment (WSI)	The WSI was constructed in 1981 and began operations in 1982 as part of a major smelter expansion and modernization. The WSI was designed to concentrate emission wastewater through evaporation and for storage/disposal of air emission control sludge. The impoundment is lined with 6 inches of sand and a 30-mil Hypalon liner. The unit was closed under RCRA in 2005 (Parametrix 2004c,d). The impoundment was closed with an engineered RCRA cap consisting of a sand layer, a geosynthetic clay layer and soil cover.	Groundwater monitoring program is ongoing (Parametrix 2004b, 2007) with most recent results collected during 2014 (GeoPro 2014).
5	Line A Secondary Scrubber Recycle Station	The recycle station consisted of a 36-foot diameter clarifier, cyclone separators, and reagent storage tanks and associated piping. Blow-down from the gas cleaning system was cleaned at the recycle station and water was returned to the secondary scrubber. There are no records or data regarding potential releases. Building s and other structures in this area have been demolished.	No environmental investigations have been conducted.
6	Line B, C, D Secondary Scrubber Recycle Stations	The secondary scrubber recycle system was installed as a part of the 1983 smelter upgrade. The system consisted of a 130-foot diameter clarifier, an emergency backup clarifier, two recycle pump tanks, 3 bulk reagent tanks and associated piping. There are no records or data regarding potential releases. Building Structures in this area have been demolished.	Clarifier sediments were sampled and disposed of associated with plant demolition. No environmental investigations have been conducted.
7	Decommissioned Air Pollution Control Equipment	Prior to the 1983 installation of the dry alumina air scrubber equipment at the smelter, air emissions from Line A and B were removed using wet electrostatic precipitators. These units were housed on the roof between the pot rooms and included redwood towers and concrete bubblers. The equipment was removed during the 1990's. Buildings and other structures in this area have been demolished.	No environmental investigations have been conducted.

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SWMU No.	Site Name	Description and Notes	Environmental Investigation Status
8	Tertiary Treatment Plant	In 1983, a tertiary treatment plant was installed to treat blow down water from the secondary scrubber systems. The treatment plant removed fluoride from the wastewater using calcium chloride to cause chemical precipitation. The plant consisted of a 12-foot thickener, 28-foot diameter clarifier, pump tanks, sand filters and associated piping. There is no documented history of releases of hazardous or toxic constituents. Buildings and other structures in this area have been demolished.	No environmental investigation has been performed.
9	Paste Plant Recycle Water System	A recirculated water system with settling tanks and a cooling tower was installed at the Paste Plant in 1986 to remove solids discharged to the NPDES pond system. In 1990, the wet gas cleaning system was converted to a dry high efficiency air filtration (HEAF) system. In 1990, this system overflowed resulting in a spill (refer to SWMU 30). The Paste Plant and coke silos have been demolished.	No environmental investigation has been performed.
10	North Pot Liner Soaking Station	SPL was water cooled at two cooling stations located at the east end of the pot lines from 1971 through 1990. The station consisted of a below ground concrete tank, recycle pump, and a spray station. Water at this unit was treated with sodium hypochlorite to oxidize cyanide that was present. The water was collected and drained back to a recycle sump. The station was paved over in early 1990s.	This unit was investigated during 2008 (URS 2008e). The soils were characterized and determined to contain PAHs above industrial screening levels and remediation was recommended.
11	South Pot Liner Soaking Station	Operations at this unit are the same as the North Pot Liner Soaking station (see SWMU 10 above).	Environmental investigation status is the same as the North Pot Liner Soaking Station (see SWMU 10 above).
12	East SPL Storage Area	This unit was located east of the A-line and received SPL from 1971-1984. The unit originally included a concrete pad 100 feet by 160 feet in dimension, but expanded to include adjacent unpaved areas. In 1984, visible SPL was transferred to a larger storage area west of the production area (SWMU 13), but soils were not sampled at that time. A building was constructed at this location during 1984 for the storage of cryolite bath material (URS 2008c) and is still present.	Sampling and characterization was conducted during 2008 (URS 2008c). Further remedial action was recommended for this area.
13	West SPL Storage Area	This storage area was operated from 1984-1988 and then was closed as a solid waste landfill consistent with environmental regulations applicable at that time. Contains SPL under engineered cap that consisted of a soil cover, 50-mil HDPE liner, sand layer, and riprap for erosion control The. SPL Pile is located primarily on a concrete pad with a small portion of the pile underlain by a 50-mil HDPE liner system. The unit was operated, closed, and monitored by Commonwealth Aluminum and its successor, Aleris International Limited (Aleris). Aleris filed for Chapter 11 bankruptcy in 2009 (Aleris 2010).	A monitoring well network was installed with most recent groundwater monitoring results available from 1990 to 2008 (Aleris 2010, Bakemeier 2009).
14	North SPL Containment Building	Constructed in 1987, the building consisted of a 20,000 square foot structure with a concrete foundation and 4-foot high concrete perimeter walls. The concrete floor slab is underlain with a PVC secondary containment liner. The building was at capacity for SPL by 1988 and sealed shut. During 1994-1995, the SPL was removed and taken off-site for permanent disposal. The unit was clean closed under RCRA during July 2009. The building is still present.	According to the Agreed Order, "based on design of the building, characteristics of the SPL stored in the building, and results of samples during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated form this unit." Soil samples were collected as part of closure (CH2MHill 2009).

Table 3-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary
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SWMU No.	Site Name	Description and Notes	Environmental Investigation Status
15	South SPL Storage Building	This building was constructed in 1988 south of the cast house. This SWMU is very similar in construction to the North SPL Storage Building and had a concrete floor and PVC liner. All SPL was removed from the building in 1995 and the building was subsequently modified. Buildings are still present in this area.	The unit was clean closed under RCRA during 1996. According to the Agreed Order, "based on the design of the building, characteristics of the SPL stored within the building, and the results of samples collected during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated from this unit." Soil samples were collected during closure (Golder 1996b).
16	SPL Handling Containment Building	This building was constructed in 1990. The building was used to demolish failed cathode shells. The building was equipped with a concrete floor slab that is underlain with a PVC secondary containment liner and 5-foot high concrete perimeter walls. It was equipped with a dust control system consisting of fans and two bag house dust collectors. All SPL was removed from the building in 2010-2011. The building has been demolished and concrete rubble has been stored at the locations of the former foundation.	The unit was clean closed under RCRA during 2011. According to the Agreed Order, "based on the design of the building, characteristics of the SPL stored within the building, and the results of samples collected during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated from this unit." Soil sampling and soil removal were performed during closure (PGG 2011).
17	East End Landfill (EELF)	The EELF is an unlined landfill located south and east of the former Paste Plant and was used between 1971 and 1982. It was reportedly closed prior to the establishment of RCRA by covering it with native soil. The landfill reportedly received smelter wastes that did not include waste oil, or spent solvents and may have included SPL. Most structures in this area have been demolished. The foundation of the Briquette Storage Slab is still present.	An RI/FS was performed at the site during 2008 (URS 2008a). The RI/FS included excavation of 12 test pits and installation of four monitoring wells for characterization purposes. The depth of the test pits ranged from 6 to 20 feet below ground surface (bgs). Additional investigation is planned to determine if SPL was present because some historical documentation indicated potential SPL disposal (Tetra Tech 2011a).
18	West End Landfill (WELF)	The WELF is an unlined landfill located west of the main parking area for the smelter, and was used between 1982 and 1987. The site was closed by covering it with native soil. The landfill reportedly received smelter wastes with the exception of SPL, waste oil, and spent solvents. The West Landfill reportedly contains wood, demolition waste, carbon waste, contaminated alumina, asbestos, and general trash.	An independent soil and groundwater RI/FS was performed in 2008 (URS 2008f). A 100 percent design for engineered landfill cap was completed during 2011 (Tetra Tech 2012). As part of the landfill cap design project a draft cleanup action plan was prepared (Tetra Tech 2010).
19	Plant Construction Landfill	During plant construction in 1969-1970, general debris and rock were disposed of at the Plant Construction Landfill located west of the Rectifier Yard.	No environmental investigations have been performed.
20	Drum Storage Area	A concrete pad located on the hillside northeast of the WSI was used as a drum staging area. The drum storage area was used between 1971 and 1987 (URS 2008d). The concrete slabs of the Drum Storage Area are still present.	This SWMU was characterized during 2008 (URS 2008d). Based on the sampling results, PAHs were detected below industrial cleanup levels in site soils. No further action (other than implementation of institutional controls) was recommended.
21	Construction Rubble Storage	Construction rubble was disposed of in the West End Landfill unit until its closure in 1987. After 1987, construction rubble was disposed of in an area east of the WSI. This SWMU was reportedly active until the smelter closed and is still present. This SWMU has also been defined by Ecology to include all disposal sites for debris generated during plant demolition. Four major areas of stockpiled concrete rubble are currently present at the site.	The Agreed Order states that because of the inert nature of the construction rubble, the possibility of soil or groundwater contamination is unlikely. In preparation for recent site demolition activities, some sampling was conducted (PGG 2012c, 2014).

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Solid Waste Management Unit (SWMU) Description and Investigation Status Summary
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SWMU No.	Site Name	Description and Notes	Environmental Investigation Status
22	Wood Pallet Storage Area	Wood waste that primarily consisted of shipping containers and pallets were disposed of in the West End Landfill until its closure in 1987. After 1987, this material was disposed of in a storage and burning area located northwest of the plant and north of the rectifier yard. Excess wood at the site was reportedly burned periodically under a permit from the county fire department. A burn pile and debris is present in this area.	No environmental investigations have been performed.
23	Reduction Cell Skirt Storage Area	This area was used from 1988 to 1995 for the storage of failed "skirts" from the reduction cells prior to recycling of the steel. These steel skirts had solid bath material (cryolite salts) attached to the steel. In 1995, the skirts and the residual bath in site soils were reportedly removed and the skirts were subsequently stored on a concrete pad next to the Paste Plant.	No environmental investigations have been performed for which data can be found. The 2004 Part B Dangerous Waste Permit Application (page 98) (Parametrix 2004a) states that soil samples were analyzed, but the data has not been found.
24	Carbon Waste Roll-off Area	In 1987 a 20-cubic yard roll-off bin located between the pot rooms was used to collect, store, and transport various solid wastes prior to offsite disposal. Wastes managed in this area included: fume system carbon, waste briquettes, production room floor sweeping, silo top paste and wastes stud hole paste. Specific locations of the collection point are unclear and may have changed during the history of operations. The Courtyards of the Production Area where these features were likely present are present and accessible.	No environmental investigations have been performed.
25	Solid Waste Collection Bin and Dumpsters	Miscellaneous, non-hazardous solid waste was placed in small dumpsters or roll-off bins at various collection points throughout the production area. Wastes reportedly included: transite, empty cans, floor sweepings, PVC/glass pipe, and secondary treatment plant screen wastes. The wastes were disposed of at the Rabanco Landfill near Roosevelt, Washington. Specific locations of the collection points are unclear and may have changed during the history of operations. The Courtyards of the Production Area where these features were likely present are present and accessible.	The Agreed Order states "because of the small volume and characteristics of the wastes, the possibility of a release from these collection points is very low." No environmental investigations have been performed.
26	HEAF Filter Roll-off Bin	The Paste Plant emission control system was converted from a wet scrubber to a dry HEAF system in 1990. Particulates containing high concentrations of PAHs were removed from the off gases into fabric filters during HEAF system operations. These wastes were stored in a 20-cubic yard capacity roll-off bin located near the Paste Plant. Wastes accumulating within the roll-off bin were periodically shipped offsite for disposal. The Paste Plant and nearby coke silos have been demolished.	The Agreed Order states that "because of the nature of the storage operation, a release of hazardous constituents from the roll-off bin to soil or groundwater is unlikely." No environmental investigations have been performed.
27	Tire and Wheel Storage Area	Worn out rubber tires and steel wheels were stored on a concrete pad from 1987 to 1994 when the area was consumed by a brush fire. This SWMU appears to overlap with SWMU 20. The concrete slabs are still present.	This area was characterized as part of the Drum Storage Area (SWMU 20) during 2008 (URS 2008d). The SWMU was reportedly cleaned up following a grass fire that consumed the tires and wheels stored in this area.

Table 3-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary
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SWMU No.	Site Name	Description and Notes	Environmental Investigation Status
28	90-Day Drum Storage Area	After the original Drum Storage Area was closed under RCRA in 1987, the 90-Day Drum Storage Area was established at the west of the A-room/line near the Capacitor Yard. Both RCRA and non-RCRA wastes were reportedly stored in this area. In 1990, a metal building was constructed over a concrete pad and a 6-inch concrete berm was added to the perimeter of the concrete pad for spill containment. An epoxy was applied to the concrete pad to seal any cracks. The 90-Day Drum Storage Area Building is still present.	According to the Agreed Order, "the design and operation of the building and frequent inspections makes the likelihood of a release of hazardous or toxic constituents from this building to the environment unlikely." No environmental investigations have been performed.
29	Caustic Spill	In October 1990, approximately 5,000 gallons of a 20 percent caustic solution (NAOH) was spilled on the ground near the A-Room/Line recycle water system during a transfer between tanks. The spilled material was reportedly flushed into the storm sewer system and monitoring of the NPDES treatment system was performed. There were no exceedances of the NPDES permit limits during the spill event. The soil in the area was flushed with water. Buildings and structures in this area have been demolished.	Limited sampling was performed during Ecology (1990b,c) inspections.
30	Paste Plant Spill	An undetermined volume of recirculated scrubber water overflowed to the ground resulting in PAH contaminated soil in a small area south of the Paste Plant. In the same area, stormwater runoff from an uncontrolled Briquette Storage Area was identified as a source of PAH soil contamination. The Paste Plant and coke silos in this area have been demolished.	Soil investigation, sampling, and contaminated soil removal was performed in 1990/1991 (Technico Environmental Services 1991c). Some additional soil contamination in this area was left in place. Landfill materials were noted that could be attributed to the East End Landfill or could be related to another site feature.
31	Smelter Sign Area	Evidence of SPL and other aluminum reduction wastes in the vicinity of the smelter sign and lawn was discovered and reported to Ecology in 2011. This SWMU also includes the area north of East Surface Impoundment (NESI). A disturbed Category III wetland is present in the NESI Area (Tetra Tech 2011b).	Work Plans for site characterization were prepared in 2011 (Tetra Tech 2011b,c).
32	Stormwater Pond and Appurtenant Facilities	Stormwater is collected in a series of catch basins that are conveyed to the stormwater retention pond at the southern edge of the production area. The pond was excavated into bedrock and is used to store accumulated stormwater runoff from the site prior to discharge under the NPDES permit. Stormwater collected in the pond was pumped to the industrial sump where it was mixed with process cooling water prior to discharge. The stormwater pond, stormwater, lines, and groundwater collection lines are still present. A stormwater bypass line has been constructed that directs discharge around the NPDES ponds.	PAH-contaminated sediment in the stormwater pond above the 1 percent State EHW designation criteria were found in 1991 (Technico Environmental Services 1991b). Stormwater catch basins have been partially cleaned (PGG 2012b). Shallow groundwater drainage lines that drain into the stormwater pond and NPDES ponds have been documented (Columbia Aluminum Corporation 2011).

The Phase 1 Work Plan includes use of area-designations (i.e., Northwest, West, East, and Production Area) to group SWMUs in support of planned future land use. However, based on further discussion with Ecology and the adoption of the Plant Area AOC, the use of area-designations has been discontinued and the SWMUs are organized by numerical order in this Phase 2 Work Plan.

The AOCs represent site-wide, media-specific, and/or fairly broad areas of the site, and the definitions of the AOC have been described in detail in the Phase 1 Work Plan. Table 3-2 provides a brief summary description of the site AOCs.

3.2 SWMU AND AOC DATA NEEDS

Table 3-3 summarizes the identified SWMU data gaps and data needs as well as broad-investigation objectives as identified in the Phase 1 Work Plan. The table has been modified to address data needs identified in Ecology and Yakama Nation (Ecology 2015b) Draft Phase 1 Work Plan comments.

As part of the Phase 1 Work Plan screening process, and consistent with Ecology and Yakama Nation comments on the Draft Phase 1 Work Plan, the following SWMUs do not need additional investigation: East Surface Impoundment (SWMU 2), Intermittent Sludge Disposal Ponds (SWMU 3), West Surface Impoundment (SWMU 4), West SPL Storage Area (SWMU 13), SPL Handling Containment Building (SWMU 16), West End Landfill (SWMU 18), Drum Storage Area (SWMU 20), Tire and Wheel Storage Area (SWMU 27), and the 90-Day Drum Storage Area (SWMU 28). Groundwater data needs associated with individual SWMUs, as identified in the Phase 1 Work Plan, are addressed as part of the Groundwater in the Uppermost Aquifer AOC.

Table 3-4 summarizes the identified data gaps and data needs for each AOC as well as broad-investigation objectives as identified in the Phase 1 Work Plan. The table has been modified to address data needs identified by Ecology and the Yakama Nation in the Phase 1 Work Plan comments (Ecology 2015b).

Table 3-2
Areas of Concern – Description and Investigation Status Summary
Columbia Gorge Aluminum Smelter Site
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Areas of Concern	Geographic Area	Description and Notes	Investigation Status
Columbia River Sediments	Columbia River near NPDES outfall and Boat Basin	Since the start of plant operations, a permitted wastewater and stormwater outfall has been operated at the Columbia River and there is concern that the treated wastewater and stormwater discharges have adversely affected Columbia River sediments (Ecology 2014). In addition, sheet flow from the plant site and two intermittent rivulets leading to the Boat Basin potentially could contribute to sediment contamination (Ecology 2014).	Limited sediment sampling for PAHs was conducted in 1985 (JUB Engineers 1985) and 1994 (ENSR 1994) in accordance with NPDES permit requirements. In addition sediment and/or surface water near the site was studied as part of 1985, 1986 and 2005 Columbia River studies (Damkaer and Dey 1986; WSDOH et al. 2005).
Groundwater in the Uppermost Aquifer at the Facility	Site-Wide	Groundwater characterization and monitoring has been performed at some of the SWMUs (the ESI and WSI, SWMUs 2 and 3, respectively) as part of long-term post-closure monitoring requirements. There are currently approximately 50 wells at the site that are completed in the shallow unconsolidated aquifer zone and within two basalt bedrock aquifer zones. The full extent of groundwater contamination in the uppermost aquifer remains uncharacterized (Ecology 2014). There are three production wells at the facility completed in deep zones within the basalt bedrock with associated water rights.	The site hydrogeologic conceptual model was originally described in groundwater characterization documents pertaining to the ESI (Century 1986) and WSI (Golder 1988). During 2009-2011, site-wide groundwater was investigated and the hydrogeologic conceptual model was updated (URS 2009, 2011). Groundwater monitoring was conducted at the West SPL Storage Area (SWMU 13) from about 1988 to 2008 (Aleris 2010). Independent cleanup investigations that include a groundwater component have been performed at the WELF (SWMU 18) (URS 2008f, Tetra Tech 2010), EELF (SWMU 17) (URS 2008a), and the North and South Pot Liner Soaking Stations (SWMUs 10 and 11) (URS 2008e).
Wetlands	Located in depressions in areas other than the Production Area	The concern identified in the Agreed Order is for potential environmental impacts from historical smelter emissions. Evaluation of contamination and potential ecological exposures is incomplete. Hydrologic interactions and transport pathways between the wetland's surface water, stormwater, and groundwater are not fully characterized. Fourteen wetlands have been delineated at the site. Most have been disturbed to at least a moderate degree by grazing, grading, or historical plant operations and represent Category III and IV wetlands.	Wetlands at the site have been delineated in PGG (2013a) and Tetra Tech (2011b). A geophysical investigation was conducted a Wetland D located in the western part of the site near the WELF and WSI (PGG 2013b).
Rectifier Yard	West of the Production Area	The rectifier yard and associated facilities were used for power transmission for the former aluminum reduction plant. Polychlorinated biphenyl (PCB) containing transformer oils were historically used in electrical equipment at the site and PCBs may have been released.	Initial investigations of the Rectifier Yard were completed associated with plant demolition (PGG 2012b).
Plant Area	Production Area	The Plant Area AOC was identified by the project team during the course of review in preparation of the Phase 1 Work Plan. It includes additional features in the area of the former plant that may have released COPC. Focus categories for further assessment include: 1) Carbon Handling, Storage, and Manufacturing Features, 2) Cryolite and Bath Storage and Handling Features, and 3) Production Buildings, Cast House, and Ancillary Features.	Initial environmental investigation of Courtyard soils was completed associated with plant demolition (PGG 2010).

AOC Area of Concern

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #1 NPDES Ponds	Independent soil removal action completed to MTCA Method B residential soil screening levels for PAHs in 2010 (ARCADIS 2011a). Potential for re-contamination of soil at Pond A from runoff will be addressed as part of the data needs for the stormwater pond and appurtenant facilities SWMU (SWMU 32) and Plant Area AOC. Groundwater data needs for this area of the site will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination of current soil concentrations at mouth of pipe that discharges to Pond A. Characterization of current groundwater conditions and extent of groundwater contamination in this area (see Groundwater in the Uppermost Aquifer AOC).
SWMU #2 East Surface Impoundment (ESI)	The unit was closed under RCRA and an Engineered cap was installed in 1987. A long-term OMM program is ongoing that includes groundwater monitoring. Groundwater chemical concentrations for some constituents have been detected above established screening levels. Groundwater data needs this area of the site (e.g. current conditions and extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of current groundwater conditions and downgradient extent of groundwater contamination (see Groundwater in the Uppermost Aquifer AOC).
SWMU #3 Intermittent Sludge Disposal Ponds	Independent soil removal action was completed to MTCA Method A Industrial Soil screening levels for PAHs in 2007 (URS 2008b). The appropriateness of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed. No groundwater data needs have been identified.	No further investigation is proposed.
SWMU #4 West Surface Impoundment	The impoundment was closed under RCRA and an engineered cap was installed in 2005. A long-term OMM program is ongoing that includes groundwater monitoring. Groundwater chemical concentrations for some constituents have been detected above established screening levels. Groundwater data for needs will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of current groundwater conditions and downgradient extent of groundwater contamination (see Groundwater in the Uppermost Aquifer AOC).
SWMU #5 Line A Secondary Scrubber Recycle Station	No environmental investigations have been conducted. Characterization of chemical concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from the unit. Characterization of COPC concentrations in surface and subsurface soil and shallow groundwater.
SWMU #6 Line B, C, D Secondary Scrubber Recycle Stations	No environmental investigations have been conducted. Characterization of chemical concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions at this unit and the nearby Tertiary Treatment Plant (SWMU 8) represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from the unit. Characterization of COPC concentrations in surface and subsurface soil and shallow groundwater.
SWMU #7 Decommissioned Air Pollution Control Equipment	SWMU represents 20 roof-top units associated with Production Buildings A and B that were removed in the late 1990s.Surface soil samples were collected in the courtyards near the Wet Electrostatic Precipitator (WESP) units during an initial investigation of the Production Area in 2010 (PGG 2010). This soil sampling effort did not specifically target the individual WESP units and other potential sources are present at the Courtyards. Soil chemical conditions in the Courtyards and Production Area will be addressed as part of the Plant Area AOC.	No SWMU-specific investigation is planned. COPC chemical concentrations in soils will be characterized as part of the Plant Area AOC.

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
Columbia Gorge Aluminum Smelter Site
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #8 Tertiary Treatment Plant	No environmental investigations have been conducted. Characterization of COPC concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions at this unit and the nearby Line B, C, D Secondary Scrubber Recycle System (SWMU 6) represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from this unit. Characterization of COPC concentrations in surface and subsurface soil and shallow groundwater.
SWMU #9 Paste Plant Recycle Water System	Spills from this unit were documented in 1990 and the system was upgraded. No environmental investigation of the recycle sump (briquette cooling sump), settling tanks, or other appurtenant facilities has been performed. Inspection of the Recycle Water System Sump and facilities that are part of Paste Plant Recycle Water System with targeted sludge and soil sampling to characterize current PAH concentrations. Shallow groundwater characterization in the sump vicinity to be addressed under the Groundwater in the Uppermost Aquifer AOC.	Determination of COPC concentrations in surface and subsurface soils and sump sludge.
SWMU #10 North Pot Liner Soaking Station	Soil and groundwater at the North and South Pot liner Soaking Stations were investigated as part of an independent RI/FS in 2008 (URS 2008e). PAH soil contamination was found above MTCA Method C screening levels. A soil removal action was recommended as the preferred remedial alternative. Characterization of the full extent of soil contamination represents a data need, but could also be performed during the remedial action. No groundwater investigation needs have been identified other than additional sampling of the existing shallow well in the site vicinity that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of soil contamination associated with this SWMU.
SWMU #11 South Pot Liner Soaking Station	Refer to SWMU 10 because the North and South Pot Liner Soaking Stations are located in close proximity and previously investigated together.	Refer to SWMU 10.
SWMU #12 East SPL Storage Area	This SWMU was investigated as part of an independent RI/FS during 2008 (URS 2008c). PAHs were found in site soils above MTCA Method C screening levels and selenium was detected above MTCA terrestrial ecological screening level values. A soil removal action was recommended as the preferred remedial alternative. Characterization of the full extent of soil contamination represents a data need, but could also be performed during the remedial action. Groundwater data need for this SWMU will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of soil contamination associated with this SWMU.
SWMU #13 West SPL Storage Area	The West SPL Storage Area was closed in 1988 under the solid waste regulations in effect at that time and still contains SPL. An engineered cap was constructed in 1988. The site was under a long-term OMM program that ceased when the responsible party went bankrupt. Groundwater monitoring was performed from 1990 to 2008 and groundwater chemical concentrations above screening levels have been detected. Characterization of current groundwater conditions will be conducted as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of groundwater contamination (see Groundwater in the Uppermost Aquifer AOC).

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
Columbia Gorge Aluminum Smelter Site
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #14 North SPL Storage Containment Building	This unit was cleaned closed under RCRA during July 2009 (CH2M Hill 2009). Soil sampling program was limited to cyanide and fluoride for a small number of samples. It is also unclear if the soil screening levels used for closure are protective of groundwater. Data gaps and data needs include: Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements and will be addressed as part of the Groundwater in the Uppermost Aquifer AOC. Current chemical concentrations of PAHs and selected metals in soil. Collection of subsurface soil samples beneath the liner. Investigation of shallow groundwater that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of COPC concentrations in soil. Development of soil screening levels protective of groundwater consistent with MTCA requirements. Characterization of shallow groundwater COPC concentrations.
SWMU #15 South SPL Storage Building	This unit was cleaned closed under RCRA during 1996 (Golder 1996a). Closure soil sampling program was limited to cyanide and fluoride for a small number of samples. It is also unclear if the soil screening levels used for closure are protective of groundwater. Data gaps and data needs include: Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements and will be addressed as part of the Groundwater in the Uppermost Aquifer AOC. Current chemical concentrations of PAHs and selected metals in soil. Verification of the presence and condition of the liner with potential soil sampling beneath the liner depending on the results of verification activities. Investigation of shallow groundwater that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of COPC concentrations in soil. Development of soil screening levels protective of groundwater consistent with MTCA requirements.
SWMU #16 SPL Handling Containment Building	This unit was cleaned closed under RCRA during 2011 (PGG 2011). Closure soil sampling program included additional chemical analyses (PAHs, metals, and PCBs) and collection of several more soil samples than during closure of the other SPL units. Contaminated soils were removed based on the detected PAH concentrations in soil above MTCA Method B screening levels. No data needs for soil have been identified. No SWMU-specific groundwater data needs have been identified.	No investigation activities are proposed.

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #17 East End Landfill	The EELF was investigated in 1991 and again 2008 as part of an independent RI/FS (URS 2008a). Elevated concentrations of PAHs were detected above MTCA Method C screening levels in landfill materials and in the underlying soils. Remedial excavation and disposal was identified as the preferred remedial alternative at the site. Additional investigation (Tetra Tech 2011a) was planned in this area because some documentation was found that indicated potential SPL disposal in this area and additional potential sources were identified. Additional landfill material and soil characterization and refinement of contaminated material volumes represent data needs for this SWMU. Groundwater data needs in this area of the site (e.g. current conditions, occurrence of groundwater, interaction with groundwater drainage/collection lines, extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of landfill materials and soil contamination. Refinement of estimates of waste and contaminated soil volumes. Characterization of groundwater occurrence and conditions and interaction with groundwater drainage/collection lines.
SWMU #18 West End Landfill	An independent soil and groundwater RI/FS was performed in 2008 (URS 2008f, 2010). Maximum concentrations of PAHs, oil-range petroleum hydrocarbons, and a few metals (arsenic, cadmium, selenium) exceeded MTCA Method A screening levels for industrial use in the landfill wastes. Low levels of arsenic, cadmium, chromium, lead, and cyanide were detected in groundwater above MTCA groundwater screening levels. However, it's unclear if the detected groundwater concentrations were representative of groundwater conditions or attributable to the WELF. An engineered cap was the recommended remedial alternative and a cap was designed (Tetra Tech 2010, 2012). No additional data needs have been identified for the soils and wastes. Groundwater data needs this area of the site (e.g., current conditions and extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	No data needs have been identified for landfill wastes or soils. Characterization of current groundwater conditions and extent of groundwater contamination in this area (see Groundwater in the Uppermost Aquifer AOC).
SWMU #19 Plant Construction Landfill	No environmental investigations have been performed. A geotechnical investigation (Fujitani Hilts & Associates 2001) suggest that the construction rubble is primarily basalt cobbles and gravel (likely from initial plant blasting and grading activities). Characterization of COPC in site surface and subsurface soils represents a data need. Verification and inspection of the existing piezometer has been identified as a data need. Current groundwater conditions will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of COPC concentrations in soil.
SWMU #20 Drum Storage Area	This SWMU was characterized as part of an independent site investigation during 2008 (URS 2008d). Results show the presence of PAHs in soil above MTCA Method B and below MTCA Method C Industrial screening levels. The appropriateness of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed. No data gaps or data needs have been identified.	No environmental investigation activities are proposed.

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #21 Construction Rubble Storage Area	No investigation of the Construction Rubble Area (SWMU 21) that is located west of the Drum Storage Area has been performed. This SWMU also includes recently generated debris from plant demolition. The concrete construction rubble stockpiles remaining at the site have been investigated (PGG 2012c, 2014). Results show the presence of PAHs above Method B screening levels and below Method C screening levels. Fluoride and cyanide concentrations were below Method B screening levels, but it is unclear if these concentrations are protective of groundwater. Characterization of chemical concentrations of soil in Construction Rubble Area west of the Drum Storage area represents a data gap and data need. Further evaluation of potential reuse of the crushed concrete material stored onsite represents a data evaluation need for the overall project. Additional RI-related data gaps and data needs have not been identified for the crushed concrete. The Rebar Storage Area near the Rectifier Yard will be addressed as part of the Rectifier Yard AOC.	Characterization of chemical concentrations in soil for the Construction Rubble Area located west of the Drum Storage Area (SWMU 21). Further investigation of crushed concrete from site demolition activities does not represent an RI-related data need and is not proposed. Potential site reuse of the crushed concrete will be further evaluated during the FS.
SWMU #22 Wood Pallet Storage Area	The Wood Pallet Storage Area was inspected in 2012 (PGG 2012a) and a burn pile was found that contained materials other than wood. Environmental sampling has not been conducted at this area. Waste profiling with potential sampling of the underlying soils represents a data need for this SWMU. No SWMU-specific groundwater data needs have been identified	Characterization of COPC chemical concentrations in waste and underlying soil.
SWMU #23 Reduction Cell Skirt Storage Area	The Reduction Cell Skirt Storage Area located northwest of the Production Building D was reportedly cleaned up at the time of closure, but soil sample results have not been documented. Characterization of surface and subsurface COPC concentrations in soil represents a data gap and data need for this SWMU. No SWMU-specific groundwater data needs have been identified.	Characterization of COPC chemical concentrations in surface and subsurface soil.
SWMU #24 Carbon Waste Roll-off Area	The specific locations of the carbon waste roll-off boxes associated with the production lines are unclear and likely changed over the period of plant operations. These areas likely included the courtyards adjacent to and/or between the Production Buildings. Characterization data for soil have been collected from the Courtyards (PGG 2010) and show PAH concentrations above MTCA Method C screening levels in some areas. Further characterization of carbon manufacturing, handling, and storage facilities represents a data need that will be addressed as part of the Plant Area AOC.	No SWMU-specific investigation is planned. Characterization of the nature and extent of soil contamination for the courtyards and other carbon handling areas near the Production Buildings is an objective for the Plant Area AOC.
SWMU #25 Solid Waste Collection Bin and Dumpsters	The exact locations of the solid waste collection bins and dumpsters in the former production area are unclear and likely changed during the period of plant operations. Soil chemical concentrations in the courtyards and other areas of the former plant represents a data gap and data need that will be addressed as part of the Plant Area AOC.	No SWMU-specific environmental investigation is proposed. Data needs for soil characterization in this area will be addressed as part of Plant Area AOC.

Table 3-3
Solid Waste Management Units
Data Needs and Investigation Objectives Summary
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #26 HEAF Filter Roll-Off Bin	No environmental investigations have been performed. The likelihood of release is low based on the period and nature of this storage operation. The specific location of this roll-off bin near the Paste Plant is unclear. Carbon handling, manufacturing, and storage facilities (including those near the Paste Plant) will be characterized and addressed as part of the Plant Area AOC.	No environmental investigation activities are proposed.
SWMU #27 Tire and Wheel Storage Area	This SWMU was reportedly cleaned up following a 1994 brush fire that consumed the existing tires and wheels stored in this area. This SWMU is co-located with Drum Storage Area (SWMU 20). Soils in the vicinity of this SWMU where investigated as part of the 2008 Drum Storage Area RI performed by Lockheed Martin (URS 2008d). No data gaps or additional data needs are identified for this SWMU; however, the appropriateness for the use of industrial cleanup levels in site soils based on future land use considerations should be confirmed.	Refer to Drum Storage Area (SWMU 20).
SWMU #28 90-Day Drum Storage Area	No environmental investigations have been performed. The likelihood of release is low based on construction, relatively recent period of operations, and the record keeping and inspection program that was implemented. No data needs have been identified.	No environmental investigation activities are proposed.
SWMU #29 Caustic Spill	The area was inspected (Ecology 1990 e,f) and some soils were reportedly excavated due to high pH in response to this NaOH spill that occurred in 1990. Characterization of COPC concentrations in soil and groundwater was not performed. Subsurface soil chemical characterization for site COPC represents a data need for this SWMU. Limited groundwater sampling of the spill area represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of COPC concentrations in subsurface soil in the spill area. Determination of whether a release to groundwater has occurred.
SWMU #30 Paste Plant Spill	Environmental investigation of the Paste Plant Spill occurred in 1991 (Technico Environmental Services 1991a,c). PAH concentrations in soil exceeded MTCA Method C industrial screening levels in the area near the fenceline south of the Paste Plant. A soil removal action was performed and confirmation sample results showed additional contaminated soils remaining. Additional areas of waste disposal and potential sources of contamination (e.g., East End Landfill) were identified. Subsurface soil sampling beneath concrete and asphalt in the area of the Paste Plant Spill to characterize PAH concentrations. Current concentrations of site COPC in soil and shallow groundwater represent a data gap and data need for this SWMU. Groundwater characterization needs will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of soil and shallow groundwater contamination in the spill area.
SWMU #31 Smelter Sign Area	Evidence of SPL and other aluminum reduction was discovered and reported to Ecology in 2011. Work plans for site characterization were prepared in 2011 (Tetra Tech 2011b,c). Data needs and data gaps include waste characterization as well as characterization of COPC concentrations in surface and subsurface soils. Characterization of shallow groundwater COPC chemical concentrations and water-level elevations in the NESI subarea near the wetlands represents a data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Nature and extent of waste and soil contamination in the Smelter Sign Area.

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Data Needs and Investigation Objectives Summary
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #32 Stormwater pond and appurtenant facilities	Sediments in the stormwater pond were investigated in 1991 (Technico Environmental Services 1991b) and contained PAHs above the state EHW designation criteria of one percent. Stormwater catch basins have been sampled and were found to consistently contain PAHs above MTCA Method C screening levels for soil. Accessible lines and catch basins at the time have been cleaned (PGG 2012b). A series of groundwater collection lines have been documented that drain into the stormwater pond (Columbia Gorge Aluminum 2011). Data gaps and data needs include the following: • Characterization of current chemical concentrations of PAHs and other site COPC in stormwater detention pond sediments. Characterization of the vertical and horizontal extent of contamination. • Estimation of the volume of contaminated sediments and the anticipated waste designations. • Verification of the groundwater collection system layout and construction. • Hydrologic evaluation of the groundwater collection system and its effect on shallow groundwater occurrence and flow beneath the production area. • Verification that stormwater lines and catch basins have been cleaned to the maximum extent practicable now that plant demolition activities have been completed and site access has become easier. • Characterization of shallow groundwater COPC chemical concentrations and water-level elevations near the stormwater pond and in the main production area represents a data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of contamination in the stormwater pond sediment. Hydrologic characterization of the groundwater collection system and its effect on shallow groundwater occurrence and flow.
Other Potential Source (Northwestern Area) – Research And Development Laboratory Septic Drain Field	This area was investigated in 2012 (PGG 2013a). Elevated concentrations of PAHs, metals (e.g., arsenic, cadmium), and low levels of a few VOCs were detected primarily in septic tank sludge for the newer septic system. The tank sludge was removed and appropriately disposed of offsite and the septic system was decommissioned. Shallow groundwater sampling was not performed and it’s unclear if contaminants could have impacted shallow groundwater. No characterization needs for soil have been identified. Limited groundwater sampling of the drain field represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination of whether a release to groundwater has occurred (see Groundwater in the Uppermost Aquifer AOC).
Other Potential Source (Western Area) – Upper Fluoride Area	This area was investigated in 2012 (PGG 2013a). No evidence of a release or waste handling/disposal was found. No data gaps or data needs have been identified.	No environmental investigation activities are proposed.
Other Potential Source (Northwestern Area) – Southern Surface Drainage Ditch near West SPL Storage Area (SWMU 13)	This investigation area was added based on Ecology (2015b) comments on the Phase 1 Work Plan. The WSI slurry lines were historically located in the ditch adjacent to the WSI. There is potential for the sludge lines to have released contaminants to the unlined ditch. This ditch was modified, repaired, and lined in 1996 and 1997 (CH2MHill 1996, 1997). Inspection of the ditch and potential soil sampling represents a data need for this area.	Verification of the lined portion of the ditch, determination of whether a release to ditch soils has occurred, determination of the amount of soil in the potentially impacted area of the ditch.

Notes:

AOC Area of Concern
COPC Chemical of Potential Concern
EELF East End Landfill
EHW Extremely Hazardous Waste
MTCA Washington State Model Toxics Control Art
NESI North of the East Surface Impoundment
PAH Polycyclic Aromatic Hydrocarbon
RCRA Resource Conservation and Recovery Act
RI/FS Remedial Investigation/Feasibility Study
SPL Spent Pot Liner
SWMU Solid Waste Management Unit
VOC Volatile Organic Compound
WELF West End Landfill

Table 3-4
Areas of Concern
Data Needs and Investigation Objectives Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Columbia River Sediments	Columbia River, Boat Basin, and Intermittent Drainages.	Current information and/or data regarding sediment transport in Boat Basin and the reach of the Columbia River near the site (e.g., depositional rate, areas of re suspension, degree of connection and circulation, and potential dredging areas).	Characterize physical processes and properties that may affect sediment quality concentrations and potential remedial alternatives analysis.
		Chemical characterization of surface (0-6 inch) sediment in the Boat Basin and Columbia River to determine current conditions for site COPC. Because anticipated land and water use is assumed to remain the same, subsurface sediments will remained covered with no exposure to potential receptors. Ecology and Yakama Nation (Ecology 2015b) comments on the Draft Phase 1 Work Plan include consideration for sampling of deeper intervals.	Characterize current sediment quality in surface sediments to evaluate potential exposure.
		Chemical characterization of sediment and surface water in the two intermittent streams draining into the Boat Basin to determine current conditions for site COPC.	Characterize potential contaminant transport to the Boat Basin and Columbia River.
		Further characterization and evaluation of background sediment concentrations for site COPC to determine current conditions.	Characterize naturally occurring background concentrations and potential contribution from other upstream sources.
		Ecology and Yakama Nation Comments (Ecology 2015b) on the Draft Phase 1 Work Plan include consideration of human health evaluation for Columbia River sediments.	The focus of this investigation is on the collection of new chemical and physical sediment data to establish current baseline sediment quality conditions and to identify associated potential ecological and human health risks.
Groundwater in the Uppermost Aquifer	Site-Wide	Confirm and update the site hydrogeologic conceptual site model to reflect current conditions. Additional site-wide investigation is needed. Detailed hydrostratigraphic characterization of the unconsolidated aquifer (UA), upper basalt aquifer (BAU), and lower basalt aquifer (BAL), including occurrence of groundwater, lithology, and continuity of permeable zones within the basalt. Evaluation of aquifer characteristics for the UA, BAU, and BAL aquifer zones including: groundwater flow directions, horizontal and vertical gradients, hydraulic conductivity, and aquifer interconnection within the underlying basalt aquifer system. Characterization of current groundwater quality for site COPC, geochemistry, and background concentrations for the UA, BAU, and BAL aquifer zones. Better definition and refinement regarding the lateral extent of contamination for various aquifer zones to evaluate the groundwater to surface water pathway. Characterization of seasonal variability in groundwater quality.	Better understand groundwater occurrence, flow, seasonal variability, and contaminant distribution to evaluate potential transport and exposure pathways.
		Development of soil screening levels protective of groundwater for fluoride and cyanide consistent with the requirements of MTCA. Development of an appropriate groundwater screening level for sulfate.	Establish necessary soil screening levels to adequately assess the potential for ongoing releases to groundwater. Better evaluate potential human health risks from exposure to sulfate in groundwater.
		Verification of the physical condition of the monitoring wells and ancillary equipment (e.g., pumps). Evaluation of the construction details for existing wells to determine which wells are appropriate from a construction standpoint for inclusion in the RI sampling program. Verification of well elevation and location information. These data needs should be addressed before completion of the Phase 2 Work Plan. Identification of monitoring wells that may serve as potential pathways for contaminant migration that may require physical modification or decommissioning as appropriate.	Determine and ensure that representative groundwater RI data will be collected. Eliminate potential well-related groundwater transport pathways.

Table 3-4
Areas of Concern
Data Needs and Investigation Objectives Summary
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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Groundwater in the Uppermost Aquifer (Continued)	Production Area	Characterization in the production area to determine hydrogeology and water quality concentrations. Further characterization at the east end of the plant in the area of the filled drainage channel and associated NPDES drainage. There is a general lack of groundwater characterization in these areas.	Characterize nature and extent of groundwater contamination and hydrogeologic conditions.
	SWMU-Specific	Evaluation of potential releases to groundwater for SWMUs and other source areas that have not been characterized.	
Wetlands	Wetlands west and south of the former smelter and excluding NPDES Ponds	Soil quality data wetlands sufficient to evaluate impacts from site operations via air deposition. Sufficient background soil samples for evaluating potential contamination in wetland sediment. Further evaluation of COPC list for wetlands soil characterization and characterization of background concentrations.	Characterize nature and extent of soil/sediment contamination in the wetlands related to former smelter emissions.
Rectifier Yard	Rectifier Yard and Rectifier Building	Collection of soil samples where feasible in areas that were previously inaccessible. Additional characterization of surface and near surface samples for a more comprehensive suite of site COPC. This effort will include resampling of: 1) selected previous transformer sampling locations and with chemical analyses of metals and petroleum hydrocarbons; 2) selected previous oil pipeline sampling locations with chemical analyses for metals and PCBs; 3) sample transformer substations not previously sampled in areas where PCBs were detected in soil and 4) selected previous aboveground storage tank (AST) sampling locations with chemical analyses of metals, fluoride, cyanide, PAHs and petroleum hydrocarbons. Further evaluation of the vertical and horizontal extent of petroleum hydrocarbon contamination in soil near the oil conveyance lines and at the interior transformer substations. Further evaluation of the horizontal and vertical extent of PAH soil contamination at the transformers and oil conveyance lines. Verification that all oil conveyance lines have been removed. Characterization of subsurface soils beneath Rectifier Building A- and B-series transformer locations, and beneath the Rectifier Building foundation with the chemical sampling program to include metals, PAHs, PCBs and petroleum hydrocarbons. Characterization of soil concentrations at the oil house to include chemical analyses of metals, PAHs, PCBs and petroleum hydrocarbons for selected samples. Characterization of surface soils in the northern portion of the Rectifier Yard used for storage of demolition debris (rebar) with the chemical sampling program to include metals, fluoride, cyanide, PAHs, PCBs, and petroleum hydrocarbons. Additional evaluation of Transformer Substation T5B to determine if additional soil removal is warranted.	Characterization of the nature and extent of soil contamination. Evaluation of potential for releases from site features to subsurface soil and shallow groundwater (groundwater investigation is addressed as part of the Groundwater in the Uppermost Aquifer AOC).

Table 3-4
Areas of Concern
Data Needs and Investigation Objectives Summary
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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Plant Area	Potential Sources in the Plant Area AOC that are not included as existing SWMUs and AOC	The Plant Area AOC has been subdivided into three main categories of features: 1) Carbon Handling, Storage, and Manufacturing. 2) Bath Handling and Storage, and 3) Cast House, Production Buildings, and Ancillary Features. SWMUs 7, 24, 25, and 26 will also be addressed under the Plant Area AOC because of their indeterminate locations. Data gaps and data needs include the following: **Carbon Manufacturing, Handling and Storage Features.** Characterization of surface and subsurface soil chemical concentrations at the identified carbon handling, storage, and manufacturing potential source areas. Inspection and evaluation of the construction of the subsurface portion of the Coke and Pitch Unloading Structure. Sampling of the groundwater collection sump if this structure is still present and accessible. **Bath Handling and Storage Features.** Characterization of surface and subsurface soil chemical concentrations at the newly identified bath storage and handling features. With the exception of the Bath Storage Building (that also represents the East SPL Storage Area, SWMU 12) environmental investigations have not been performed at these locations. Particularly for bath handling and storage features, development of a fluoride soil screening level under MTCA that is protective of groundwater for drinking water use represents a RI data evaluation need. **Cast House and Production Buildings Foundation Footprint**. Characterization of chemical concentrations in soils within the footprint of the Cast House and Production Buildings represents a data gap and data need for the RI. In particular, subsurface soils associated with low lying structures beneath building foundations where waste, effluent, or direct contact cooling water may have accumulated should be characterized (e.g., sumps, subsurface ducts, under-floor trenches, DC casting pits). Specific data gaps and data needs include the following: • **Casting Pits.** Further information regarding the casting pit(s) design and construction represents a data gap and data need to determine the potential for these subsurface structures to affect groundwater occurrence and flow. Characterization of shallow groundwater in the vicinity of the Casting Pits represents a data gap and data need. • **Courtyards.** Supplemental characterization of soils to better define the extent of contamination and for additional COPC represents a RI data gap and data need. Confirmation of current post-demolition chemical concentrations for surface and near surface soils also represent an RI data gap and need for the Courtyards. Determination of the extent of PAH contamination above MTCA Method C formula values represents a FS data need. • **Industrial Sump.** The Industrial sump is part of both the industrial wastewater and stormwater conveyance system. Stormwater is pumped from the stormwater pond to the Industrial Sump with gravity drainage from the sump to the Columbia River. Characterization of chemical concentrations in subsurface soil and shallow groundwater in the vicinity of the Industrial Sump represents an RI data gap and data need. Characterization of chemical concentrations in sump sludge/sediments, and estimation of sludge/sediment volumes in the Industrial Sump represent remediation data needs.	Characterization of the nature and extent of soil contamination. Evaluation of potential for releases from site features to subsurface soil and shallow groundwater. Evaluation of potential contaminant transport pathways. Characterization of potential hydrologic interaction between subsurface features and shallow groundwater.

Table 3-4
Areas of Concern
Data Needs and Investigation Objectives Summary
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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Plant Area (Continued)	Potential Sources in the Plant Area AOC that are not included as existing SWMUs and AOC	• **Industrial Lines.** Verification that the lines and associated catch basins have been cleaned to maximum extent practicable now that site demolition activities (that previously limited access to the lines) have been completed. Further cleaning of the lines should be performed as appropriate. • **Discharge Line to NPDES Pond A.** Determination of current concentrations of COPC in the discharge line water represents a RI data gap and data need. Chemical characterization of soil/sediment at the discharge point near Pond A represents a data gap and data need to evaluate the potential for re-contamination of NPDES Pond A soil. • **Hydrologic Characterization of Electrostatic Precipitation Lines/Groundwater Collection Line**. Hydrologic evaluation of the groundwater collection system including estimation of the relative contribution of groundwater and electrostatic precipitation line water conveyed by the piping systems to NPDES Pond A. Evaluation of the effects of the electrostatic precipitation lines and groundwater collection system on shallow groundwater occurrence, flow, and groundwater contaminant concentrations represents a RI data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC. • **Fuel Handling and Storage Areas.** Characterization of current COPC concentrations in surface and subsurface soils in UST and AST areas represents a RI data gap and data need. • **Shops, Maintenance, and Repair Areas.** Characterization of COPC concentrations in surface and subsurface soil represents a RI data gap and data need. Additional characterization of subsurface soil and shallow groundwater represents a data gap and data need for the Equipment Wash Station, Oil Change Pit, and Friction Weld Press Pit. • **Ancillary Features.** Data gaps and data needs include characterization of COPC concentrations in surface and subsurface soils. Characterization of groundwater occurrence, chemical concentrations, and flow in the Production Area represents an RI data need that will be addressed under the Groundwater in the Uppermost Aquifer AOC.	

Notes:
AOC Area of Concern

Section 4
Risk Pathway Evaluation Approach

Media-specific environmental screening levels proposed for use during the RI work effort are summarized and presented in the Phase 1 Work Plan. RI analytical data will be initially compared to the media-specific human health and ecological screening values to establish the occurrence and nature and extent of potential environment release(s).

This section summarizes the risk pathway evaluation approach for specific pathways with data or data evaluation needs as identified in the Phase 1 Work Plan or as identified in Ecology (2015b) comments on the Draft Phase 1 Work Plan.

4.1 SOIL SCREENING LEVELS FOR PROTECTION OF GROUNDWATER

MTCA (WAC 173-340-740(1)(d) and WAC 173-340-747(1)(a) requires that soil cleanup levels be established at concentrations that do not cause exceedance of cleanup levels for other media (e.g., groundwater). Methods of deriving soil concentrations for protection of groundwater under the MTCA regulation include the use of: 1) a fixed-parameter three-phase partitioning model, 2) a four-phase partitioning model, 3) leaching tests, 4) alternative fate and transport models, and 5) empirical demonstration.

For the RI, a fixed parameter three phase partitioning model will be initially used to determine soil screening levels protective of groundwater (WAC 173-340-747). The calculated soil screening levels for protection of groundwater will be compared to the MTCA Method B (residential) and C (industrial) soil formula values to preliminary determine if groundwater protection potentially affects the soil screening level selection for particular chemicals.

Based on preliminary review, it appears that groundwater protection may affect soil cleanup levels for fluoride and cyanide. During preparation of the Draft Phase 1 Work Plan, it was noted that the MTCA Method B formula values for two of the main groundwater COPC have been lowered. For example, the MTCA Method B formula values for fluoride and free cyanide are 640 micrograms per Liter (µg/L) and 9.6 µg/L, respectively. These values are below the maximum contaminant levels (MCLs) previously used for screening purposes in the long-term groundwater monitoring programs at the site for fluoride (4,000 µg/L) and free cyanide (200 µg/L). Leaching tests for site soils for fluoride and cyanide will be conducted to evaluate the applicability of soil screening levels for protection of groundwater as initially determined through the fixed-parameter three-phase partitioning model.

4.2 TERRESTRIAL ECOLOGIC EVALUATION FOR SOILS

Consistent with MTCA requirements (WAC 173-340-7490), SWMUs and AOC will be evaluated to determine 1) whether a release of hazardous substances to soil may pose a threat to the terrestrial environment, 2) to characterize potential threats to terrestrial plants or animals, and 3) establish site soil screening levels for the protection of terrestrial plants and animals. The terrestrial ecologic evaluation approach specified in MTCA is not intended for use in wetlands.

Based on the collected RI data, in the event of a documented release of a hazardous substance at a particular SWMU or AOC in soil, the following approach will be used for terrestrial ecologic evaluation consistent with MTCA requirements:

- **Exclusions from Terrestrial Ecological Evaluation.** Exclusions for particular SWMU or AOC will be documented consistent with the regulation (WAC 173-340-7491). Exclusions include the following: 1) all soil contamination present at the site is located below the point of compliance depth [that is either 6 or 15 feet below ground surface (bgs) depending on circumstances], 2) all soil contamination is or will be covered by buildings, paved roads, pavement or other physical barrier, 3) consideration of the amount of contiguous undeveloped land on or adjacent to SWMU or AOC. Under the first two exclusions, institutional controls are typically required.

  Particular SWMU or AOC that do not qualify for exclusion will then be evaluated to determine if a simplified or site-specific evaluation is needed.

- **Simplified Terrestrial Ecological Evaluation.** Simplified terrestrial ecological evaluations are used to identify those sites which do not have a substantial potential for posing a threat of significant adverse effect to terrestrial ecological receptors and are commonly used to protect terrestrial wildlife at industrial or commercial sites. It is anticipated that the majority of SWMUs and AOC with releases of COPC to soil that do not qualify for exclusion will be addressed through simplified terrestrial ecological evaluations.

- **Site-Specific Terrestrial Ecological Evaluation.** A site-specific terrestrial ecological evaluation will be performed for SWMU or AOC under the following circumstances: 1) those SWMU or AOC located on or directly adjacent to an area where management or land use plans will maintain or restore native or semi-native vegetation (e.g., regulated wetland or other environmentally sensitive areas), 2) SWMU or AOC used by various categories of threatened or endangered species as specified in MTCA, 3) SWMU or AOC located on a property that contains at least 10 acres of native vegetation within 500 feet, and 4) if Ecology determines that the site may present a risk to significant wildlife populations (WAC 173-340-7491).

Based on preliminary review, it does not appear that site-specific terrestrial ecological evaluations will be necessary for the vast majority of the SWMUs and AOC. Based on initial RI results and screening, if a site-specific terrestrial ecological evaluation is determined to be necessary, a work plan will be prepared and the assessment will be performed as a supplemental RI investigation.

4.3 DEVELOPMENT OF RISK-BASED SCREENING LEVELS FOR SELECTED CHEMICALS

MTCA formula values for some site COPC have not been established in the Ecology Cleanup Level and Risk Calculation (CLARC) database (refer to screening level summary tables for soil, groundwater, sediment, and surface water in Section 3.0 of the Phase 1 Work Plan). If these chemicals are detected at sufficient frequency and concentrations in the RI chemical data set, then risk-based screening levels will be developed consistent with MTCA requirements.

Reference doses and carcinogenic potency factors will be determined from the integrated risk information system (IRIS) database, the U.S. Environmental Protection Agency (EPA) Health Effects Assessment Summary Table (HEAST) or the National Center for Environmental Assessment (NCEA) database consistent with MTCA requirements (refer to WAC 173-340-708). Risk-based screening levels for specific media will be calculated consistent with the applicable MTCA equations for each chemical type (non-carcinogenic and non-carcinogenic) and media (soil, groundwater, or surface water) of potential concern.

4.4 RISK EVALUATION FOR COLUMBIA RIVER SEDIMENTS

Ecology and Yakama Nation comments on the Draft Phase 1 Work Plan (Ecology 2015b) have identified the need for a human health risk evaluation of Columbia River Sediments as part of the remedial investigation. The available historical data summarized in the Phase 1 Work Plan (Volume 1) generally indicate that historical chemical concentrations in sediment were relatively low compared to the identified screening levels. Because the historical sediment data are more than 10 years old, new sediment chemical data is needed to characterize current conditions.

The RI will focus on the evaluation of sediment chemistry consistent with the Washington State SMS. The Phase 1 Work Plan identifies preliminary ecological and human health pathways for sediment, including direct contact and ingestion as the primary potential exposure routes. For this reason, the RI work effort will focus on collection of representative surface sediment chemistry data for the biologically active zone.

Background chemical concentration data will be collected from upstream areas to distinguish site impacts from other inputs unrelated to releases at the site. A literature survey will be performed to determine available screening levels for site COPC that are relevant and appropriate for evaluation of freshwater sediment human health exposures. COPC not covered by the SMS (e.g., sulfate and fluoride) will be initially evaluated through review of literature values.

The results for bioaccumulative chemicals [e.g., PAHs, Polychlorinated biphenyls (PCBs), and the metals arsenic and mercury] or other chemicals are found in sediment will be evaluated to determine if there is a potential ecological and/or human health risk. This screening comparison will be performed consistent with Ecology's Sediment Cleanup User's Manual (SCUM II) (Ecology 2015c). SCUM II serves as guidance for implementing the cleanup provisions of the Washington State SMS. Risk-based sediment concentrations protective of human health will be initially evaluated using the "sediment only" approach outlined in SCUM II. The sediment data collected will be compared against the SMS screening levels, and other available ecological screening levels where no SMS values are available, as well as collected site background data. A supplemental work plan addendum for risk evaluation will be prepared if chemicals are present above the identified screening levels and associated background concentrations.

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Section 5
Field Sampling Plan

This section summarizes the investigation objectives, scope of work, and rationale for the SWMUs and AOCs. Field methods and procedures to be employed during the RI field investigation are also described. The laboratory analytical methods and procedures and the field quality control sample requirements are described in Section 6.0 – Quality Assurance Project Plan.

5.1 SWMU INVESTIGATION OBJECTIVES, SCOPE OF WORK, AND RATIONALE

This section summarizes the objectives, scope of work and rationale for the 32 SWMUs. Background information regarding the SWMUs is also briefly summarized as it relates to the proposed sampling. A detailed summary of each SWMU including existing environmental data is included in the Phase 1 Work Plan.

5.1.1 NPDES Ponds (SWMU 1)

The NPDES Ponds SWMU consists of four former wastewater settling ponds (Ponds A through D) and associated drainage between the ponds that were used for detention and settlement of solids in wastewater from the former aluminum reduction facility. The ponds were constructed during the early 1970's in a natural drainage feature and gravity-discharged to the Columbia River. Waste streams from the smelter's air pollution control scrubber systems were discharged under a NPDES permit into Ponds A and B and the discharge from these ponds was historically combined with plant's other industrial discharges (e.g., cooling water, stormwater run-off, and treated sewage). NPDES Pond D and a portion of NPDES Pond C are located on property owned by USACE. The sediment loading rates to the ponds were reduced by a series of wastewater treatment improvements in the late 1970s and 1980s, in particular, the change from wet to dry air pollution scrubbers in 1978.

As stated in the Phase 1 Work Plan, several environmental investigations have been conducted at the ponds. A remedial action was completed at the NPDES Ponds during 2010. A total of 55,529 tons of sludge were removed from the ponds and the associated drainage ditch. This total mass included 46,812 tons of solid waste and 8,717 tons of extremely hazardous waste (EHW). Portions of the ponds were excavated down to bedrock, and the soil confirmation sample results indicated that the remaining soils met MTCA Method B soil screening levels for PAHs.

A pipeline was constructed in May 2010 to route process wastewater flows and stormwater around the former ponds. The pipeline is equipped with an automated monitoring station and flow controls. The autosampler reportedly controls an emergency bypass that discharges to the main NPDES channel between NPDES Ponds B and C in the event of a system upset.

5.1.1.1 Investigation Objectives

The Phase 1 Work Plan identified runoff from the discharge pipe at the head of Pond A as having some potential to re-contaminate Pond A soil. The discharge pipe appears to be connected to the old electrostatic precipitation lines as well as a shallow groundwater collection line. Pipe discharge water results have shown fluoride consistently above the MCL of 4,000 µg/L and aluminum above the surface water chronic ecologic screening level of 87 µg/L. The objective of the sampling is to determine if soils in contact with the discharge pipe runoff have become re-contaminated following completion of the remedial action.

Discharge from the emergency bypass also could potentially re-contaminate the NPDES drainage channels and lower ponds. The objective of the sampling is to determine current chemical concentrations in bypass channel soils and evaluate the recontamination potential of the emergency bypass.

5.1.1.2 Investigation Scope

Six surface soil samples will be collected with a hand-auger from the area of the discharge pipe at the head of Pond A to characterize current conditions (Figure 5.1.1-1). One sample will be collected about 10 feet downstream from the pipe outlet and extending downstream about 200 feet from the pipe outlet. The sample stations will be located within the drainage channel and the area white-grey sediment/precipitate identified in previous investigations that appears to mark an area of standing water that is present during wet periods. The samples will be collected at a depth of 0 to 0.5 feet bgs. The samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate.

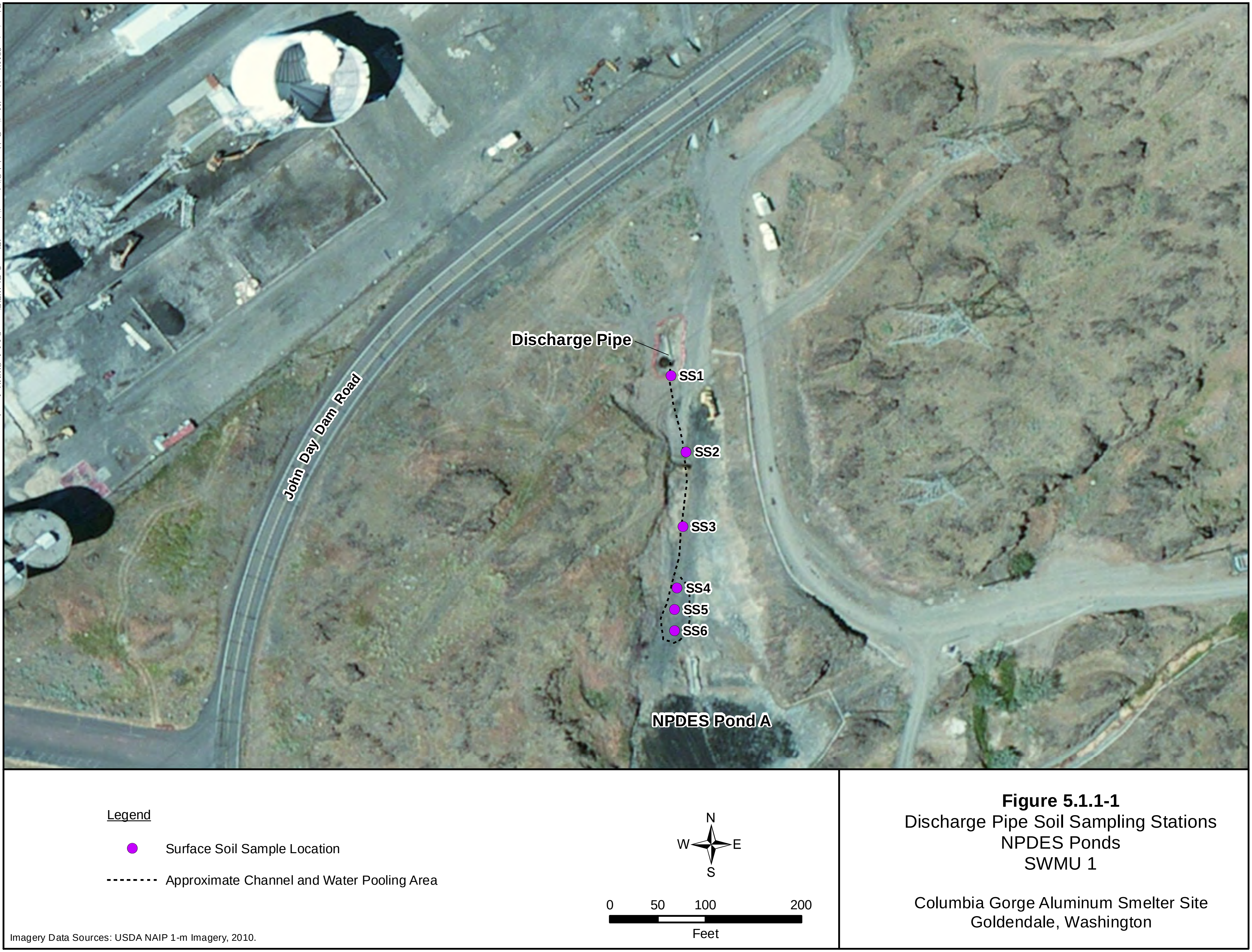

Figure 5.1.1-1
Discharge Pipe Soil Sampling Stations
NPDES Ponds
SWMU 1

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

In addition, five surface soil samples will be collected from the stormwater bypass channel to characterize current chemical conditions (Figure 5.1.1-2). These samples will also be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate.

Groundwater data needs for the NPDES Ponds will be addressed as a part of the Groundwater in the Uppermost Aquifer AOC and include installation of a shallow basalt bedrock well (RI-MW18-BAL) at NPDES Pond D. as well as groundwater monitoring of existing well BAMW-4. Sampling of the discharge pipe is addressed as part of the Plant Area AOC and evaluated and addressed as part of the Groundwater in the Uppermost Aquifer AOC.

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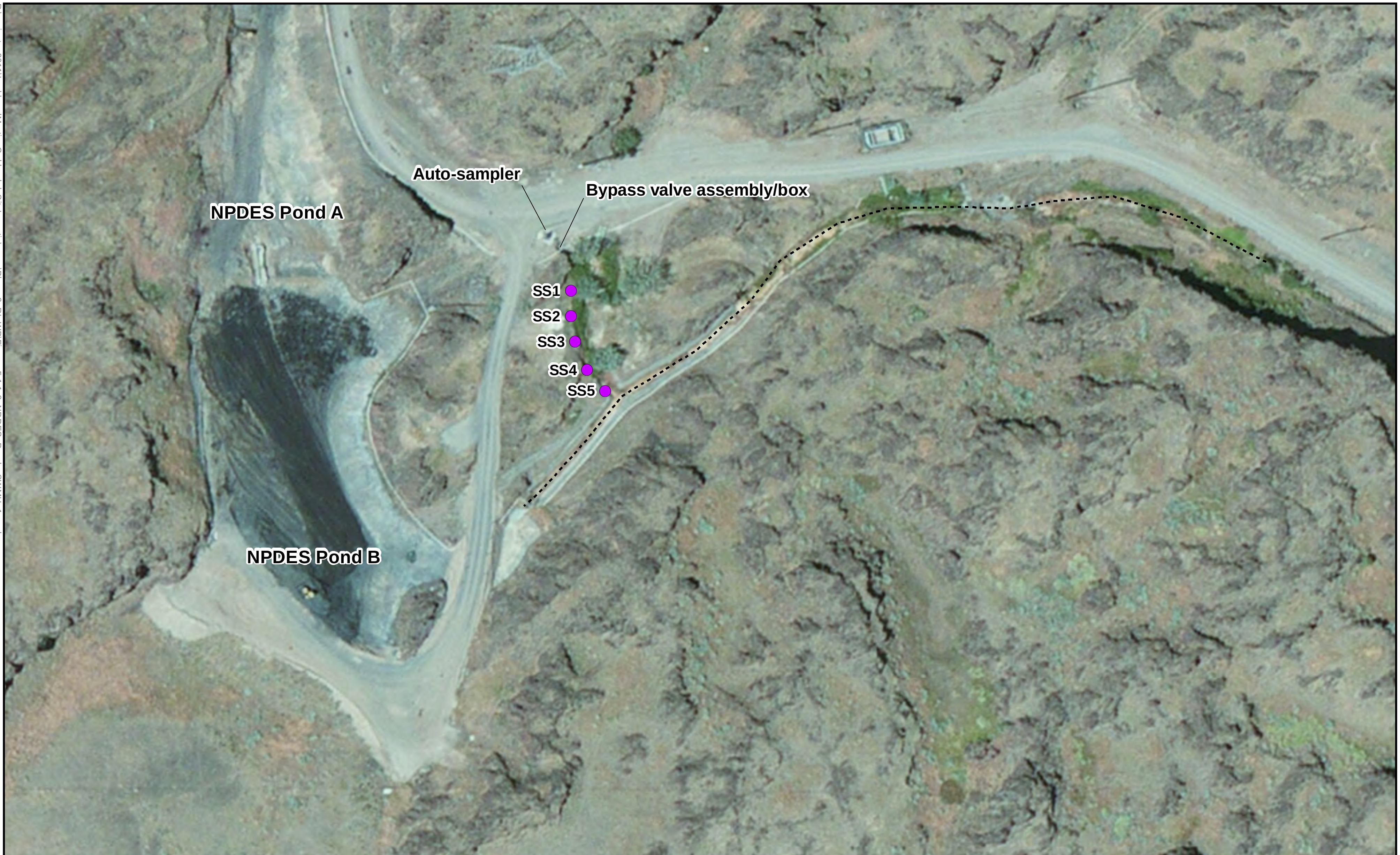


Legend

● Surface Soil Sample Location

- - - - Main Channel between Ponds B and C

N
W E
S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.1-2
Stormwater Bypass Channel Sampling Stations
NPDES Ponds
SWMU 1

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.2 East Surface Impoundment (SWMU 2)

No RI data needs were identified, as described in the Phase 1 Work Plan other than groundwater monitoring and characterization, which are addressed as part of the Groundwater in the Uppermost Aquifer AOC (refer to Section 5.2.2).

A brief description of this SWMU is provided for context and convenience. The ESI was operated from 1973 to 1985 as an unlined surface impoundment for disposal of NPDES pond sludge and blow down from the North SO2 scrubber. The ESI unit was closed under the RCRA in 1987. The engineered and impermeable RCRA cap consists of a one-foot sand cover, 30-mil PVC liner, and a 0.05-inch geotextile fabric, one foot of transitional material, and one foot of rip-rap.

5.1.3 Intermittent Sludge Disposal Ponds (SWMU 3)

No RI data needs were identified, as described in the Phase 1 Work Plan, and no further investigation is planned. The appropriateness of future industrial land use for this area will be further evaluated and confirmed during preparation of the RI/FS.

A brief description of this SWMU is provided for context and convenience. Following closure of the ESI, additional areas east of the smelter were discovered that had been used for the disposal of sludge from the NPDES ponds. Thirteen small deposits of sludge with no standing water were found. This site has accordingly also been called the East Surface Deposits. This SWMU was investigated in 2006 and an independent soil removal action performed during 2007 (URS 2008b). The remaining soils at the SWMU meet MTCA Method A Industrial Soil Cleanup Levels for PAHs.

5.1.4 West Surface Impoundment (SWMU 4)

No RI data needs were identified, as described in the Phase 1 Work Plan other than groundwater monitoring and characterization, which are addressed as part of the Groundwater in the Uppermost Aquifer AOC in Section 5.2.2.

A brief description of this SWMU is provided for context and convenience. The WSI was constructed in 1981 and began operations in 1982 as part of a major smelter expansion and modernization. The WSI was designed to concentrate emission wastewater through evaporation and for storage/disposal of air emission control sludge. The impoundment is lined with 6 inches of sand and a 30-mil Hypalon liner. The unit was closed under RCRA in 2005. The impoundment was closed with an engineered cap consisting of a sand layer, a geosynthetic clay layer and soil cover.

5.1.5 Line A Secondary Scrubber Recycle Station (SWMU 5)

Line A Secondary Scrubber Recycle Station (SWMU 5) was one part of the plant air emission pollution control system, and was located south of Production Building A and near the eastern end of the cast house shipping area (Figure 5.1.5-1). The Line A Secondary Scrubber Recycle Station system consisted of a screen box, cyclone separators, a 36-foot diameter clarifier, and overflow recycle tanks. About 6,000 gallons per minute (gal/min) of contaminated scrubber water was treated at the recycle station to remove solids and adjust pH. After treatment, some of the water was recycled back to the wet roof scrubbers and the rest of the treated water was pumped to the 130-foot diameter clarifier associated with Line B, C, and D Secondary Scrubber Recycle Station (SWMU 6). The clarifier and all above ground structures have been demolished.

Secondary fugitive emissions from the Production Buildings were moved by the building ventilation system into the roof scrubbers to remove fluoride and particles from gases. Resultant spray water containing particulates, fluoride, and other pollutants including sulfur dioxide flowed to the recycle station for further treatment. No documentation exists indicating releases have occurred and no environmental investigations have been conducted.

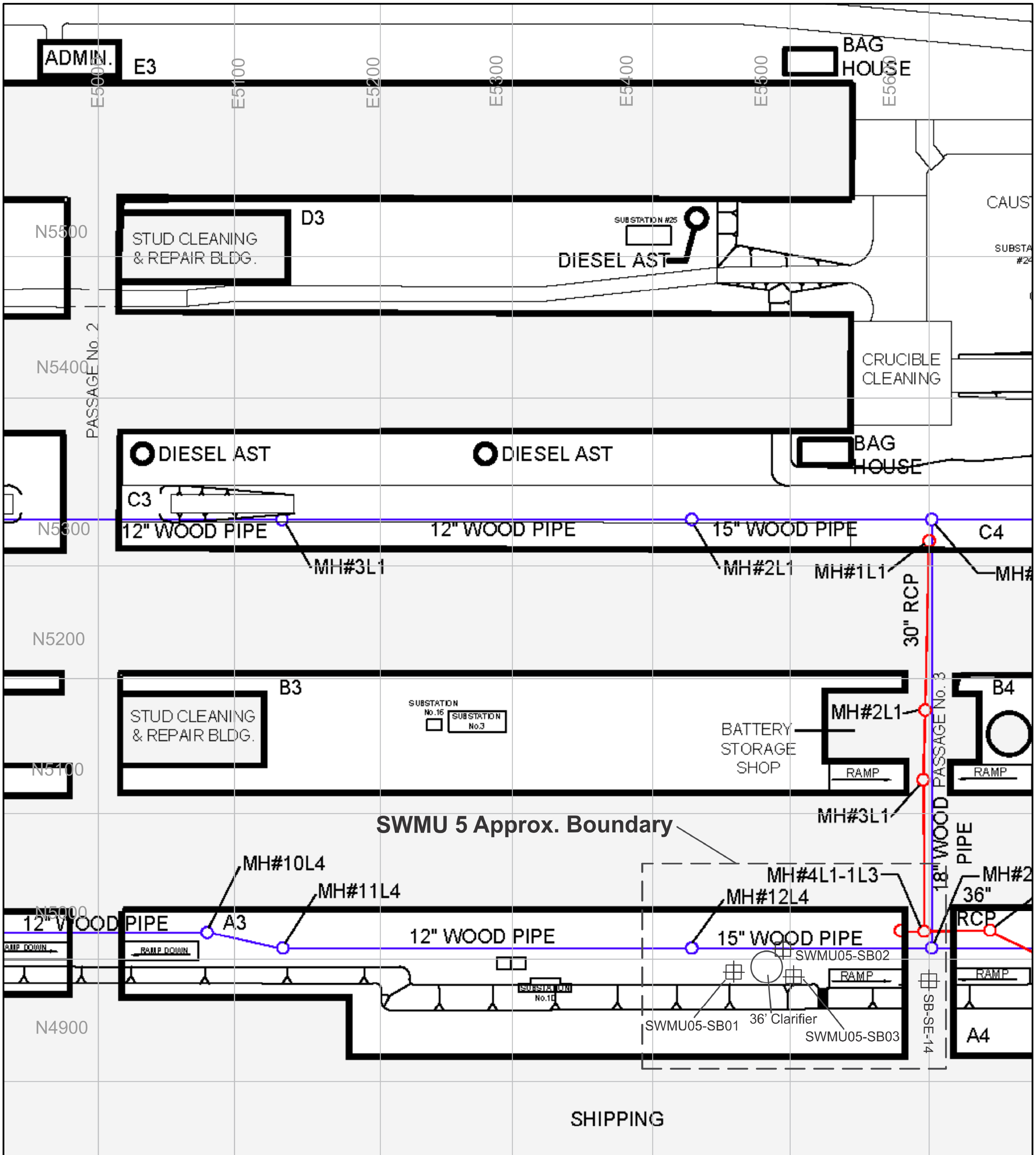
5.1.5.1 Investigation Objectives

Data needs and data gaps for Line A Secondary Scrubber Recycle Station (SWMU 5) are summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps:

- Characterize COPC in soil.
- Determine whether a release has occurred.

5.1.5.2 Investigation Scope

The preliminary investigation step will be system identification. Site plans will be reviewed to identify construction details for the recycle station including underdrains, piping, connections with other lines, and associated structures. The existing clarifier foundation will be inspected for cracks or other indicators of leakage that may have occurred prior or during plant demolition activities. In addition, geophysical methods will be employed to locate existing underground piping that may be



Legend

Soil Boring
SWMU05-SB01

Industrial Drain Lines

Scrubber Effluent Lines

Please see Figure 5.2.5-4 for adjacent sample locations near SWMU 5.

Proposed soil boring for SE lines
PAAOC-SE-SB14

0 50 100
Feet

Source: Modified from GAC 1996f

Figure 5.1.5-1

Sample Locations for SWMU 5

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

associated with the clarifier. Ground-penetrating radar (GPR), and potentially electromagnetic methods, would be used to identify pipes and types of pipe materials. The boring locations and vertical intervals for sampling may be modified based on the results of system identification.

The recycle station will be investigated with three soil borings located around the perimeter of the 36-foot diameter clarifier (Figure 5.1.5-1). The soil borings will be completed to a depth of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, and pH. Table 5.1.5-1 summarizes the soil sampling program.

A shallow temporary well (RI-GW5) is planned at this SWMU to determine if a release has occurred to shallow groundwater and to help characterize the nature and extent of groundwater contamination. This work is further described and will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2).

Table 5.1.5-1
Summary of Sampling for SWMU 5 Line A Secondary Scrubber Recycle Station

SWMU 5 Line A Secondary Scrubber Recycle Station					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (3)	Surface Soil	3	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals, Sulfate, and pH	Characterize COPC in soil.
	Subsurface Soil	6	2 feet bgs, base of the boring		

Notes:

See Figure 5.1.5-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (3) Total of three soil borings.

5.1.6 Line B, C, D Secondary Scrubber Recycle Station (SWMU 6)

Line B, C, D Secondary Scrubber Recycle Station (SWMU 6) is located east of Production Building D, and east of the Tertiary Treatment Plant (SWMU 8) (Figure 5.1.6-1). The Recycle Station system consisted of a 130-foot diameter clarifier, a backup 90-foot diameter clarifier, two recycle tanks, three bulk reagent/recycle tanks, and appurtenant pipes (Ecology 2014). The clarifiers and all above ground structures have been demolished. Only the clarifier and associated caustic tank foundations remain.

Similar to SWMU 5 Recycle Station, the SWMU 6 Recycle Station was part of the site air pollution control system and treated spray water from roof scrubbers to remove particulates, fluoride, and other pollutants including sulfur dioxide. After treatment, some of the water flowed from the clarifier to recycle tanks and were then recycled to the roof scrubbers, and some of the water and solids slurry from the clarifiers flowed through the Tertiary Treatment Plant for further treatment, with discharge of water under the plant NPDES permit. No documentation exists indicating releases occurred and no environmental investigations have been conducted for the SWMU 6 Recycle Station.

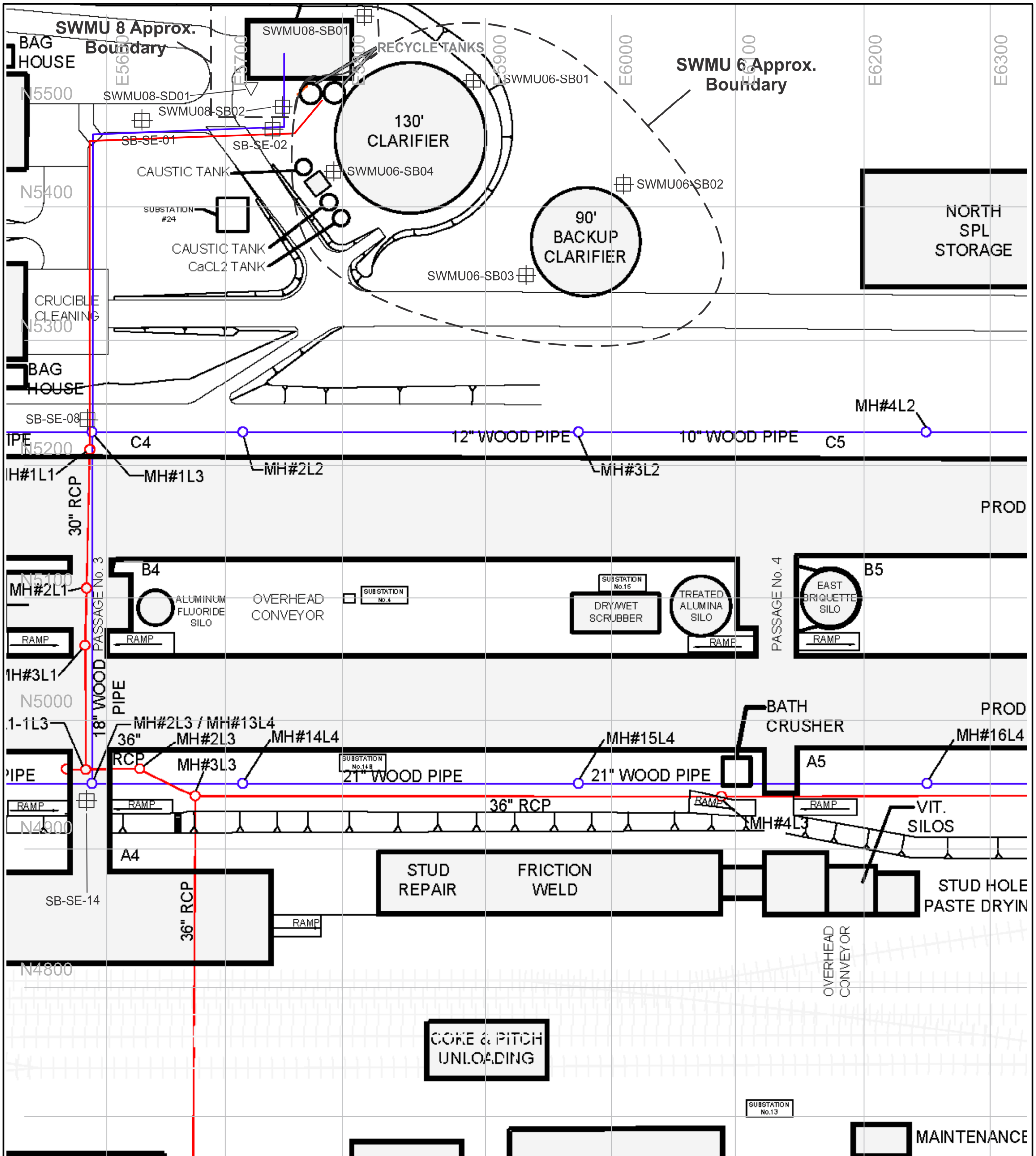
5.1.6.1 Investigation Objectives

Data needs and data gaps for Line B, C, and D Secondary Scrubber Recycle Stations (SWMU 6) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps:

- Characterize COPC in soil.
- Determine whether a release has occurred.

5.1.6.2 Investigation Scope

The preliminary investigation step will be system identification. Site plans will be reviewed to identify construction details for the recycle station including underdrains, piping, connections with other lines, and associated structures. The existing clarifier foundations will be inspected for cracks or other indicators of leakage. Geophysical methods will be employed to locate existing



Legend

- Soil Boring (SWMU06-SB01)
- Sediment Sample (SWMU08-SB01)

Please see Figure 5.2.5-5 for adjacent sample locations near SWMU 6 and SWMU 8.

- Industrial Drain Lines
- Scrubber Effluent Lines
- Proposed soil boring for SE lines (PAAOC-SE-SB01)

0 50 100
Feet

Source: Modified from GAC 1996f

Figure 5.1.6-1

Sample Locations for
SWMU 6 and SWMU 8

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

underground piping that may be associated with the clarifier. GPR, and potentially electromagnetic methods, would be used to identify pipes and types of pipe materials. Sample locations may be slightly modified based on findings from the site plan review and geophysical investigations.

The Recycle Station will be investigated with four soil borings located to the north and south of the two clarifiers, and adjacent to the caustic tank foundations (Figure 5.1.6-1). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, and pH as summarized in Table 5.1.6-1.

A monitoring well (RI-MW6-BAU) will be completed in the BAU unit in this area as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2). A shallow temporary well (RI-GW-7) is also planned to determine if a release has occurred (to shallow groundwater) and to help characterize the nature and extent of groundwater contamination.

Table 5.1.6-1
Summary of Sampling for SWMU 6 Line B, C, and D Secondary Scrubber Recycle Station

SWMU 6 Line B, C, D Secondary Scrubber Recycle Station					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (4)	Surface Soil	4	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals, Sulfate, and pH	Characterize COPC in soil.
	Subsurface Soil	8	2 feet bgs, base of the boring		

Notes:

See Figure 5.1.6-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern.
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (4) Total of four soil borings.

5.1.7 Decommissioned Air Pollution Control Equipment (SWMU 7)

The Decommissioned Air Pollution Control Equipment (SWMU 7) will be investigated and addressed as part of the Plant Area AOC investigation. Because SWMU 7 does not have a specific ground footprint, it will be investigated as part of the Plant Area AOC (refer to Section 5.2.5.3).

A brief description of this SWMU is provided for context and convenience. Prior to the 1983 installation of the dry alumina air scrubber equipment at the smelter, air emissions from Line A and B were removed using wet electrostatic precipitators. There were about 20 units housed on the roof between the Production Buildings A and B and included redwood towers and concrete bubblers. The equipment was removed around 1997. Emissions from these units could have potentially impacted soils in the vicinity of the Courtyards and plant area along with other historic operations and potential sources.

5.1.8 Tertiary Treatment Plant (SWMU 8)

The former Tertiary Treatment Plant (SWMU 8) was located east of Production Building D, and adjacent to Line B, C, and D Secondary Scrubber Recycle System (SWMU 8) (Figure 5.1.6-1). The plant building and associated structures have been demolished and their foundations remain. The treatment plant was the final process step of the plant's liquid portion of the air pollution control system and consisted of a 12-foot thickener vessel, a 28-foot diameter reactor/clarifier, reaction and surge tanks, sand filters, pumps, and appurtenant pipes. The plant was designed to treat the combined blowdown from the two scrubber water recycle systems and two wet SO2 scrubbers to remove fluoride, PAH compounds, and total suspended solids (TSS), and meet the NPDES permit effluent limitations. The Tertiary Treatment Plant was designed to treat up to 150 gal/min of combined scrubber water blowdown. The treatment process consisted of: 1) chemical precipitation of fluoride as calcium fluoride, 2) flocculation to increase TSS settling, 3) clarification to remove TSS, and 4) deep bed filtration to remove residual TSS prior to discharge. Water from the treatment process was recycled back through the SWMU 5 and SWMU 6 Recycle Stations to use as make-up water, or discharged under the plant NPDES permit. In later years of plant operation, solids from the treatment process were disposed offsite.

The water treatment process was conducted primarily inside the Tertiary Treatment Plant building. A sump is located at the southwest corner of the building, two recycle tanks were located along the northeastern side of the building, and a filter press was located along the northwest side of the building. The scrubber effluent and industrial lines both enter and exit at the southeast side of the Tertiary Treatment Plant building. No documentation exists indicating releases have occurred and no environmental investigations have been conducted.

5.1.8.1 Investigation Objectives

Data needs and data gaps for the Tertiary Treatment Plant (SWMU 8) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps:

- Characterize COPC in soil.
- Determine whether a release has occurred.

5.1.8.2 Investigation Scope

The preliminary investigation step will be system identification. Site plans will be reviewed to identify construction details for the plant including underdrains, piping, connections with effluent/sewer lines, and associated structures. The remaining building and tank foundations will be inspected for cracks or other indicators of leakage. In addition, geophysical methods will be employed to locate existing underground piping that may be associated with the clarifier. GPR, and potentially electromagnetic methods, would be used to identify pipes and types of pipe materials. Locations of soil borings and samples may be modified slightly depending on the results of system identification and geophysical investigations.

The plant will be investigated with two soil borings located at the perimeter of the building foundation (Figure 5.1.6-1). Proposed soil borings to investigate the scrubber effluent lines (SWMU 7), part of the Plant Area AOC, also are shown on Figure 5.1.6-1 because the lines are associated with the Tertiary Treatment Plant. The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. One sample of process solids will be collected from the sump, if feasible. Soil and process solids samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, and pH as summarized in Table 5.1.8-1.

The Tertiary Treatment Plant (SWMU 8) is in close proximity to the Line B, C, and D Secondary Scrubber Recycle Stations (SWMU 6). A monitoring well (RI-MW6-BAU) will be completed in the BAU unit as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2). A shallow temporary well (RI-GW7) is also planned in this area to determine if a release to shallow groundwater has occurred and to help characterize the nature and extent of groundwater contamination.

Table 5.1.8-1
Summary of Sampling for SWMU 8 Tertiary Treatment Plant

SWMU 8 Tertiary Treatment Plant					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals Sulfate, and pH	Characterize COPC in soil and process solids.
	Subsurface Soil	4	2 feet bgs, base of the boring		
Grab	Process Solids	1	NA		

Notes:

See Figure 5.1.6-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
NA Not applicable.
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (2) Total of two soil borings.

5.1.9 Paste Plant Recycle Water System (SWMU 9)

The Paste Plant Recycle Water System (SWMU 9) and the associated scrubber and cooling tower structures were in close proximity to the Paste Plant Building (Figure 5.1.9-1). The Paste Plant was located in the southeastern portion of the main production area and produced carbon paste for use in the reduction cells. The anode paste briquette production and extrusion process required a final quenching step in which water was sprayed onto the newly-formed briquettes. The quenching process was performed using conveyors on the eastern side of the Paste Plant Building. Water from the quenching process was recycled using several large water settling tanks and associated recycle sump also located just east of the main Paste Plant Building.

In addition to quenching the anode paste briquettes, water was also used in several fume scrubbers located within the Paste Plant Building. Both the quench water and the scrubber blow down were cooled and recycled back to the Paste Plant as part of the Paste Plant Recycle Water System.

No environmental investigation of the recycle sump, settling tanks, or other appurtenant facilities has been performed.

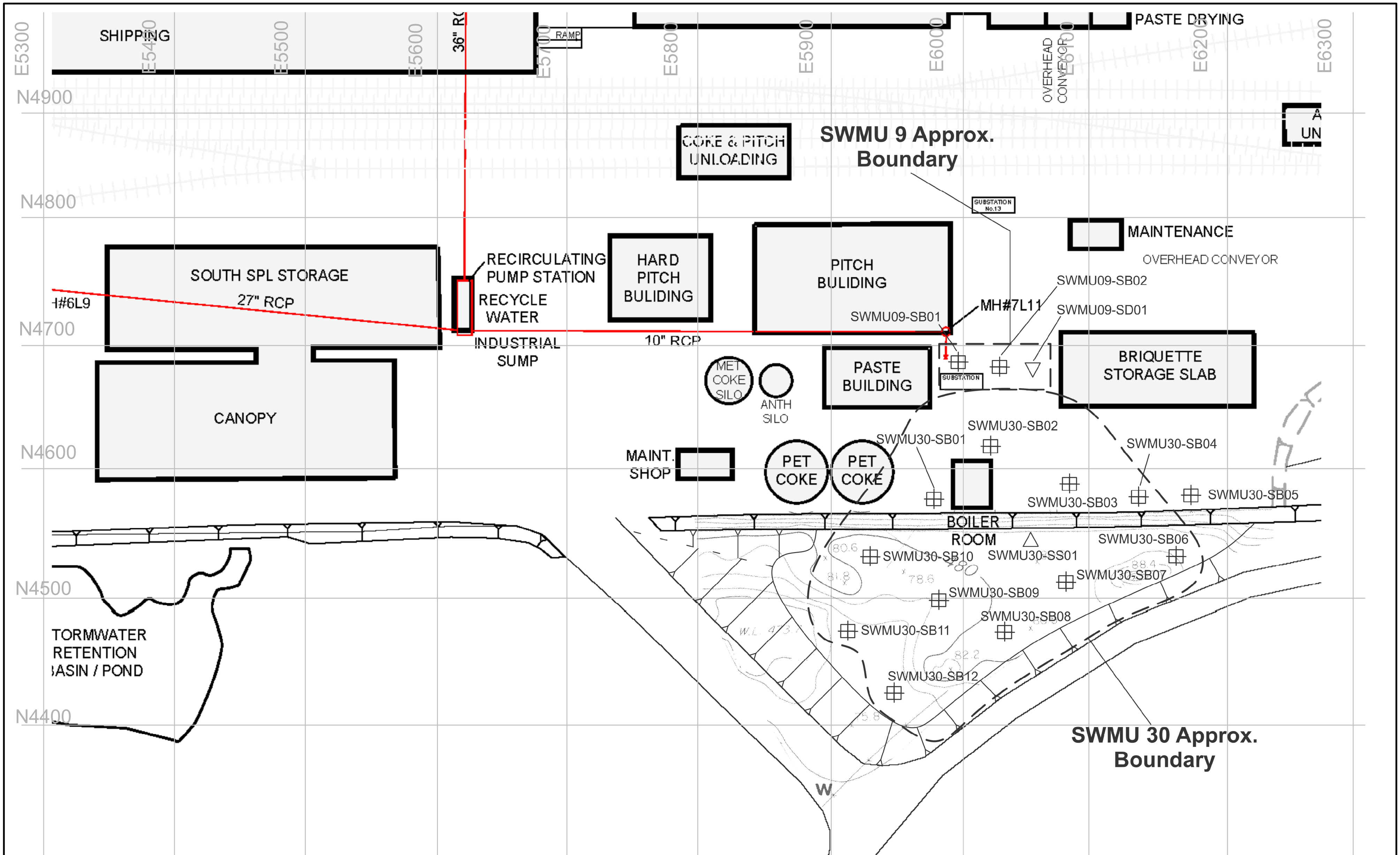
5.1.9.1 Investigation Objectives

Data needs and data gaps for Paste Plant Recycle Water System (SWMU 9) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps for SWMU 9:

- Characterize COPC in soil.
- Characterize COPC in sump process solids.

5.1.9.2 Investigation Scope

The former Paste Plant Recycle Water System will be investigated with two soil borings located east of the Paste Plant Building in the vicinity where the water system was located (Figure 5.1.9-1). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring.



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Soil Boring
SWMU09-SB01

Sediment Sample
SWMU09-SD01

Surface Soil Sample
SWMU30-SS01

Please see Figure 5.2.5-8 for adjacent sample locations near SWMU 9 and SWMU 30.

Industrial Drain Lines

0 50 100
Feet

Source: Map modified from CDMSmith 2011
Topography Commonwealth Aluminum A1/1722 (no date)
Slope interpreted from Google (2015)

Figure 5.1.9-1

Sample Locations for SWMU 9 and SWMU 30

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The area of the former SWMU 9 will be inspected to locate the sump and other related features, such as a floor drain. If a sump is present and sampling is feasible, one sample of process solids will be collected from the sump. Sump solids data will be used to determine if COPC are present and whether cleanout of the sump is warranted. Additional samples may be collected if additional related features are identified.

Soil and process solids samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate as summarized in Table 5.1.9-1.

Installation of a shallow temporary well (RI-GW4) at the sump is planned as part of the Groundwater in the Uppermost Aquifer AOC investigation to determine if a release to shallow groundwater has occurred in the vicinity of the sump and to help characterize the nature and extent of shallow groundwater contamination. Refer to Section 5.2.2 for further details.

Table 5.1.9-1
Summary of Sampling for SWMU 9 Paste Plant Recycle Water System

SWMU 9 Paste Plant Recycle Water System					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals, and Sulfate	Characterize COPC in soil and process solids.
	Subsurface Soil	4	2 feet bgs, base of the boring		
Grab	Process Solids	1	NA		

Notes:

See Figure 5.1.9-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
NA Not applicable
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (2) Total of two soil borings.

5.1.10 North and South Pot Liner Soaking Stations (SWMUs 10 and 11)

Although identified as individual SWMUs, the North and South Pot Liner Soaking Stations have been investigated together and are therefore addressed together in this Phase 2 Work Plan. The Pot Liner Soaking Stations operated between 1971 and 1990, and were composed of two concrete basins in which steel Hall Cells (i.e., aluminum smelting pots) were soaked with water (i.e., "quench water") to remove refractory SPL material. This SPL residue represents a listed hazardous waste (K088) because it can contain cyanide (URS 2008e). Because of the potential for leaching cyanide from the pot liners, quench water was treated with hypochlorite to oxidize the cyanide. Excess quench water that overflowed the cathode or leaked through holes in the steel shell was collected and directed back to the recycle sump. No documented historic spills or leaks have been reported for these SWMUs, and in 1990 the concrete basins were removed (URS 2008e).

In 2008, a RI/FS was performed at the North and South Pot Liner Soaking Stations (URS 2008e). Eight shallow soil borings (1.5 to 4.5 feet bgs) and two deeper borings (20 feet bgs) were drilled during the investigation (refer to Figure 5.1.10-1). In addition, one shallow (2 feet bgs) test pit was excavated to bedrock in an area where runoff from the soaking stations likely accumulated. The analytical program for soil included PAHs, total cyanide, fluoride, metals, sulfate, and PCBs. PAHs were detected in 10 soil samples, but only the two samples from an unpaved area south of the Soaking Stations exceeded the MTCA Method C Industrial screening level of 18 milligrams per kilogram (mg/kg) for carcinogenic polycyclic aromatic hydrocarbons (cPAHs) based on the total toxicity equivalent concentration (TTEC) methodology. All samples taken in the paved area immediately adjacent to the Soaking Stations met MTCA Method C screening levels. These results suggest that overflows may have occurred from the Soaking Station, but direct leakage to the subsurface does not appear to have been a significant contaminant transport mechanism. The area of PAH-impacted soil was estimated at about 14,400 square feet with a conservative average depth of about 3 feet bgs, or about 1,600 cubic yards. The estimated area of contamination is bounded by: 1) the 8 borings within the asphalt that meet MTCA industrial soil screening levels, 2) the topographic bedrock high to the east, and 3) runoff areas near the edge of the asphalt.

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\Phase2_RI_WP\Figure_5.1.32-1_West_SPL_Ditch.mxd

Legend

- Existing Monitoring Well
- 2008 Test Pit
- 2008 Soil Boring
- Proposed Soil Boring
- Proposed Shallow Well

N W E S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.10-1
North and South Potliner Soaking Stations
SWMUs 10 and 11

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.10.1 Investigation Objectives

The Phase 1 Work Plan identified collection of additional soil chemical data to fully define the extent and volume of PAH-impacted soil in this area and that this supplemental data collection activity could be conducted during the RI or during remedial action as appropriate. Ecology (2015b) comments on the Draft Phase 1 Work Plan state that collection of additional soil data from this area should be performed as part of the RI. The objective of the field investigation is to more fully characterize the nature and extent of soil contamination and to more accurately assess the volume of contaminated soil.

5.1.10.2 Investigation Scope

To address this data need, four borings will be drilled using hollow-stem or direct-push drilling techniques. The borings will be drilled to the basalt bedrock contact or a maximum depth of 10 feet bgs, whichever is shallower. The boring locations will be situated in gravel or dirt areas near the edge of the paving where runoff could have transported contamination form the paved potliner soaking areas. Three soil samples will be collected for chemical analyses from each boring at the surface (0 to 0.5 feet bgs), 2 feet bgs, and the base of the boring. The soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate.

A new well will be installed (RI-MW8-BAU) on the south (downgradient) side of SWMUs 10 and 11 to characterize water quality and groundwater flow in this area (refer to Figure 5.1.10-1). Groundwater data needs for the North and South Potliner Soaking Stations will be addressed as a part of the Groundwater in the Uppermost Aquifer AOC. The groundwater investigation data needs and scope of work are described in Section 5.2.2.

5.1.11 East SPL Storage Area (SWMU 12)

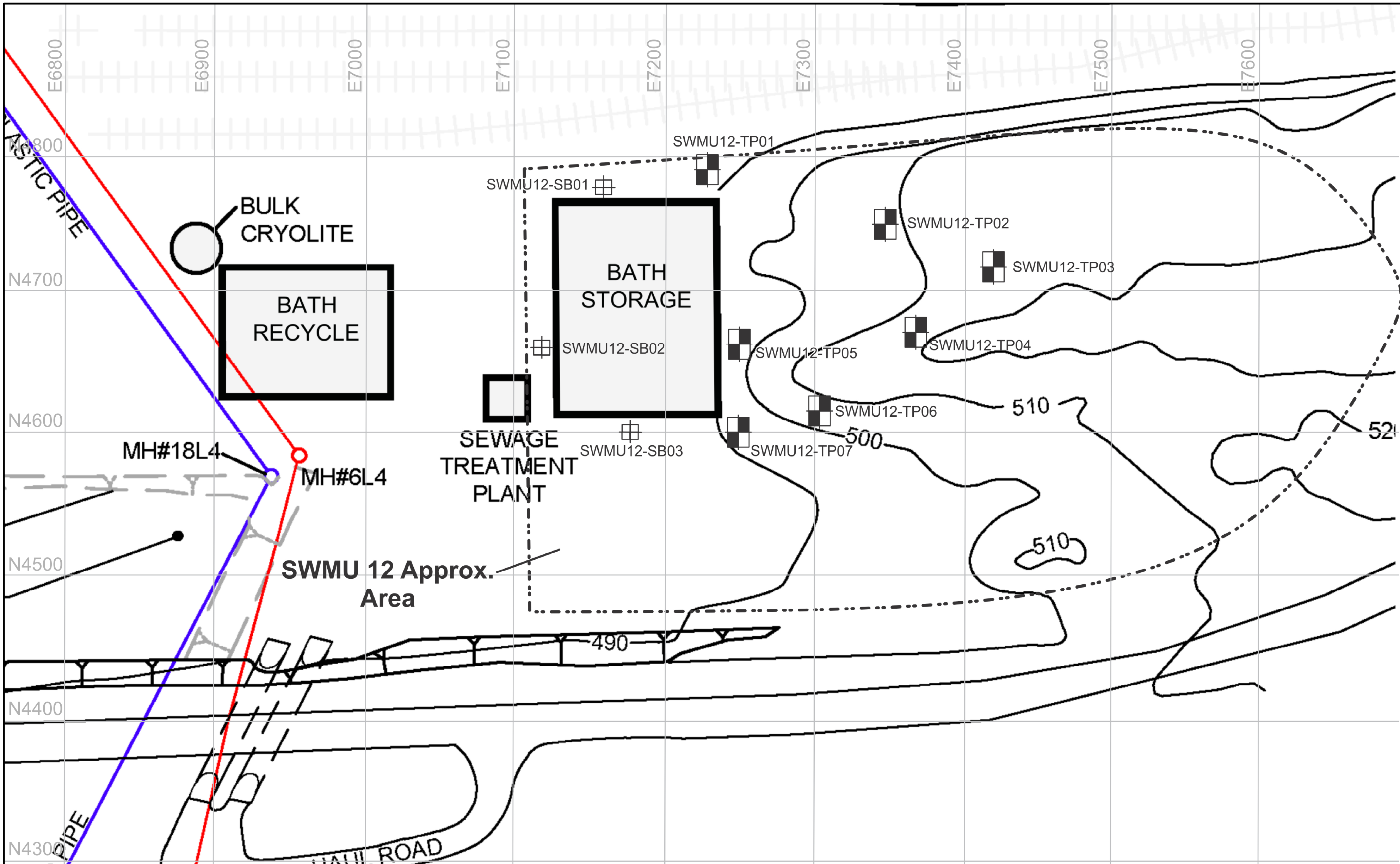
The East SPL Storage Area (SWMU 12) is located to the southeast of the former Production Buildings (Figure 5.1.11-1) and received SPL generated at the smelter from 1971 to 1984. SPL was stored on a 100-foot wide by 160-foot long concrete pad; however, the concrete pad capacity was exceeded and SPL storage expanded onto adjacent unpaved areas, primarily the rocky area to the northeast of the pad.

In 1984, storage of SPL was discontinued at the East SPL Storage Area, and approximately 105,000 tons of SPL was removed and transferred to the West SPL Storage Area (SWMU 13). Between 1987 and 1994, the Bath Storage Building was constructed within the footprint of the former East SPL Storage Area (SWMU 12) and was used for the storage of reclaimed bath material. In 2011, sediment from the cleanout of the stormwater line system was stored in the Bath Storage Building prior to offsite disposal (PGG, personal communication, November 2014). The Bath Storage Building currently remains on site.

A soil investigation of SWMU 12 was conducted in 2008 (URS 2008c) and included 17 shallow soil test pits, one shallow soil boring, and three deeper soil borings. Most soil samples were collected at depths of about 1 foot. Many of the test pits were less than about 5 feet deep and did not encounter bedrock, even though bedrock is exposed at ground surface in the center of the investigation area. Soil samples were analyzed for PAHs, total cyanide, fluoride, metals, sulfate, and PCBs. VOCs were eliminated through preliminary field screening, and no PCBs were detected. PAHs and selenium exceeded MTCA screening levels in some samples. No groundwater was encountered. Approximately 2,400 cubic yards of PAH-impacted soil was identified for SWMU 12, but was not removed.

5.1.11.1 Investigation Objectives

Similar to SWMUs 10 and 11, the Phase 1 Work Plan identified collection of additional soil chemical data to fully define the extent and volume of PAH-impacted soil in this area and that this supplemental data collection could be conducted during the RI or during remedial action as appropriate. Ecology (2015b) comments on the Draft Phase 1 Work Plan state that collection of additional soil data from this area should be performed as part of the RI. The objective of the field investigation is to more fully characterize the nature and extent of soil contamination and more accurately assess the volume of contaminated soil.



Legend

- Soil Boring (SWMU12-SB01)
- Test Pit (SWMU12-TP01)
- Industrial Drain Lines
- Scrubber Effluent Lines
- Area of Concern (URS 2008c)

Please see Figure 5.2.5-9 for adjacent sample locations near SWMU 12.

Source: Modified from GAC 1996f

Figure 5.1.11-1

Sample Locations for SWMU 12

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.11.2 Investigation Scope

The East SPL Storage Area will be investigated with three soil borings and seven test pits (Figure 5.1.11-1). Soil borings will be completed on the north, southwest, and southeast sides of the Bath Storage Building, where soil is expected to be deepest. Soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring.

Test pits will be located northeast of the Bath Storage Building where the soil is expected to be shallowest, and within the area the 2008 investigation defined as the "area of concern" (URS 2008). Bedrock also is exposed at ground surface in center portion of the area of concern. Some of the test pits will be located where the previous investigation detected elevated concentrations of metals and PAHs in soil. Test pits will be excavated to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs and 2 feet bgs due to the thin soil on the hill.

Soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate. Table 5.1.11-1 summarizes the sampling program for the East SPL Storage Area.

Table 5.1.11-1
Summary of Sampling for SWMU 12 East SPL Storage Area

SWMU 12 East SPL Storage Area					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (3)	Surface Soil	3	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals, and Sulfate	Characterize COPC in soil.
	Subsurface Soil	6	2 feet bgs, base of the boring		
Test Pits (7)	Surface Soil	7	0.5 feet bgs		
	Subsurface Soil	7	2 feet bgs		

Notes:

See Figure 5.1.11-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (3) Total of three soil borings.

5.1.12 West SPL Storage Area (SWMU 13)

Ecology (2015b) comments on the Draft Phase 1 Work Plan identified characterization of the ditch on the south side of the West SPL Storage Area as a RI data need. Inspection and characterization activities associated with the ditch are summarized as an additional investigation area in Section 5.1.32 because the ditch historical operations were separate from the West SPL Storage Area. Groundwater monitoring and characterization needs for the West SPL Storage Area (SWMU 13) are addressed as part of Groundwater in the Uppermost Aquifer AOC in Section 5.2.2.

The West SPL Storage Area was operated from 1984-1988 and then was closed as a solid waste landfill consistent with environmental regulations applicable at that time. The West SPL Storage Area contains SPL under an engineered cap that consists of a soil cover, 30-mil PVC liner, sand layer, and riprap for erosion control. The SPL waste is also located on a concrete pad.

5.1.13 North SPL Storage Containment Building (SWMU 14)

The North SPL Storage Building is located at the northeastern end of the former production area (Figure 3-1). The North Storage Building was placed in service in 1987 and was used for the storage and handling of SPL. The building's floor was originally constructed to include a compacted gravel base material, 30 mil PVC liner, sand layer, and 6-inch, reinforced concrete slab (Golder 1995, ENSR 1991).

The building was full of SPL by 1988 and sealed shut (Ecology 2014, ENSR 1991). SPL was removed from the North SPL Storage Building in mid-1995 for off-site disposal pending the outcome of federal and state land disposal restriction regulations for SPL. The North SPL Storage Building was upgraded in 1996 to meet the requirements of 40 CFR 24.1101 and became certified as a Containment Building (Golder 1996c, Ecology 1997).

The North SPL Storage Building was cleaned and inspected prior to the upgrade (Golder 1996b,c) and the following conditions were noted: wet areas at the base of the concrete walls on the north and west sides and in the interior of the building, extensive cracks and jointing in the concrete slab and perimeter concrete wall, concrete slab height 1 to 2 feet lower than the surrounding grade, and gaps between the aluminum sheeting and concrete wall (Golder 1996b). The following modifications and evaluations were made at the North SPL Containment Building (Golder 1996c) including: assessment of slab structural integrity, sealing of floor slab joints and cracks, sealing of holes in the walls and roof, modification in operational procedures for storage and equipment staging/decontamination, installation of outer and inner doors, and exterior drainage improvements.

The upgraded North SPL Containment Building was operated from 1996 until the plant ceased operations in 2003 and was closed under RCRA during 2008 and 2009 (Ecology 2009, CH2MHill 2009). During closure sampling, total cyanide and free cyanide were not detected in the four surface soil samples collected from the outside of the building and adjacent to the building walls. Total fluoride was detected in the soil samples at concentrations ranging between 805 mg/kg and 12,000 mg/kg and water-soluble fluoride as determined through SPLP analyses was detected at concentrations ranging between 4.96 milligrams per liter (mg/L) and 30 mg/L. The maximum total fluoride concentrations exceed the current MTCA Method B soil formula value of 3,200 mg/kg. The SPLP leachate concentrations exceed the groundwater MCL for fluoride of 4.0 mg/L. Six samples were collected during closure from the sand layer below the concrete flooring and above the PVC liner. Total cyanide exceeded the screening level (in use at that time) in one sample (35.5 mg/kg), and low levels of free cyanide (0.44 mg/kg) were also detected in this same sample. Total fluoride concentrations in the sand layer varied from 506 to 2,890 mg/kg and water-soluble fluoride concentrations as measured through SPLP analyses ranged from 0.264 mg/L to 19 mg/L.

5.1.13.1 Investigation Objectives

Data gaps and data needs identified in the Phase 1 Work Plan include:

- Current chemical concentrations of COPC in soil.
- Collection of subsurface soil samples beneath the liner.

The objectives of the RI field investigation at the North SPL Storage Area is to characterize current chemical concentrations in soils both outside and within the building footprint. Within the building, the objective is to characterize soil chemical concentrations below the liner.

5.1.13.2 Investigation Scope

Eight borings will be drilled using hollow-stem auger or direct-push drilling techniques to investigate current COPC concentrations in soil at this SWMU (refer to Figure 5.1.13-1). Each boring will be drilled to a maximum depth of 10 feet bgs, or the bedrock contact, whichever is shallower. Four of the borings (SB1 through SB4) will be drilled within the building. The targeted vertical interval for the initial samples is immediately below the PVC liner. Additional samples will be collected at 2 feet below the initial sample and at the base of the boring. Based on the plans in the RCRA Part B Permit Application (Goldendale Aluminum Company 1997) for the SPL Handling Containment Building, the concrete is 6-inches thick and the underlying sand layer is about 3-inches thick with the sand layer underlain by the PVC liner. It is assumed that the construction at the other SPL buildings is similar. If the liner is not found within 3 feet of the base of the concrete and/or no sand layer is found, the liner will be assumed to be absent and a soil sample will be collected from 2 to 3 feet below the concrete.

In addition, four borings (SB5 through SB8) will be drilled outside the building (one per side) and one sample will be collected from each boring. The SB5 through SB8 borings will be drilled to the basalt bedrock contact or a maximum depth of 10 feet bgs, whichever is shallower. One soil sample

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\Phase2_RI_WP\Figure_5.1.13-1_SWMU_14.mxd

Legend

- Proposed Soil Boring Location
- Proposed Shallow Well

N
W E
S

0 25 50 100
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.13-1
North SPL Storage Containment Building
SWMU 14
Soil Boring Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

will be collected for chemical analyses from each boring from 0.5 feet bgs, 2 feet bgs, and the bottom of the boring. The soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate.

A monitoring well (RI-MW7-BAU) will be installed on the southwest (downgradient) near the southwest corner of the building to characterize water quality and groundwater flow in this area as part of the Groundwater in the Uppermost Aquifer AOC investigation. A soil sample will be collected from the well boring based on field observations and field screening, and analyzed for the same suite of chemical analyses. Refer to Section 5.2.2 for additional information regarding the proposed groundwater investigation activities.

5.1.14 South SPL Storage Building (SWMU 15)

The South SPL Storage Building was constructed in 1988 and is located south of the Cast House (Figure 3-1). The building's floor was reportedly originally constructed with a compacted gravel base material, 60-mil PVC liner, sand layer, and reinforced 6-inch concrete slab (Golder 1995, Goldendale Aluminum Company 1997). All SPL was removed from the buildings and shipped to Chemical Waste Management's hazardous waste landfill in Arlington Oregon in 1994 and 1995 and the South SPL Storage Building and South SPL Building Annex were clean closed under RCRA in 1996 (Golder 1996a).

The South Annex Building was constructed in 1991 and was put into service in 1992. The South Annex was co-located with the South SPL Containment Building and was created by extending the foundation walls of the original building about 100 feet to the west (Golder 1995, Goldendale Aluminum Company 1997).

Soil samples collected from the south and east side of the building during 1996 closure activities contained relatively low levels of total cyanide (maximum of 7.2 mg/kg) and total fluoride (maximum of 1,030 mg/kg) that were below the screening levels in the closure plan. Sand layer samples collected from below the concrete slab contained low concentrations of total cyanide (maximum of 1.94 mg/kg) and total fluoride (maximum of 750 mg/kg) at concentrations below screening levels.

5.1.14.1 Investigation Objectives

RI Data gaps and data needs as identified in the Phase 1 Work Plan include the following:

- Current chemical characterization of COPC in site soil.
- Verification of the presence and condition of the PVC liner with potential soil sampling based on findings.

The objective of the RI field investigation at the South SPL Storage Building is to characterize soil chemical concentrations within the building footprint and beneath the liner.

5.1.14.2 Investigation Scope

Four borings (SB1 through SB4) will be drilled within the building using hollow-stem auger or direct-push drilling techniques to a maximum depth of 10 feet bgs to investigate current COPC concentrations for subsurface soil beneath the liner at this SWMU (refer to Figure 5.1.14-1). One sample will be collected from each of these borings. The targeted vertical interval for the samples is immediately below the PVC liner, 2 feet below the liner, and the base of the boring, similar to the North SPL Storage Area (SWMU 14). The soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate.

Legend

- - - - - Approximate SWMU Area

● Proposed Soil Boring Location

N
W E
S

0 25 50 100

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.14-1

South SPL Storage Building

SWMU 15

Soil Boring Location Map

Columbia Gorge Aluminum Smelter Site

Goldendale, Washington

5.1.15 SPL Handling Containment Building (SWMU 16)

As discussed in the Phase 1 Work Plan, no RI data needs have been identified for the SPL Handling Containment Building (SWMU 16) and no further investigation is planned.

A brief description of this SWMU is provided for context and convenience. The SPL Handling Containment Building (SWMU 16) was constructed in 1990 and was used to demolish failed cathode shells. The building was equipped with a concrete floor slab that is underlain with a PVC secondary containment liner and 5-foot high concrete perimeter walls. All SPL was removed from the building in 2010-2011 and the unit was clean closed under RCRA during 2011 with a detailed soil sampling program. The building has been demolished and concrete rubble has been stored at the locations of the former foundation.

5.1.16 East End Landfill (SWMU 17)

The East End Landfill (EELF) represents an unlined landfill located southeast of the Paste Plant that was operated from 1971 to 1982. According to the Agreed Order, material disposed of in the EELF reportedly included wood, demolition waste, carbon waste, contaminated alumina, and general trash. An engineering drawing of paving and roads (Harvey Aluminum 1971b, Drawing A01099 Revision 3) shows that SPL storage may have occurred at the EELF, although SPL has not been found during past environmental investigations.

The EELF was investigated in 1991 as a test pit investigation (Technico Environmental Services 1991a) and in 2008 (URS 2008a) as a draft RI/FS. The RI/FS included excavation of 19 test pits, installation of 5 soil borings and installation of 4 monitoring wells. Landfill waste ranged in thickness from 2 to 19 feet and was encountered in the majority of the test pits at the site. The volume of landfill waste was estimated to be 35,380 cubic yards. Waste material encountered during the RI/FS consisted of construction debris (metal pipes, fiberglass siding, brick, plastic sheeting, asphalt, and concrete), smelter wastes (reportedly carbon briquettes), potential asbestos-containing material (siding, insulation), crushed metal drums, tires, and both gray and black fine-grained material that comprised about 60 to 70 percent of the waste encountered. The 2008 RI/FS report states that the gray waste material may be cryolite bath material and the black waste material may be carbon waste material (URS 2008a). Remedial excavation and disposal was identified as the preferred remedial alternative in the draft RI/FS.

5.1.16.1 Investigation Objectives

The Phase 1 Work Plan identified additional soil and landfill waste characterization and refinement of contaminated material volumes as data needs. Groundwater data needs for this area will be addressed as part of the Groundwater in the Uppermost Aquifer AOC (refer to Section 5.2.2). The objectives of the RI field investigation are to determine: 1) the rough amount of listed K088 spent potliner waste at the EELF Area as well as other state and federal hazardous waste, and 2) the extent of COPC in site soils that underlie the wastes. These objectives will be accomplished through implementation of a test pit sampling program and associated waste and soil sampling.

5.1.16.2 Investigation Scope

This section summarizes the waste sampling and soil sampling programs for the EELF.

<u>EELF Waste Sampling</u>

The EELF is one of two SWMUs with RI data needs where there is a reasonable likelihood of encountering SPL, a listed hazardous waste, as well as other aluminum process wastes that include anode or other carbon wastes, cryolite, and alumina waste, and potential scrubber sludges. The other SWMU where significant amounts of aluminum process waste is expected to be encountered is Smelter Sign Area (SWMU 31) [that includes the Smelter Sign Area proper as well as the area North of the East Surface Impoundment (NESI)]. For this reason, a waste recognition, categorization, and sampling approach has been developed for these two SWMUs. The technical memorandum regarding definition and recognition of SPL wastes (Appendix D) will be used to help confirm the presence and/or absence of SPL (K088) wastes and to roughly estimate the quantity of SPL waste, if any.

Test pit excavations will be used to qualitatively determine the type of wastes present in particular areas and to determine the lateral extent of wastes. The physical characteristics of encountered waste materials will be described and these observations will be used to categorize the wastes. The field observations, physical characteristics, and the waste categories that will be identified in the field are described in Section 5.3.7. The highest priority is to identify probable spent potliner waste using the protocols in Appendix D. Other types of aluminum process wastes may also be sampled if they are found in significant quantities including anode wastes or other carbon wastes (particularly if they are mixed in with suspected potliners), cryolite and alumina waste, and potential scrubber sludges. All excavations will be backfilled with the excavated materials and compacted and graded using the excavator.

The location of the test pits was based on field observations of waste and debris at the ground surface and review of historical aerial photographs. A total of eight test pits are included in the EELF Area as shown in Figure 5.1.16-1. Up to four additional test pits may be installed depending on the results of the eight test pits.

Legend

- Proposed Test Pit Location
- Historic Test Pit
- Monitoring Well
- Drainage Line From Plant Plans
- Slope Break From Plant Plans
- Investigation Area
- Intial Briquette Storage (1972 Photo)
- Expanded Briquette Storage (2006 Photo)

N
W E
S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.1.16-1
Test Pit Location Map
East End Landfill Area
SWMU 17

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The investigation area shown in Figure 5.1.16-1 was determined based on the following: 1) review of historical aerial photographs, 2) review of the limits of the landfill and excavation locations as presented in the RI/FS (URS 2008a), 3) review of site plans that show a slope break and drain line that likely delineates the northern and eastern extent of the landfill, and 4) information obtained during the site reconnaissance. Figure 5.1.16-1 shows the landfill boundaries based on the RI/FS and historical aerials. Excavation and monitoring well locations based on the URS (2008) RI/FS survey data are also included. The slope break and drainage line shown on the engineering facility engineering plans were approximately placed to help refine the extent of the EELF. In addition, the extent of the Briquette Storage Area as outlined from the 1972 and 2006 aerial photos is superimposed to define the portion of the EELF that may be present below the concrete slab of the briquette storage area.

Representative waste samples will be collected from test pit excavations with significant (greater than 5-10 cubic yards as estimated from field observations) amounts of waste and temporarily archived in a cooler under proper chain-of-custody. The waste samples that will be submitted for chemical analyses will be selected near the end of characterization activities at the EELF Area.

Two to three suspected bulk SPL waste samples will be submitted for chemical analyses if suspected SPL waste is found. The suspected SPL profiling analytical program includes the following suite of analyses: PAHs, total cyanide, weak acid dissociable (WAD) cyanide, fluoride, fluoride by Synthetic Precipitation Leaching Procedure (SPLP), metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, aluminum (total), sodium, alumina, calcium, magnesium, lithium, phosphorus, silica (as silicon), manganese, and carbon (total). These chemical data will be used to supplement the identification of SPL as that waste determination depends primarily on process knowledge and field identification.

Other bulk carbon wastes associated with the spent potliners (e.g., anode wastes) that do not likely represent spent potliner materials based on the field observations will be analyzed for a more limited suite of analyses to confirm the field identification approach, and to characterize the wastes. The analytical program for the carbon wastes that are likely non-SPL includes: total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals, and sodium. Interviews with facility personnel and chemical data for spent SPL show that spent potliners are significantly enriched in sodium and fluoride (Tschope, K., et al. 2009) compared to other carbon wastes that are similar in appearance and for this reason, sodium and fluoride represent key parameters in distinguishing the wastes. Two to three suspected non-SPL carbon samples will be submitted for chemical analyses. These samples will be paired (collected from adjacent areas) with the suspected SPL samples.

Some aluminum wastes (scrubber sludges, anode waste, pitch and briquettes) contain elevated concentrations of PAHs. In Washington, wastes that contain greater than 1 percent PAHs represent Extremely Dangerous Wastes [refer to WAC 173-303-100(6)] based on their persistence. These wastes may present potential risks to human health and the environment at concentrations significantly lower than one percent if they were transported or leached into environmental media such as soil, sediment, or groundwater. For these reasons, if significant quantities of suspected PAH-containing wastes are found, representative samples will be collected and analyzed for PAHs. Two to three samples will include PAH analyses. The samples will be collected if significant amounts of carbon containing wastes (e.g., potential scrubber sludges, anode wastes, pitch or coke, or other mixed carbon wastes) are found.

Fluoride is included in the spent potliner profiling analyses and non-SPL profiling analyses. These analyses will include both total fluoride and SPLP for fluoride. A representative sample of suspected cryolite bath materials will be analyzed for fluoride if significant quantities are found.

EELF Soil Sampling

Test pit excavations will be installed to determine the vertical extent of wastes, and to provide characterization of the vertical extent of contamination in soil below the waste. Each test pit will extend to a depth of three feet below encountered waste unless bedrock is encountered. The maximum depth of characterization will be about 15 bgs based on the reach of the excavator.

Soil samples will be collected to determine the extent of contamination in soils that underlie the waste. Two vertical sample intervals will be selected for analysis: 1-foot and 3-feet below the waste. The vertical interval and number of soil samples may be varied, depending on site-specific considerations. For example, if only one to two feet of soil is found below the waste before bedrock is encountered, the vertical sampling interval may be shortened or only one soil sample may be collected.

Eight soil sampling stations (16 samples) will be selected from the test pit excavations made at the site. Table 5.1.16-1 provides a sampling summary for the EELF Area, including number of samples for the various media. The soil samples will be analyzed for an expanded suite of analyses for aluminum sites including: PAHs, total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, TPH-Dx, TPH-Gx, PCBs, VOCs, and asbestos.

Logging of wastes in test pits and trenches will be performed consistent with the procedures presented in Section 5.3.7.

Table 5.1.16-1
Field Investigation and Analytical Summary for the East End Landfill Area, Goldendale, Washington

Test Pits[a]	Samples	Sampling Suite	Laboratory Analyses	Rationale
8	**16 Soil Samples**	Expanded	PAHs Total Cyanide WAD Cyanide Fluoride Metals Sulfate TPH-Dx TPH-Gx PCBs VOCs Asbestos	Characterization of the nature and extent of soil contamination beneath waste areas
	If suspected SPL encountered: up to 3 SPL bulk waste samples	Suspected SPL Profiling	Total Cyanide WAD Cyanide Fluoride Fluoride-SPLP Metals Sulfate Aluminum (T) Sodium Alumina Calcium Magnesium Lithium Phosphorus Silica (as silicon) Manganese Carbon (T) Iron Oxide (as Iron) by X-ray Diffraction Sulfur	Waste profiling; evaluation and confirmation of potential SPL wastes
	If suspected SPL wastes encountered, up to 3 samples of associated carbon wastes (anode wastes) that likely do not represent SPL. Samples will be paired with suspected SPL waste samples	Non-SPL Determination	Total Cyanide WAD Cyanide Fluoride Soluble Fluoride-SPLP Metals Sodium	Waste profiling; evaluation and verification of non-SPL carbon wastes
	Up to 3 waste samples	PAH profiling	PAHs	Waste profiling, evaluation of Washington EHW designation for PAH-containing wastes
	Up to 1 waste sample of suspected cryolite/alumina waste	Fluoride sampling	Fluoride Soluble Fluoride-SPLP	Characterization of fluoride concentrations; evaluation of protection of groundwater

a Up to 4 additional Test Pits may be installed based on field observations.

Notes:

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals analyses include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

IDW Investigation-derived waste
NA Not applicable
PAHs Polycyclic aromatic hydrocarbons
PCBs Polychlorinated biphenyls
SPL Spent potliner
SPLP Synthetic Precipitation Leaching Procedure
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
TPH-Gx Gasoline-range petroleum hydrocarbons
VOCs Volatile organic compounds
WAD Weak-acid dissociable

5.1.17 West End Landfill (SWMU 18)

No data needs were identified in the Phase 1 Work Plan for the WELF (SWMU 18) other than for groundwater monitoring and characterization that have been addressed as part of the Groundwater in the Uppermost Aquifer AOC investigation in Section 5.2.2.

A brief description of the WELF is provided for context and convenience. The WELF is an unlined landfill located west of the main parking area for the smelter, and was used between 1982 and 1987. The site was closed by covering it with native soil. The landfill reportedly received smelter wastes with the exception of SPL, waste oil, and spent solvents. The West Landfill reportedly contains wood, demolition waste, carbon waste, contaminated alumina, asbestos, and general trash. An independent soil and groundwater RI/FS was performed in 2008 (URS 2008f). A 100 percent design for engineered landfill cap was completed during 2011 (Tetra Tech 2012). As part of the landfill cap design project, a draft cleanup action plan was also prepared (Tetra Tech 2010).

5.1.18 Plant Construction Landfill (SWMU 19)

The Plant Construction Landfill was reportedly created during construction of the smelter in 1969-1970 where rock and general debris was disposed of in the flat and open area west of the Rectifier and east of the WSI (Ecology 2014, Parametrix 2004a).

A geotechnical investigation was performed in 2001 and included 19 borings (one completed as a piezometer [B11], 4 backhoe test pits, geotechnical testing of soils, and a geophysical survey (Fujitani Hilts & Associates 2001). No environmental samples were collected during the 2001 geotechnical investigation. The geotechnical investigation identified a fill unit consisting of fine to coarse gravel rock fragments with silty sand that ranges in thickness from 3 to 22 feet. The presence of man-made debris/landfill materials was not noted in the logs for the borings and test pits. The fill unit is underlain by flood deposits consisting of stratified sand and silty sand, and basalt bedrock. Groundwater was typically encountered at a depth of about 20 feet bgs.

5.1.18.1 Investigation Objectives

The Phase 1 Work Plan identified collection of surface and subsurface soil chemical data as a data need given the size, lack of documentation, and likely future development of this area. The RI investigation objective is to characterize current soil chemical concentrations.

5.1.18.2 Investigation Scope

Eight borings are proposed for SWMU 21 to characterize chemical concentrations in the fill material present in this area (Figure 5.1.18-1). A surface soil sample will be collected at each boring location. Each boring will be drilled using a hollow-stem auger to a maximum depth of the base of the fill, shallow groundwater, refusal, or 25 feet bgs, whichever is shallowest. Soil samples will be collected at 5-foot intervals with a split-spoon sampler and examined for visual or olfactory evidence of contamination and field screened using a photoionization detector (PID). Based on field observations and PID field screening, the suspected most contaminated interval from each boring will be submitted for laboratory analyses. The analytical program for surface and subsurface soil samples includes: PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, and diesel- and oil-range petroleum hydrocarbons (TPH-Dx). If no contamination is suspected, a representative sample of fill material will be collected from each boring. VOCs and gasoline-range petroleum hydrocarbons (TPH-Gx) will be added to the analytical program as warranted, if field observations and headspace field screening indicate potential VOC or gasoline contamination.

Legend

- - - - - Approximate Location Boundary

● Boring Location

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.1.18-1
Plant Construction Landfill
SWMU 19
Soil Boring Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.19 Drum Storage Area (SWMU 20)

No RI data needs have been identified as summarized in the Phase 1 Work Plan, and no further investigation is proposed. The appropriateness of industrial cleanup levels based on future land use considerations will be further evaluated during preparation of the RI/FS.

The following description of this SWMU is provided for context and convenience. The Drum Storage area represents a concrete pad located on the hillside northeast of the WSI was used as a drum staging area between 1971 and 1987 (URS 2008d). This SWMU was characterized as part of an independent cleanup action during 2008 (URS 2008d). Diesel and oil-range petroleum hydrocarbons were detected in 9 of 10 soil samples, but at concentrations below the MTCA Method A Cleanup Level of 2,000 mg/kg. PAHs were detected, but at concentrations below the MTCA Method C Cleanup Level of 18 mg/kg (cPAH TTEC). Detected concentrations of metals were below MTCA Method C Cleanup Levels. PCBs and VOCs were not detected with the exception of naphthalene at a low concentration in one sample.

5.1.20 Construction Rubble Storage Area (SWMU 21)

The Agreed Order states that construction rubble was disposed of in an area west of the Drum Storage Area (SWMU 20) following closure of the West End Landfill in 1987, and that this area was active until the smelter closed. No environmental chemical data have been previously collected from this area.

5.1.20.1 Investigation Objectives

Characterization of chemical concentrations of soils in the Construction Rubble Area was a data need identified in the Phase 1 Work Plan. The RI investigation objective is to characterize chemical concentrations in the fill at this SWMU.

While this SWMU also includes recently generated concrete debris from plant demolition, the chemical concentrations of the concrete rubble have been characterized (PGG 2012c, 2014). Further evaluation of potential reuse of the crushed concrete material stored onsite represents a data need for the overall project, but does not represent an RI data need.

5.1.20.2 Investigation Scope

Two borings are proposed for SWMU 21 to characterize chemical concentrations in the fill material present in this area (Figure 5.1.20-1). It is anticipated that the fill material in this area will consist of gravel-sized concrete and sandy or silty soil that can be penetrated using hollow-stem auger drilling techniques proposed for this investigation. If this proves unfeasible based on observations during an initial site visit, test pits will be excavated.

Each boring will be drilled using a hollow-stem auger to a maximum depth of the base of the fill, shallow groundwater, refusal, or 20 feet bgs, whichever is shallowest. Soil samples will be collected at 5-foot intervals with a split-spoon sampler and examined for visual or olfactory evidence of contamination and field screened using a PID. Based on field observations and PID field screening, the suspected most contaminated interval from each boring will be submitted for laboratory analyses will be submitted for chemical analyses including: PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Ni, Se, and Zn), sulfate, and TPH-Dx. If no contamination is suspected a representative sample of fill material will be collected. VOCs and TPH-Gx will be added to the analytical program as warranted, if field observations and headspace field screening indicate potential VOC or gasoline contamination.

Legend

- - - - - Approximate Location Boundary

● Boring Location

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N W E S

0 125 250 500
Feet

Figure 5.1.20-1
Construction Rubble Storage Area
SWMU 21
Soil Boring Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.21 Wood Pallet Storage Area (SWMU 22)

According to the Agreed Order, following closure of the West End Landfill in 1987, wood waste was transported to a storage and burning area northeast of the smelter and north of the Rectifier Yard. The excess wood at the site was burned periodically at this location under a permit from the county fire department (Ecology 2014). A debris pile with burn residue was observed during a site visit in March 2012. Debris included wood, plastic, metal, and coated and uncoated wires. Based on review of a recent aerial photograph, the dimension of the waste pile are about 75 feet by 100 feet. Based on 2012 photographs, the waste pile was about 4 to 6 feet high.

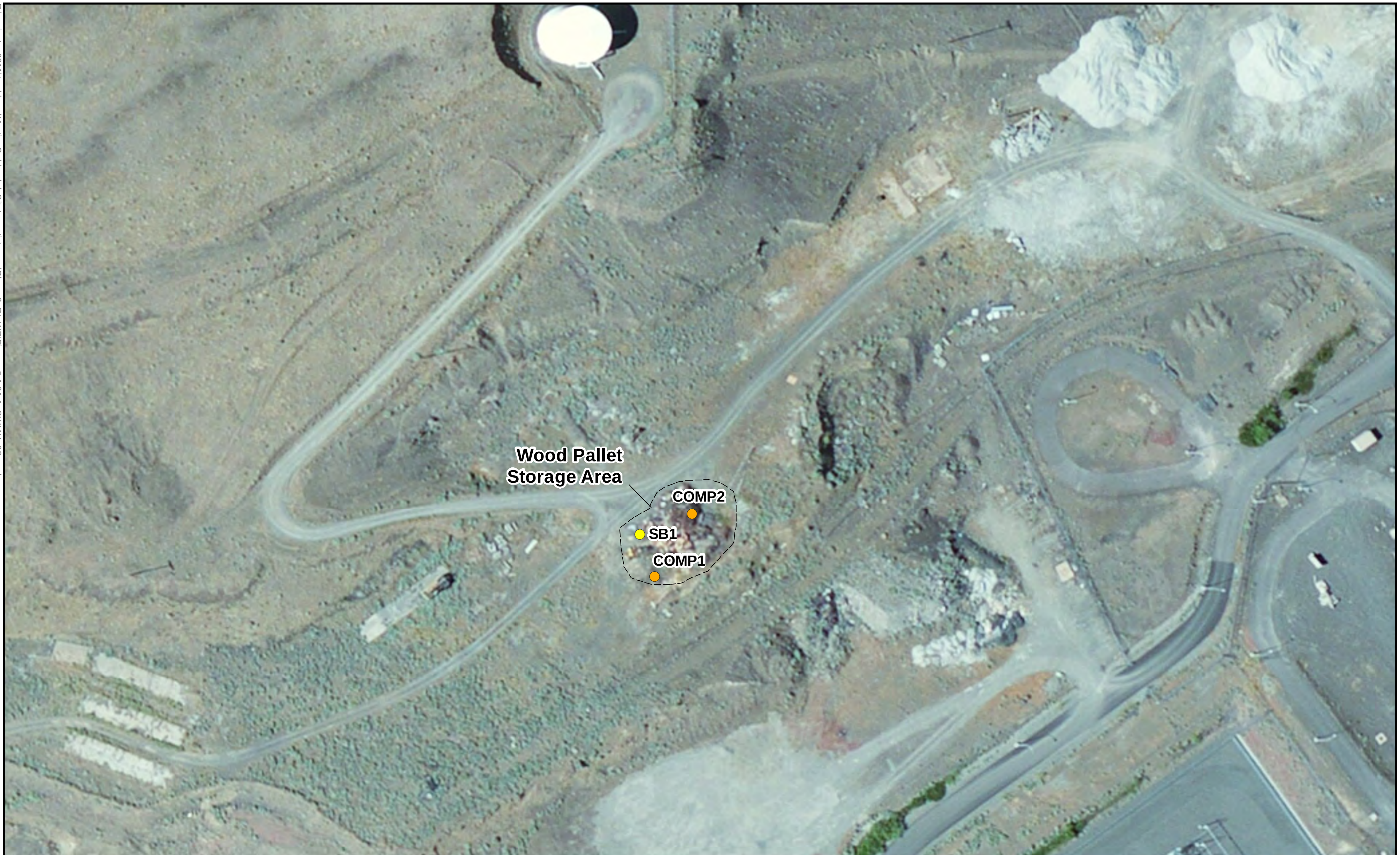
5.1.21.1 Investigation Objectives

Due to the presence of materials other than wood in the pile, a data need and investigation objective is to characterize and profile the wastes prior to excavation and proper off-site disposal. A second objective is to characterize chemical concentrations in the soils below the waste.

5.1.21.2 Investigation Scope

The volume of the waste pile, metal debris, wood debris, other trash, and burn residue will be estimated by the field crew. The presence and estimated quantities of suspected aluminum process wastes, drums, and miscellaneous containers that hold chemicals will also be documented by the field team, if any are found.

Two 5-point composite samples will be collected from the waste pile: one from the eastern half and one from the western half (refer to Figure 5.1.21-1). A boring will be drilled using a hollow stem auger to characterize chemical concentrations in the soils in the waste pile footprint. The boring will be installed to a maximum depth of 10 feet bgs or to bedrock contact, whichever is shallower. Soil samples will be collected at the ground surface, 2 feet bgs, and the base of the boring. The soil and waste samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, and TPH-Dx. The shallowest sample collected from the soil boring will also be analyzed for dioxins/furans due to potential historical site burning practices.



Legend

- Proposed Soil Boring Location
- Waste Composite Sample Location
- Wood Pallet Storage Area

N
W E
S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.21-1
Wood Pallet Storage Area
Sample Locations
SWMU 22

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.22 Reduction Cell Skirt Storage Area (SWMU 23)

The Agreed Order states that an area between Line D and the Drum Storage Area (SWMU 20) was used for the storage of failed skirts from the reduction cells from 1988 to 1995. The steel skirts reportedly had soil bath (cryolite salts) attached to the steel skirts and the skirts were stored in the area until the steel was recycled off-site. According to the Agreed Order, the skirts and residual bath material in soils were removed in 1995. After 1995, the skirts were stored on a concrete pad next to the Paste Plant before recycling. The 2004 RCRA Part B Permit Application states that the unit was "clean closed" (Parametrix 2004a), however, no documentation has been found of Ecology or other regulatory agency approval of the closure activities.

5.1.22.1 Investigation Objective

Current concentrations of COPC in soils represent a data gap and investigation objective for SWMU 23.

5.1.22.2 Investigation Scope

Three borings are proposed to be drilled using hollow-stem or direct push drilling techniques to characterize COPC concentrations at this SWMU. Figure 5.1.22-1 shows the former location of the Reduction Cell Skirt Storage are and the proposed soil boring locations. The location of the Reduction Cell Skirt Storage Area is based on review of historical aerial photographs for the 1988-1995 period.

Each soil boring will be drilled and sampled continuously to a maximum depth of 10 feet bgs, or bedrock, whichever is shallower. Three soil samples per boring will be collected at 0.5 feet bgs, 2 feet bgs, and at the bottom of the boring. The nine samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, and TPH-Dx.

Legend

- - - - - Approximate SWMU Area

● Soil Boring Location

N
W E
S

0 50 100 200

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.22-1
Reduction Cell Skirt Storage Area
SWMU 23
Soil Boring Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

5.1.23 Carbon Waste Roll-Off Area (SWMU 24)

Because the Carbon Waste Roll-Off Area does not have a specific operational footprint, it will be investigated as part of the Plant Area AOC as part of the proposed Courtyards sampling efforts. A discussion of the scope of investigation for SWMU 24 is presented in Section 5.2.5.3.

A brief description of this SWMU is provided for context and convenience. According to the Agreed Order, in 1987, a 20-cubic yard roll-off bin located between the pot rooms was used to collect, store, and transport various solid wastes prior to offsite disposal. Wastes managed in this area included: fume system carbon, waste briquettes, production room floor sweepings, silo top paste and wastes stud hole paste. Carbon waste was collected and stored onsite, prior to offsite disposal, in 20-yard roll-off bins. Roll-off bins were located in several areas throughout the site inside the Production Buildings and in the courtyards between buildings, notably south of Production Building A at its eastern end. The Carbon Waste Roll-Off Bin was shown on historical SWMU maps as located on the south side of Production Building A. Characterization data for soil have been collected from the Courtyards (PGG 2010) and show PAH concentrations above MTCA Method C screening levels in some areas.

5.1.24 Solid Waste Collection Bin and Dumpsters (SWMU 25)

No RI data needs have been identified for the Solid Waste Collection Bin and Dumpsters (SWMU 25) and no further SWMU-specific investigation is proposed. Characterization of current soil COPC concentrations in the Courtyards and other areas of the former plant represents a data gap and data need that will be addressed as part of the Plant Area AOC as described in Section 5.2.5.5.

A brief description of this SWMU is provided context and convenience. Miscellaneous, non-hazardous solid waste was placed in small dumpsters or roll-off bins at various collection points throughout the production area. Wastes reportedly included: transite, empty cans, floor sweepings, PVC/glass pipe, and secondary treatment plant screen wastes. The specific locations of the collection points are unclear and appear to have changed during the history of operations. One location at the east end of Production Building A was noted in a 1990 inspection conducted by Ecology (Ecology 1990a).

5.1.25 HEAF Filter Roll-Off Bin (SWMU 26)

No environmental investigations have been performed of the HEAF Filter Roll-Off Bin. The likelihood of release is low based on the period and nature of this storage operation. Because SWMU 26 does not have a clearly defined ground footprint, it will be investigated as part of the Plant Area AOC. A discussion of the scope of investigation for SWMU 26 is presented in Section 5.2.5.4 as part of the investigation of carbon handling, manufacturing, and storage features.

A brief description of this SWMU is provided for context and convenience. The HEAF system air emission control system for the Paste Plant used fabric filters in its process. Particulates containing high concentrations of PAHs were removed from the off gases into fabric filters during HEAF system operations. Spent filters were collected in a 20-yard roll-off bin prior to offsite disposal. The Paste Plant emission control system was converted from a wet scrubber to a dry HEAF system in 1990. The HEAF filter roll-off bin was located east and north of the Paste Plant near the northern end of the briquette storage slab.

5.1.26 Tire and Wheel Storage Area (SWMU 27)

No RI data needs have been identified for the Tire and Wheel Storage Area (SWMU 27) and no further investigation is proposed.

A brief description of this SWMU is provided for context and convenience. Worn out rubber tires and steel wheels were stored on a concrete pad from 1987 to 1994 when the area was consumed by a brush fire. This SWMU appears to physically overlap with the Drum Storage Area (SWMU 20). The concrete slabs are still present. This area was characterized as part of an independent cleanup action at the Drum Storage Area (SWMU 20) during 2008 (URS 2008d). The Tire and Wheel Storage Area was reportedly cleaned up following a grass fire that consumed the tires and wheels stored in this area.

Ecology (2015b) comments on the Draft Phase 1 Work Plan noted with respect to the Tire and Wheel Storage Areas that during a tire fire, pyrolitic oil can form and flow if sufficient gradient is present. The Ecology (2015b) comments requested whether the cleanup included any pyrolitic oil that may have formed. Interviews with remaining former plant employees indicate that a tire fire occurred in 1994 as a result of sparking from railroad traffic. At that time, about 20 tires were present and half or fewer of the tires caught fire. The local fire department was called in to assist in putting out the fire and subsequently the local Les Schwab removed all tires for recycling. No indications of residue oils were observed the next day after cleanup.

5.1.27 90-Day Drum Storage Area (SWMU 28)

No RI data needs have been identified at 90-Day Drum Storage Area (SWMU 28) and no further investigation is proposed.

A brief description of this SWMU is provided for context and convenience. After the original Drum Storage Area was closed under RCRA in 1987, the 90-Day Drum Storage Area was established at the west of the A-room/line near the Capacitor Yard. Both RCRA and non-RCRA wastes were reportedly stored in this area. In 1990, a metal building was constructed over a concrete pad and a 6-inch concrete berm was added to the perimeter of the concrete pad for spill containment. An epoxy was applied to the concrete pad to seal any cracks. According to the Agreed Order, the design and operation of this unit together with the frequent inspections, makes it unlikely that there was a release of hazardous or toxics constituents from this building to the environment. The relatively recent period of operations with associated regulatory oversight, and the documented general lack of soil contamination at the Drum Storage Area (SWMU 20) (URS 2008d) that represents an older and similar waste management unit at the site also suggest a low likelihood of a release.

5.1.28 Caustic Spill (SWMU 29)

A caustic spill associated with operations of the Line A Secondary Scrubber Recycle System (SWMU 5) occurred in late 1990 (Ecology 1990b,c). The spill occurred in an area north of the railway lines and south of the two fixed above-ground NaOH storage tanks (capacities of 30,000 and 60,000 gallons) that were located near the southern wall of SWMU 29 (Figure 5.1.28-1).

Approximately 5,000 gallons of 20 percent NaOH, originating from a transfer of liquid between the tanks, was spilled on the ground. Reportedly, other smaller spills had occurred previously in this area. Spill response included flushing liquid to the nearest storm drain while the NPDES system was monitored. NPDES limits were not exceeded. Some soil with elevated pH was removed and the area was repaved.

5.1.28.1 Investigation Objectives

Data needs and data gaps for Caustic Spill (SWMU 29) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps for SWMU 29:

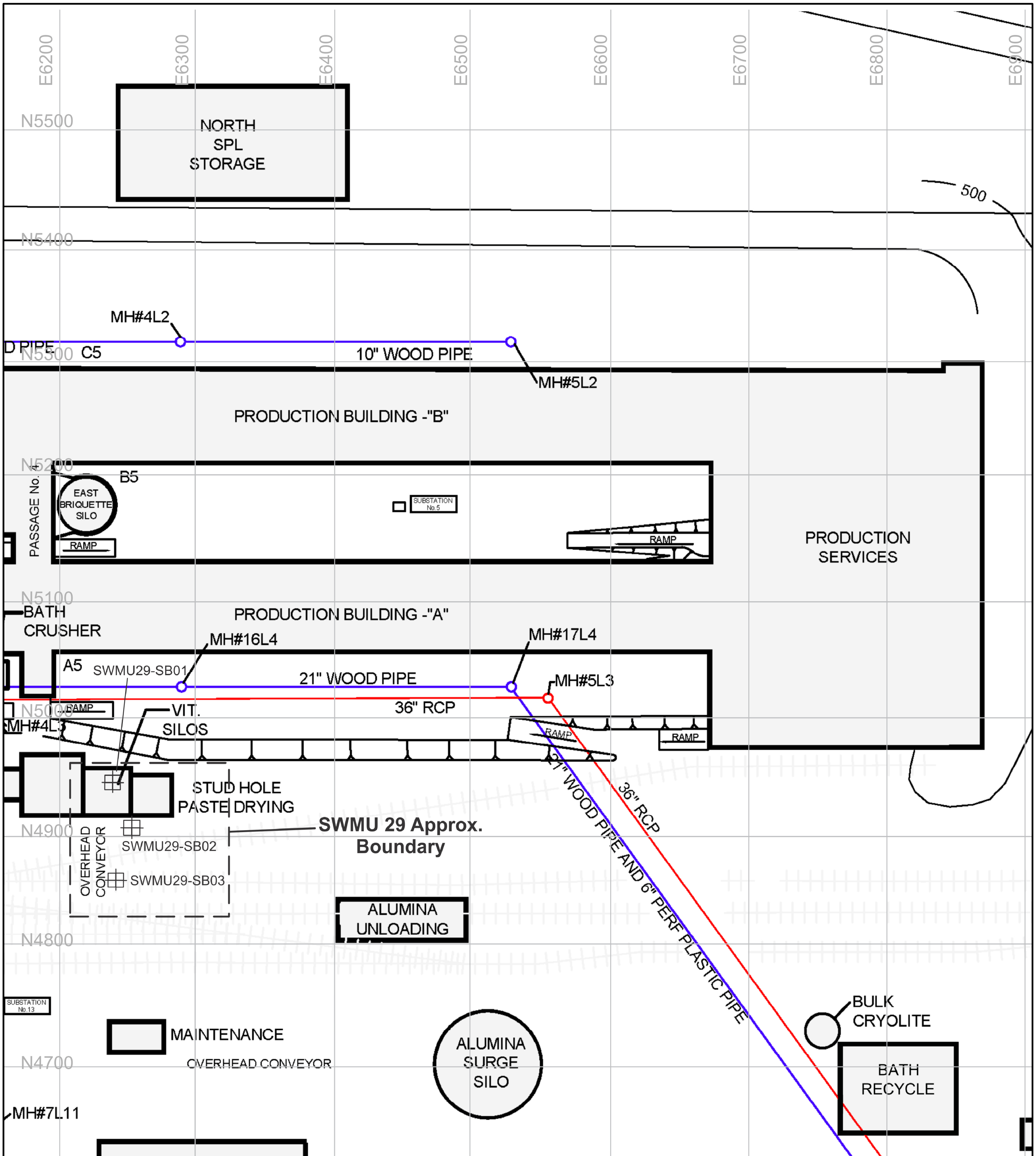
- Characterize COPC in soil.
- Determine whether a release from SWMU 29 has occurred.

5.1.28.2 Investigation Scope

The perimeter of the spill does not appear to have been well documented. Ecology noted during their 1990 inspection that groundwater may have been impacted by the spill (Ecology 1990b).

The Caustic Spill will be investigated with three soil borings located within the caustic spill area (Figure 5.1.28-1). The borings will be completed to a maximum depth of 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and pH, as summarized in Table 5.1.28-1.

One shallow temporary well (RI-GW3) will be installed in the area of the Caustic Spill as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2). The temporary well will be used to assess whether a release to groundwater has occurred, and to help evaluate the nature and extent of shallow groundwater contamination in this area.



Legend

Soil Boring
SWMU29-SB01

Industrial Drain Lines

Scrubber Effluent Lines

Source: Modified from CDMSmith 2011

Please see Figure 5.2.5-6 for adjacent sample locations near SWMU 29.

W N S E

0 50 100
Feet

Figure 5.1.28-1

Sample Locations for SWMU 29

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table 5.1.28-1
Summary of Sampling for SWMU 29 Caustic Spill

SWMU 29 Caustic Spill						
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Sample Type**	**Analytes**	**Sample Rationale**
Soil Borings (3)	Surface Soil	3	0.5 feet bgs	Discrete	Metals, pH	Characterize COPC in soil.
	Subsurface Soil	6	2 feet bgs, base of the boring			

Notes:

See Figure 5.1.28-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern

5.1.29 Paste Plant Spill (SWMU 30)

The Paste Plant Spill (SWMU 30) is an area affected by a number of spills that were associated with the Paste Plant Recycle Water System (SWMU 9) and the adjacent Briquette Slab Storage Area (Figure 5.1.9-1). Those spills, collectively referred to as the Paste Plant Spill, are detailed in the Phase 1 Work Plan. A soil removal action was performed, and confirmation samples collected at the conclusion of that action indicated that contaminated soils remained in place. The area of the spill shown on Figure 5.1.9-1 was documented during an Ecology inspection (Ecology 1990a).

The purpose of the SWMU 30 investigation will be to supplement data from a previous investigation and associated soil removal (Technico Environmental Services 1991a,c). Post-removal soil samples indicated PAH concentrations in soil that exceeded MTCA Method C Cleanup Levels. The spill area extends from a location east of the Paste Plant, south to the southern plant area fenceline, and farther south into the triangle of land bounded by John Day Dam Road and the plant service entrance road (Figure 5.1.9-1). Soil beneath asphalt paving in the spill area inside the fenceline was not previously investigated. In addition, a pipe associated with the Paste Plant Recycle Water System was discovered south of the fenceline during the soil removal and may have been a source of historical discharges to the Paste Plant Spill area.

5.1.29.1 Investigation Objectives

Data needs and data gaps for Paste Plant Spill (SWMU 30) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps for SWMU 30:

- Characterize COPC in soil.
- Confirm the area and approximate volume of PAH-contaminated soil above MTCA Cleanup Levels.

5.1.29.2 Investigation Scope

The spill area will be investigated with a series of 12 soil borings (Figure 5.1.9-1). Five soil borings will be located inside the plant area fenceline, and seven will be located in the area south of the fenceline and John Day Dam Road. Two of the soil borings south of the fenceline will be completed using a hand auger to confirm the down slope extent of contamination.

Twelve soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil in portions of the spill area may thin significantly, and samples may not be collected if bedrock is encountered.

If feasible, one surface soil sample will be collected at the discharge pipe or, if a discharge pipe does not exist, from surface soil at a location immediately south of the fenceline at the reported location of discharge pipe.

Soil samples will be analyzed for PAHs, total cyanide, fluoride, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), as summarized in Table 5.1.29-1.

A monitoring well (RI-MW9-BAU) will be installed in BAU aquifer zone on the southwest (downgradient) side of the Paste Plant Spill area as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2). The well will be used to characterize groundwater chemical conditions in the filled-in depression at the Paste Plant Spill area.

Table 5.1.29-1
Summary of Sampling for SWMU 30 Paste Plant Spill

SWMU 30 Paste Plant Spill					
Sample Method	**Media Sampled**	**Number of Samples**	**Sample Depth**	**Analytes**	**Sample Rationale**
Soil Borings (12)	Surface Soil	12	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, Metals	Characterize COPC in soil.
	Subsurface Soil	24	2 feet bgs, base of the boring		
Grab	Surface Soil	1	0.5 feet bgs		

Notes:

See Figure 5.1.29-1 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

List of COPC analytes and analytical methods is presented in Tables 6-1 and 6-2.

COPC Chemicals of Potential Concern
PAHs Polycyclic aromatic hydrocarbons
Soil Borings (12) Total of twelve soil borings.

5.1.30 Smelter Sign Area (SWMU 31)

The Smelter Sign Area actually consists of two primary areas, including the Smelter Sign Area located between the eastern edge of the Production Area and John Day Dam Road and an area located North of the East Surface Impoundment (NESI Area) (refer to Figure 5.1.30-1). According to former facility personnel, the Smelter Sign Area was a location where SPL and other wastes were disposed of in the early 1970's. The period of potential disposal associated with the Smelter Sign Area is assumed to be limited to the early to mid-1970's based on review of historical aerial photographs (Tetra Tech 2011c). The NESI Area appears to have potentially been used for disposal of a variety of facility wastes based on aerial photograph review and field observations. Review of the historical aerial photographs suggests that the majority of the physical disturbance and potential disposal activities at the site occurred during the early 1970's shortly after construction of the aluminum plant (Tetra Tech 2011b).

No environmental investigation has been completed in the areas associated with the Smelter Sign Area SWMU. However, site inspections were performed in 2011 to better understand site conditions and to help develop the scope for the remedial investigation.

5.1.30.1 Smelter Sign Area Description

The Smelter Sign Area consists of: 1) the plant sign area with associated irrigated lawn and gravel access road along the northern lawn boundary, 2) a built-up bench-area with a rough gravel roadway and two small concrete pads that is present south of the lawn, and 3) a knoll area with basalt outcrops and backfill material with some evidence of historical disposal that is located southwest of the lawn and northwest of the bench area. From the top of the bench area the topography slopes downward to the north, west, south, and east (refer to Figure 5.1.30-1).

During the 2011 inspection, two concrete pads were observed present on top of bench area along with a line of small, low-lying metal supports. These supports may potentially be related to historical piping for ESI area that was closed during the late 1980's. Scattered chunks of suspected pot liner wastes and a few small piles of miscellaneous plant wastes were observed in the bench area and the knoll area southwest of the lawn. Also observed were plant-related waste that included bricks in the northeastern area adjacent to the irrigated lawn. No wastes were observed on the grassy southeast facing slope of the bench area above the railway spur (Tetra Tech 2011c).

Legend

Smelter Sign and NESI Area Boundaries

Note: NESI Area (Area North of East Surface Impoundment)

N
W E
S

0 125 250 500
Feet

Figure 5.1.30-1
Smelter Sign and NESI Area
SWMU 31

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\Phase2_RI_WP\Figure_5.1.30-1_SWMU31.mxd

5.1.30.2 NESI Area Description

The NESI Area consists of an open area that currently appears to be used as pasture land (refer to Figure 5.1.30-1). The site is characterized by hummocky topography with some outcrops of basalt bedrock. A gravel road enters the site from the west and north. A spur of the gravel road serves as an entrance to the closed ESI Area. A series of rock walls composed of basalt cobbles and boulders are present at the site. Some low-lying areas of the site were observed to have seasonal standing water and appeared to be wetland areas.

Carbon wastes, suspected SPL, and cryolite wastes were observed in several areas of the site. The wastes appeared to be distributed along the sides of gravel road, particularly in areas of low elevations. In some areas, it appears that the wastes had been graded and pushed up to the sides of depression areas. The largest accumulation of waste appeared to be present immediately west of the road in the central part of the investigation area and can be readily seen in Figure 5.1.30-1.

During the 2011 site inspection, a wetlands assessment was performed to ensure that the field investigation of this area can be appropriately conducted, and that necessary permits can be obtained prior to conducting previously planned investigation activities. Evidence of waste disposal was found within the wetlands in the central and eastern portion of the planned NESI Area investigation. As the proposed investigation includes excavation work in a wetland area, the fieldwork will require permitting through the USACE Nationwide 6 Permit, as well as the completion of a JARPA. The JARPA application, project plans, and wetland delineation report will need to be submitted concurrently for review to the USACE and Ecology. Klickitat County is not party to the JARPA process, but should be notified to ensure that the project complies with the Klickitat County Critical Areas Ordinance (Tetra Tech 2011b).

5.1.30.3 Investigation Objectives

The overall purpose of the sampling program is to determine the areas and depths containing listed K088 spent potliner waste at SWMU 31 as well as other state and federal hazardous waste, and to determine the extent of COPC in site soils that underlie the wastes. These objectives will be accomplished through implementation of a trenching and test pit sampling program and associated waste and soil sampling.

Rough order-of-magnitude estimates of the volume of wastes in various categories (e.g., RCRA–listed wastes, Washington State Dangerous and Extremely Dangerous Wastes, and non-hazardous wastes) will be made to facilitate future evaluation of remedial alternatives and associated costs. The plan is for all excavations to be backfilled with the excavated materials and compacted and graded using the excavator.

Shallow trenches and test pit excavations are proposed to qualitatively determine the type of wastes present in particular areas and to determine the lateral and vertical extent of wastes. The physical characteristics of encountered waste materials will be described and these observations will be used to categorize the wastes. The field observations, physical characteristics, and the waste categories that will be identified in the field are described in Section 5.3.7. The highest priority is to identify probable spent potliner waste using the protocols in Appendix D. Other types of aluminum process wastes may also be sampled if they are found in significant quantities including anode wastes or other carbon wastes (particularly if they are mixed in with suspected potliners), cryolite and alumina waste, and potential scrubber sludges.

5.1.30.4 Smelter Sign Area Investigation Scope

This section summarizes the sampling program for the Smelter Sign Area.

Smelter Sign Area Waste Sampling

The location of the trenches and test pits was based on field observations of waste and debris at the ground surface and review of historical aerial photographs. A total of 12 shallow trenches are included in the Smelter Sign Area as shown in Figure 5.1.30-2. Trenches will be bucket-width (2-3 feet wide) and up to 4 feet deep. In some areas where less wastes are suspected, or based on access constraints, test pits are also proposed to characterize wastes. A total of 8 test pits are proposed. Figure 5.1.30-2 does not include test pits that may be needed in association with the trenches if the shallow trenches do not penetrate the full thickness of the waste. The sampling program for the Smelter Sign Area is summarized in Table 5.1.30-1.

Representative waste samples will be collected from excavations with significant (greater than 5-10 cubic yards as estimated from field observations) amounts of waste and temporarily archived in a cooler under proper chain-of-custody. The waste samples that will be submitted for chemical analyses will be selected near the end of characterization activities at the Smelter Sign Area.

R:\projects_2011\LockheedMartin_GoldendaleSite\Investig\maps\Phase2_RI_WP\Figure_5.1.30-2_SWMU31_Excavation.mxd

Legend

- Proposed Test Pit Location
- Proposed Characterization Trench
- Investigation Area

N
W E
S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.1.30-2
Excavation Location Map
Smelter Sign Area
SWMU 31

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table 5.1.30-1
Field Investigation and Analytical Summary Table for the Smelter Sign Area
Goldendale, Washington (SWMU 31)

Trenches	Test Pits[a]	Samples	Sampling Suite	Laboratory Analysis	Rationale
12	8	**2 Soil Samples**	Expanded	PAHs Total Cyanide WAD Cyanide Fluoride Metals Sulfate TPH-Dx TPH-Gx PCBs VOCs Asbestos	Characterization of the nature and extent of soil contamination beneath waste area. Expanded sampling suite in areas with greatest waste accumulation and/or field indications of soil contamination.
		Up to 38 Soil Samples	Standard	PAHs Total Cyanide WAD Cyanide Fluoride Metals Sulfate TPH-Dx TPH-Gx	Characterization of the nature and extent of soil contamination beneath waste areas.
		If suspected SPL encountered: up to 3 SPL bulk waste samples	Suspected SPL Profiling	Total Cyanide WAD Cyanide Fluoride Fluoride-SPLP Metals Sulfate Aluminum (T) Sodium Alumina Calcium Magnesium Lithium Phosphorus Silica (as silicon) Manganese Carbon (T) Iron Oxide (as Iron) by X-ray diffraction Sulfur	Waste profiling; evaluation and confirmation of potential SPL wastes.
		If suspected SPL wastes encountered, up to 3 samples of associated carbon wastes (anode wastes) that likely do not represent SPL. Samples will be paired with suspected SPL waste samples	Non-SPL Determination	Total Cyanide WAD Cyanide Fluoride Fluoride-SPLP Metals Sodium	Waste profiling; evaluation and verification of non-SPL carbon wastes.
		Up to 3 waste samples	PAH profiling	PAHs	Waste profiling, evaluation of Washington EHW designation for PAH-containing wastes.
		Up to 1 waste sample of suspected cryolite/alumina waste	Fluoride sampling	Fluoride Fluoride-SPLP	Characterization of fluoride concentrations; evaluation of protection of groundwater.

a Additional Test Pits may be installed based on field observations.

Notes:

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

EHW	State-designated Extremely Hazardous Waste	SVOCs	Semi-volatile organic compounds
PAHs	Polycyclic aromatic hydrocarbon	TPH-Dx	Diesel- and oil-range petroleum hydrocarbons
PCBs	Polychlorinated biphenyls	TPH-Gx	Gasoline-range petroleum hydrocarbons
SPL	Spent potliner	VOCs	Volatile organic compounds
SPLP	Synthetic Precipitation Leaching Procedure	WAD	Weak acid dissociable

Two to three suspected bulk SPL waste samples will be submitted for chemical analyses if suspected SPL waste is found. One suspected SPL sample will be collected from each subarea where significant wastes are found including: the bench area, the lawn/sign area, and the knoll southwest of the lawn area. The suspected SPL profiling analytical program includes the following suite of analyses: total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, aluminum (total), sodium, alumina, calcium, magnesium, lithium, phosphorus, silica (as silicon), manganese, and carbon (total). The SPL waste chemical analyses will be used to supplement and confirm the waste determination, which will be made based primarily on field observations and process knowledge.

Other bulk carbon wastes associated with the spent potliners (e.g., anode wastes) that do not likely represent spent potliner materials based on the field observations will be analyzed for a more limited suite of analyses to confirm the field identification approach, and to characterize the wastes. The analytical program for the carbon wastes that are likely non-SPL includes: total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals, and sodium. Interviews with facility personnel and chemical data for spent SPL show that spent potliners are significantly enriched in sodium and fluoride (Tschope, K., et al. 2009) compared to other carbon wastes that are similar in appearance and for this reason, sodium and fluoride represent key parameters in distinguishing the wastes. Two to three suspected non-SPL carbon samples will be submitted for chemical analyses. These samples will be paired (collected from adjacent areas) with the suspected SPL samples.

Some aluminum wastes (scrubber sludges, anode waste, pitch and briquettes) contain elevated concentrations of PAHs. In Washington, wastes that contain greater than one percent PAHs represent Extremely Dangerous Wastes [refer to WAC 173-303-100(6)] based on their persistence. These wastes may present potential risks to human health and the environment at concentrations significantly lower than one percent if they were transported or leached into environmental media such as soil, sediment, or groundwater. For these reasons, if significant quantities of suspected PAH-containing wastes are found, representative samples will be collected and analyzed for PAHs. Two to three samples will include PAH analyses. The samples will be collected if significant amounts of carbon containing wastes (e.g., potential scrubber sludges, anode wastes, pitch or coke, or other mixed carbon wastes) are found.

Fluoride is included in the spent potliner profiling analyses and non-SPL profiling analyses. These analyses will include both total fluoride and SPLP for fluoride. A representative sample of suspected cryolite bath materials will be analyzed for fluoride if significant quantities are found.

For the Smelter Sign Area, trenches at the bench and knoll areas will be installed first, followed by test pits in these same areas. After this work is completed, work in the lawn and sign area will be implemented. For the lawn and sign area, the test pits will be installed prior to the trenches to allow for preliminary assessment of the likelihood of wastes beneath the lawn area without significant damage to the lawn and associated irrigation piping. Based on the results of the three test pits in the lawn area, the project team will discuss the best manner to proceed before the full trenching program is implemented in the lawn area.

Smelter Sign Area Soil Sampling

Test pit excavations will be installed to determine the vertical extent of wastes, to provide characterization of smaller suspected areas of waste accumulation, and to provide characterization of the vertical extent of contamination in soil below the waste. Each test pit will extend to a depth of 2 feet below encountered waste unless bedrock is encountered. The maximum depth of characterization will be about 15 feet bgs based on the reach of the excavator.

Soil samples will be collected from each trench and test pit station containing waste to determine the extent of contamination in soils that underlie the waste. Two vertical sample intervals will be selected for analysis at 0.5-foot and 2-feet below the waste. The vertical interval and number of soil samples may be varied, depending on site-specific considerations. For example, if only 1 to 2 feet of soil is found below the waste before bedrock is encountered, the vertical sampling interval will include only one soil sample.

At least one test pit will be excavated at each trench location, unless wastes aren't found or the total thickness of waste is penetrated by the trench. For trenches completed in waste that are over one hundred feet in length, two test pits will be excavated to better establish the waste thickness along the trench transect.

Up to 20 soil sampling stations (one per test pit and trench) will be sampled with up to a total of 40 soil samples being collected. The soil samples will be analyzed for a standard suite of analyses for aluminum sites including: PAHs, total cyanide, WAD cyanide. fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, TPH-Dx, and TPH-Gx.

Two of these samples (two vertical intervals from one of the sampling stations) will be sampled for an expanded list of constituents that includes analyses of VOCs, PCBs, and asbestos as well as the standard suite. The soil sampling station with the expanded sampling suite will be selected from the area with the greatest amount of waste observed unless there are field indications of these specific chemicals (e.g., elevated photoionization detector readings, odors, presence of suspected asbestos-containing waste, and presence of suspected electrical transformers).

Table 5.1.30-1 provides a sampling summary for the Smelter Sign Area, including number of samples for the various media and associated analytical methods. The Performing Contractor will follow the trench and test pit waste logging procedures specified in Section 5.3.7.

5.1.30.5 Area North of the East Surface Impoundment Investigation Scope

This section summarizes the sampling program for the NESI area.

NESI Waste Sampling

The location of the trenches and test pits are based on field observations of waste and debris at the ground surface and review of historical aerial photographs. A total of 11 shallow trenches are included in the NESI Area as shown in Figure 5.1.30-3. Trenches will be bucket-width (about 2-3 feet wide) and up to 4 feet deep. In some areas where less wastes are suspected, or based on access constraints, 12 test pits are also proposed to characterize wastes. Figure 5.1.30-3 does not include test pits that may be needed in association with the trenches if the shallow trenches do not penetrate the full thickness of the waste. The sampling program for the NESI area is summarized in Table 5.1.30-2.

In addition, a relatively small potential area of waste disposal was found by Lockheed Martin representatives east of the ESI during the 2011 site reconnaissance. This area has been included with the NESI Area investigation and will be characterized through two hand-auger borings. One waste sample and one underlying soil sample will be collected from each boring. Waste samples will be analyzed for PAHs, total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals (Al, As, Cd,

Legend

- Proposed Characterization Trench
- Fence
- Wetland Boundary
- East Surface Impoundment Drainage Area
- Investigation Area
- Impoundment Area(Closed)

N W E S

0 50 100 200

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.1.30-3

Excavation Location Map

North of East Surface Impoundment (NESI) Area

SWMU 31

Columbia Gorge Aluminum Smelter Site

Goldendale, Washington

Table 5.1.30-2
Field Investigation and Analytical Summary for the Area North of the East Surface Impoundment Goldendale, Washington (SWMU 31)
(Page 1 of 2)

Trenches	Test Pits[a]	Samples	Sampling Suite	Laboratory Analysis	Rationale
11	12	**2 Soil Samples**	Expanded	PAHs Total Cyanide WAD Cyanide Fluoride Metals Sulfate TPH-Dx, TPH-Gx PCBs VOCs Asbestos	Characterization of the nature and extent of soil contamination beneath waste area. Expanded sampling suite in areas with greatest waste accumulation and/or field indications of soil contamination.
		Up to 44 Soil Samples	Standard	PAHs Total Cyanide WAD Cyanide Fluoride Metals Sulfate TPH-Dx TPH-Gx	Characterization of the nature and extent of soil contamination beneath waste areas.
		If suspected SPL encountered: up to 4 SPL bulk waste samples	Suspected SPL Profiling	Total Cyanide WAD Cyanide Fluoride Fluoride-SPLP Metals Sulfate Aluminum (T) Sodium Alumina Calcium Magnesium Lithium Phosphorus Silica (as silicon) Manganese Carbon (T) Iron Oxide (as Iron) by x-ray diffraction Sulfur	Waste profiling; evaluation and confirmation of potential SPL wastes.
		If suspected SPL wastes encountered, up to 4 samples of associated carbon wastes (anode wastes) that likely do not represent SPL. Samples will be paired with suspected SPL waste samples	Non-SPL Determination	Total Cyanide WAD Cyanide Fluoride Fluoride-SPLP Metals Sodium	Waste profiling; evaluation and verification of non-SPL carbon wastes.
		Up to 4 waste samples	PAH profiling	PAHs	Waste profiling, evaluation of Washington EHW designation for PAH-containing wastes.
		Up to 2 waste sample of suspected cryolite/alumina waste	Fluoride sampling Fluoride sampling	Fluoride Fluoride-SPLP	Characterization of fluoride concentrations; evaluation of protection of groundwater.
NA	**NA**	**2 Wetland Water Samples (Wet and Dry Season)**	Surface Water	PAHs Total Cyanide WAD Cyanide Free Cyanide Fluoride Metals Sulfate Iron Geochemistry[b]	Characterize surface water chemistry for wetland water in close proximity to wastes.

a	Additional Test Pits may be installed based on field observations.		
b	Geochemistry parameters include major ions (Ca, Mg, Na, K, and Cl) and Conventional Parameters (hardness, TDS, and total alkalinity).		
Notes:			
Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).			
Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.			
Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.			
Metals analyses include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.			
EHW	State-designated Extremely Hazardous Waste	TDS	Total dissolved solids
PAHs	Polycyclic aromatic hydrocarbon	TPH-Dx	Diesel- and oil-range petroleum hydrocarbons
PCBs	Polychlorinated biphenyls	TPH-Gx	Gasoline-range petroleum hydrocarbons
SPL	Spent potliner	VOCs	Volatile organic compounds
SPLP	Synthetic Precipitation Leaching Procedure	WAD	Weak-acid dissociable

Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, and sodium. Soil samples will be analyzed for PAHs, total cyanide, WAD cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, TPH-Dx, and TPH-Gx.

Representative waste samples will be collected from excavations with significant (greater than 5-10 cubic yards as estimated from field observations) amounts of waste and temporarily archived in a cooler under proper chain-of-custody. The waste samples that will be submitted for chemical analyses will be selected near the end of characterization activities at the NESI Area.

Up to four suspected SPL waste samples will be submitted for chemical analyses. One suspected SPL sample will be collected from each subarea where significant wastes are found including: the southern area along the fence line (NESI-TR1 and NESI-TR2), the biggest area in the center of the site (NESI-TR5 and NESI-TR6), the eastern portion of the site (NESI-TR10 and NESI-TR11), and the vicinity of either NESI-TR3 or NESI-TR7 depending on the findings. The suspected SPL profiling analytical program includes the following suite of analyses: total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, aluminum (total), sodium, alumina, calcium, magnesium, lithium, phosphorus, silica (as silicon), manganese, carbon (total).

Similar to the Smelter Sign Area approach, up to four suspected non-SPL carbon samples will be submitted for chemical analyses. These samples will be paired (collected from adjacent areas) with the suspected SPL samples. The analytical program for the carbon wastes that are likely non-SPL includes: total cyanide, WAD cyanide, fluoride, fluoride by SPLP, metals, and sodium.

If significant quantities of suspected PAH-containing wastes are found (e.g., potential scrubber sludges, anode wastes, pitch or coke, or other mixed carbon wastes), up to four representative samples will be collected and analyzed for PAHs.

Fluoride is included in the spent potliner profiling analyses and non-SPL profiling analyses. These analyses will include both total fluoride and SPLP for fluoride. Up to two representative samples of suspected cryolite bath materials will be analyzed for fluoride if significant quantities are found.

NESI Soil Sampling

Test pit excavations will be installed to determine the vertical extent of wastes, to provide characterization of smaller suspected areas of waste accumulation, and to provide characterization of the vertical extent of contamination in soil below the waste. Each test pit will extend to a depth of 2 feet below encountered waste unless bedrock is encountered. The maximum depth of characterization will be about 15 feet bgs based on the reach of the excavator.

Soil samples will be collected to determine the extent of contamination in soils that underlie the waste. Two vertical sample intervals will be selected for analysis at 0.5 feet and 2 feet below the waste. The vertical interval and number of soil samples may be varied, depending on site-specific considerations. For example, if only one to two feet of soil is found below the waste before bedrock is encountered, only one soil sample will be collected.

At least one test pit will be excavated at each trench location, unless wastes aren't found or the total thickness of waste is penetrated by the trench. For trenches completed in waste that are over one hundred feet in length, two test pits will be excavated to better establish the waste thickness along the trench transect.

Up to 23 soil sampling stations (trenches and test pits) will be sampled. Soil samples will be collected from two vertical intervals beneath the waste (0.5 feet and 2 feet, up to 46 soil samples total). The soil samples will be analyzed for a standard suite of analyses for aluminum sites including: PAHs, total cyanide, WAD cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, TPH-Dx, and TPH-Gx.

Two of these samples (two vertical intervals from one of the sampling stations) will be sampled for an expanded list of constituents that includes analyses of PCBs, VOCs, and asbestos as well as the standard aluminum suite. The soil sampling station with the expanded sampling suite will be selected from the area with the greatest amount of waste observed unless there are field indications of these specific chemicals (e.g., elevated photoionization detector readings, odors, presence of suspected asbestos-containing waste, and presence of suspected electrical transformers).

NESI Surface Water Sampling

A water sample will be collected of wetland water in the NESI area during wet and dry seasons (if water is present). The objective of the surface water sampling is to characterize chemical concentrations and geochemistry of surface water that may be in connection with shallow groundwater in this area.

Table 5.1.30-2 provides a sampling summary for the NESI Area, including number of samples for the various media and associated analytical methods. Logging of wastes in test pits and trenches will be performed consistent with the procedures presented in Section 5.3.7.

5.1.31 Stormwater Pond and Appurtenant Facilities (SWMU 32)

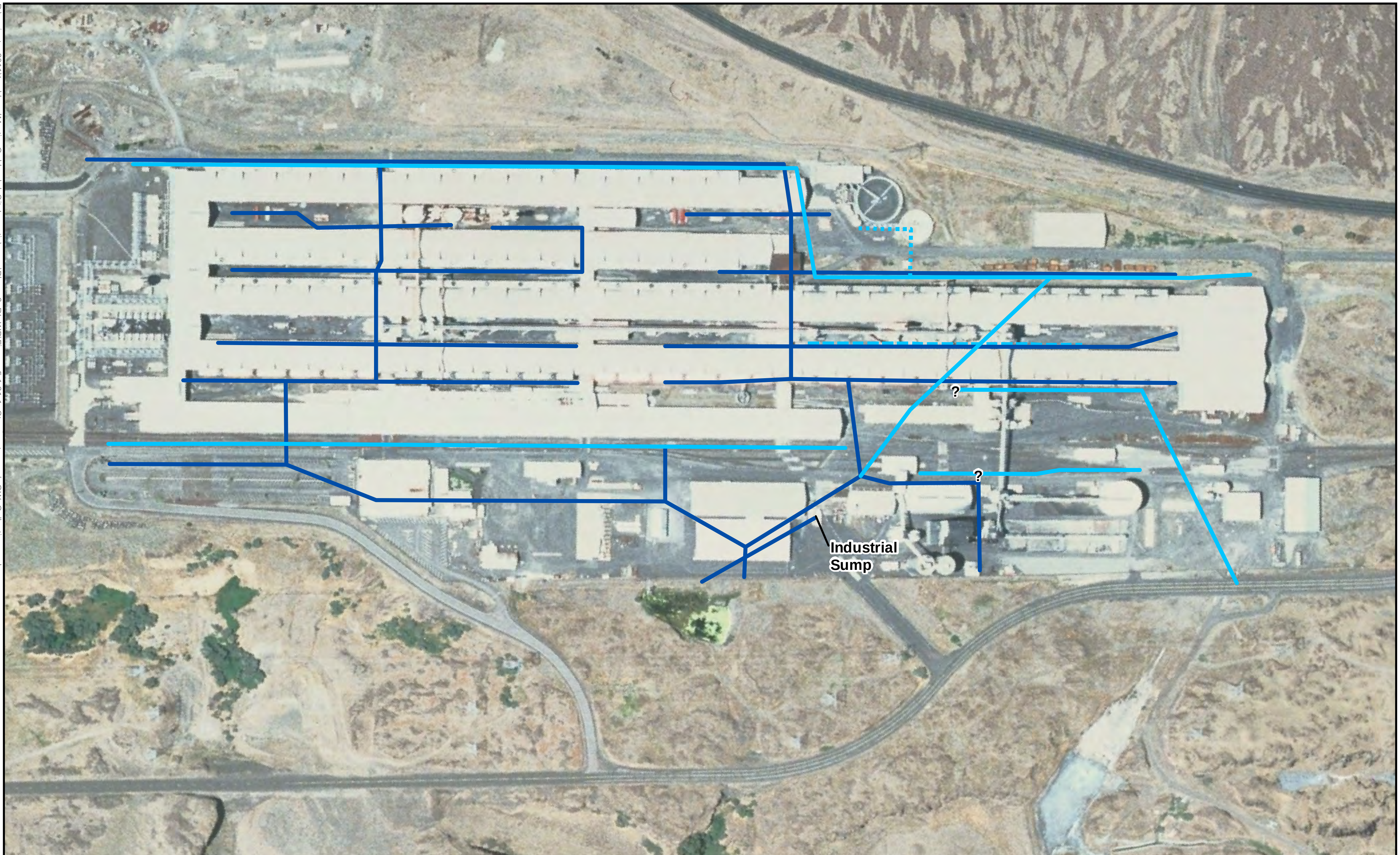
SWMU 32 is defined as the stormwater detention pond and appurtenant facilities that drains stormwater and shallow groundwater from the former plant area to the stormwater detention pond. SWMU 32 consists of three main elements that include the stormwater collection system, the groundwater collection system, and the stormwater detention pond. The line that conveys stormwater pumped from the stormwater pond to the industrial sump is also included in SWMU 32. The groundwater collection system conveys shallow groundwater to the stormwater detention pond through tie-in(s) with the stormwater system. Figure 5.1.31-1 shows the general layout of the stormwater and groundwater collection systems, and the stormwater detention pond. Figure 5.1.31-2 shows the stormwater detention pond and associated sample locations.

5.1.31.1 Investigation Objectives

Data needs and data gaps for the Stormwater Pond and Appurtenant Facilities (SWMU 32) were summarized in Table 3-3 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and gaps for the SWMU 32:

- Determine the status of cleanup for the stormwater catch basin and conveyance line system.
- Confirm construction and layout of the stormwater and groundwater collection system and its tie-in with the stormwater system.
- Evaluate the hydrology of the groundwater collection system and its impact on shallow groundwater.
- Characterize the nature and extent of COPC in sediments and surface water in the stormwater detention pond.

The hydrologic relationship between the stormwater detention pond and groundwater will be addressed as part of the Groundwater in the Uppermost AOC investigation as is characterization of potential releases from the stormwater system (refer to Section 5.2.2).



Legend

- Groundwater Collection Network
- Groundwater Collection Network (Inferred from Original Groundwater Drainage Plan)
- Line location based on design plans. Line has likely been modified because of construction in this area, but the modification is undocumented.
- Storm Drain Network

W N S E

0 125 250 500

Feet

Source: Harvey Aluminum (1971)

Figure 5.1.31-1
Stormwater and Groundwater Collection System Layout

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Legend

- Sediment Sample (SWMU32-SED-01)
- Sediment Core (SWMU32-SC-01)
- Surface Water Sample (SWMU32-SW-03)
- Surface Soil Sample (SWMU32-SS-01)

N W E S

0 125 250 Feet

Source: Google 2010, Lockwood Green et al. 1999

Figure 5.1.31-2

Sample Locations
Stormwater Pond and Vicinity

Stormwater Pond and Appurtenant Facilities
SWMU 32

Columbia Gorge Aluminum Smelter Site

5.1.31.2 Investigation Scope

The three main elements of SWMU 32 will be investigated with a series of field tasks, including collection of samples from soil, sediment, and surface water. Shallow groundwater is addressed in the Groundwater in the Uppermost AOC investigation. The overall flow of field tasks is detailed in Table 5.1.31-1. Table 5.1.31-2 summarizes the SWMU 32 sampling program.

The following subsections describe the specific scope of work for the three elements of SWMU 32 including the stormwater collection system, groundwater collection system, and the stormwater detention pond.

5.1.31.3 Stormwater Catch Basins and Lines Status of Cleanup

Stormwater is collected in a series of catch basins (CBs) located throughout the former plant and is conveyed by associated piping to the stormwater detention pond (Figure 5.1.31-1). The stormwater detention pond is located at the southern boundary of the Plant Area AOC (Figure 5.1.31-2). Uncertainties associated with the stormwater and groundwater collection systems include details on construction and layout, location of all tie-ins between the systems, and identification of all CBs associated with each system. For example, four CBs are located between the south SPL building and the canopy adjacent to the south, and some or all drain to the north inlet of the stormwater pond, but are not shown on more recent plant plan maps.

Some of the stormwater CBs and a portion of the industrial lines were sampled as part of investigations related to plant demolition activities (PGG 2012b). COPC detected in the stormwater system include:

- Metals (aluminum, arsenic, cadmium, lead, and mercury), detected in most CB samples, except lead and mercury detected infrequently.
- Fluoride, detected in all 47 CB samples.
- Total cyanide, detected in 17 of 47 CB samples at low concentrations.
- Carcinogenic PAHs, detected in all 47 CB samples.
- Aroclor 1254, detected in 6 of 47 CB samples.
- Diesel-range and/or lube oil range petroleum hydrocarbons, detected in all CB samples.

Table 5.1.31-1
Summary of Field Tasks for Stormwater Pond and Appurtenant Facilities (SWMU 32)

SWMU 32 Focus	Investigation Objective	Investigation Task	Task Description
Stormwater Collection System	Determine Status of Cleanup for Stormwater Catch Basins (CBs) and Conveyance Lines	System Identification	Locate all CBs, inspect for sediment accumulation, depth, and presence of water. Clear any CBs buried or impacted by demolition activities (Figure 5.1.31-1).
			Video survey lines for sediment accumulation, type of material present, presence of water, line integrity, and connections to other systems (e.g., groundwater collection).
			Survey CBs, inverts and inlet/outlet for horizontal and vertical elevation control.
			Update system maps and cross sections.
		Sample CBs	Collect dry/wet season stormwater samples. Sample locations will be selected based on results of system identification. Analyze stormwater for all site COPC.
			Collect CB sediment samples where sediment is present. Sample locations will be selected based on results of system identification. At a minimum, samples will be collected at CBs that were not previously sampled or where post-demolition re-sedimentation has occurred.
			Stormwater conveyance lines are expected to be inaccessible for sediment sampling. Standard practice is to sample CBs as representative of sediment in the system.
		Confirm System Cleanup	Evaluate presence of contaminated sediments, and whether additional cleanup is warranted.
Groundwater Collection System	Confirm Groundwater System Layout, Tie-in with Stormwater System	System Construction Identification	Review site plans for construction details.
		Confirm Layout of System	Locate all CBs, inspect for depth, sediment accumulation, and presence of water.
			Video survey of groundwater collection system lines for sediment accumulation, type of material present, presence of water, integrity of lines, and connection to other systems (e.g., stormwater system).
			Survey CBs, inverts and inlets/outlets for horizontal and vertical elevation control.
			Update system maps and cross sections.
	Hydrologic Evaluation of System	Hydrologic Evaluation	Determine area for system input.
			Collect water samples from CBs and analyze for all COPC.
			Determine dry/wet season flows to stormwater detention pond and NPDES Pond A.
Stormwater Pond	Characterize COPC in Sediment and Surface Water	Sample Stormwater Pond Sediment and Surface Water	Conduct preliminary assessment of pond sediment for thickness and consistency to confirm best sampling methodology. Measurements made on longitudinal and transverse transects.
			Collect sediment samples from three sediment cores located within the main body of the pond (Figure 5.1.31-2). Cores penetrate full sediment thickness using sediment corer and pontoon boat.
			Collect sediment grab samples from two pond inlets. Two sample stations will be located at the northeast inlet, and one sample station will be located at the north inlet (Figure 5.1.31-2).
			Collect surface water samples from the bottom of the pond water column, above the sediment surface.
			Collect surface soil samples at 100 foot spacing in ravine adjacent to the pond. The pond reportedly overflowed in the past into the ravine that leads to the Boat Basin at the Columbia River.
			Calculate volume of contaminated sediments. Conduct hazardous waste determination.

Notes:

See Figures 5.1.31-1 and 5.1.31-2 for sample locations.

CB Catch Basins

Table 5.1.31-2
Summary of Sampling for Stormwater Pond and Appurtenant Facilities (SWMU 32)

Investigation Feature	Sample Method	Media Sampled	Number of Samples	Sample Depth	Sample Type	Analytes	Sample Rationale
Stormwater CBs	Grab	Stormwater	4	NA	Discrete (dry/wet seasons)	PAHs, Total Cyanide, Fluoride, Metals, Sulfate, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in stormwater.
	Grab	Sediment	TBD	NA	Discrete	PAHs, Total Cyanide, Fluoride, Metals, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in stormwater CB sediment. Collect samples primarily from CBs that are re-sedimented after demolition, and areas not previously sampled.
Groundwater Collection System	Grab	Water in collection line	8	NA	Discrete (dry/wet seasons)	PAHs, Total Cyanide, Fluoride, Metals, Sulfate, PCBs, TPH-Dx, TPH-Gx, VOC	Characterize COPC in water in the groundwater collection lines.
Stormwater Pond	Coring (3)	Sediment	9	Top, middle, bottom of sediment column	Discrete	PAHs, Total Cyanide, Fluoride, Metals, PCBs, TPH-Dx, TPH-Gx, VOC	Characterize COPC in pond sediment in the central portion of the pond.
	Grab	Sediment	2 1	0.5 feet 0.5-1 foot	Discrete	PAHs, Total Cyanide, Fluoride, Metals, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in pond sediment at northeastern pond inlet.
	Grab	Sediment	1	0.5-1 foot	Discrete	PAHs, Total Cyanide, Fluoride, Metals, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in pond sediment at northern pond inlet.
	Grab	Surface Water	3	Bottom of water column	Discrete	PAHs, Total Cyanide, Fluoride, Metals, Sulfate, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in pond surface water. One water sample to be analyzed for geochemistry parameters for comparison to groundwater
	Grab	Surface Soil	4	0.5 feet	Discrete	PAHs, Total Cyanide, Fluoride, Metals, PCBs, TPH-Dx, TPH-Gx	Characterize COPC in surface soil of ravine adjacent to pond.

Notes:

See Figures 5.1.31-1 and 5.1.31-2 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

CB Catch Basin
COPC Chemicals of Potential Concern
NA Not applicable
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
Coring (3) Total of 3 sediment cores.
TBD To be determined based on results of stormwater system surveys
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
TPH-Gx Gasoline-range petroleum hydrocarbons
VOCs Volatile Organic Chemicals

About 80 CBs and about 3,420 linear feet of stormwater and industrial lines were cleaned (PGG 2012b). Water from the cleaning process was pumped to the large clarifier located near the water treatment plant for evaporation. All solids were transported for temporary storage to the Bath Storage Building located southeast of the east end of Production Building A. About 21 tons of solids from the CBs were transported to Columbia Ridge Landfill for disposal. Several line segments could not be accessed during the 2012 investigation and were not cleaned (PGG 2012b). In addition, plant demolition continued for about one year after sampling and cleaning occurred, presenting the potential for re-sedimentation in the stormwater CBs and lines.

Assessing the status of cleanup for the Stormwater system will include system identification, CB sampling, and evaluation of field survey and sampling data. The goal of assessing the status of cleanup will be to determine whether additional CB cleanup is warranted.

System Identification

System identification will include review of existing plans and maps, locating and inspecting all CBs, conducting video and elevation surveys, and updating maps and cross sections. The stormwater collection piping systems will be inspected to determine the following and to verify that field conditions are consistent with available construction drawings. The following are some key aspects of the systems that will be inspected.

- Presence of connections between the systems.
- Piping materials.
- Piping condition.
- Slope of each segment.
- Diameter of each segment.
- Depth of flow in each segment.

Inspection methods that include confined-space entry will not be employed.

Some CBs may have been buried as a result of demolition activities and will have to be located using methods such as probing or a metal detector. Once located, CBs will be sounded for total depth, and depth of water and/or sediment that may be present. CBs will be visually inspected for cracks or other indications of damage.

CBs will be surveyed for horizontal and vertical elevation control. Elevations to be measured include top of CB, bottom of CB, and entry and exit line inverts.

Stormwater system lines will be inspected by video camera. Images and data from video inspection will be used to determine slope, pipe diameter, pipe material, locations of joints, line condition, connections between the stormwater and groundwater collection systems, and depth of flow at the time of inspection. Video inspection can also be used to identify CBs that may have been buried.

Once the above activities have been completed, system maps and cross sections will be updated to include findings.

Sample Catch Basins

Samples of CB sediment will be collected from CBs where re-sedimentation has occurred post-demolition or where CBs were not previously sampled. The specific CBs to be sampled will be determined based on results of the system identification. Sediment samples will be collected from CB sumps and will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, TPH-Dx, and TPH-Gx. A summary of CB sampling and analysis is presented on Table 5.1.31-2.

Samples of stormwater will be collected onsite from CBs at minimum during the dry season (summer months, typically June through September), and during the subsequent wet season (winter months, typically October through May). CB and manhole stormwater sampling locations will be selected to represent catchment areas. The number of catchment areas, and therefore sampling locations, will be determined by evaluation of survey data and of system construction data as described above. Once system identification is complete, the piping networks will be analyzed to determine sampling locations, to calculate typical flowrates, to estimate discharge to perched groundwater through pipe breaches, and to evaluate transport of COPC through the piping networks.

Up to four stormwater samples will be collected generally consistent with the schedule for sampling stormwater under the 2011 Industrial Storm Water Pollution Prevention Plan (Columbia Gorge Aluminum Company 2011). Stormwater samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, TPH-Dx, and TPH-Gx. Sampling locations, and their number, will be determined based on evaluation of the stormwater piping and groundwater collection piping systems as described below. A summary of CB stormwater sampling and analysis is presented on Table 5.1.31-2.

5.1.31.4 Confirm Groundwater Collection System Layout

The groundwater collection system consists of lines located along the northern and eastern portions of the former plant that conveys shallow groundwater to the stormwater detention pond through tie-ins with the stormwater system (Figure 5.1.31-1). The shallow groundwater collection system was originally constructed of two east-west trending lines of 18-inch perforated pipe. These connected to a larger 24-inch NE-SW trending perforated pipe that drained into the stormwater system (Harvey Aluminum 1971a). This system was later expanded to include additional groundwater collection lines at the northern edge of the plant when Production Buildings C and D were added (Goldendale Aluminum Company 1996, Martin Marietta 1980). The northern groundwater collection lines consisted of 18-inch diameter, perforated, corrugated metal pipes (Martin Marietta 1980).

In addition, a series of east-west trending 8-inch perforated pipe segments and associated catch basin are present on the south side of the railroad tracks (on the south side of the Cast House in the western part of the site and the north side of the Pitch Building east of the Coke and Pitch Unloading Structure (Goldendale Aluminum Company 1996). This portion of the system is labeled as a storm drain on the construction drawings; however, its overall design and construction appear to be similar to the groundwater collection lines in other areas of the plant. This collection system may affect shallow groundwater flow beneath the Former Plant and may provide a transport pathway for shallow groundwater into the stormwater system (or vice versa).

System Construction Identification

System investigation for the groundwater collection system will be conducted jointly with investigation of the stormwater system since both systems share similar features and the system identification steps and equipment will be similar. Groundwater collection system plans will be reviewed for construction details. Items to be noted during review include pipe dimensions, materials, elevations, slopes, access manholes, and relation to bedrock contact.

Confirm Layout of System

Manholes will then be located in the field. Some manholes may be buried, and may therefore have to be located using methods such as probing or a metal detector. Upon location, manholes will be sounded for total depth and depth of water and/or sediment, if present. Invert elevations of inlet and outlet pipes and water surface elevation will be determined in these manholes.

Groundwater collection system lines will be inspected by video camera. Images and data from video inspection will be used to determine slope, pipe diameter, pipe material, locations of joints, line condition, the connections between systems, and depth of flow at the time of inspection. Video inspection can also be used to identify manholes that may have been buried. Alternative methods of inspection may be considered for smaller lines if video inspection proves to not be feasible.

Once the above activities have been completed, system maps and cross sections will be updated to include findings. System construction information for the stormwater and groundwater collection systems will provide an understanding of the layout, construction and interconnection of these systems and updating system maps and sections as appropriate. This information will also form the basis for selection of sediment and water sample locations in the stormwater and groundwater collection systems. In addition, this information also will contribute to evaluation of stormwater/groundwater discharge into NPDES Pond A as part of the Plant Area AOC investigation.

The Industrial Sump is a feature to be investigated as part of the Plant Area AOC, but is included in this discussion as it relates to overall flow of stormwater and groundwater to the stormwater pond. The separate shallow groundwater collection and conveyance system at the eastern end of the plant that appears to discharge to the NPDES Pond A is included as part of the stormwater system investigation, but the discharge to NPDES Pond A is to be investigated as part of the Plant Area AOC.

Evaluation of System Impact on Shallow Groundwater

The shallow groundwater collection system may impact shallow groundwater occurrence and flow through removal of volumes of groundwater from the subsurface in one area of the site, and recharge to shallow groundwater in a different area of the site. In addition, shallow groundwater inflowing to the system may be transporting chemicals from sources of contamination located in one area of the site to a different area with the potential to facilitate migration of site contaminants horizontally and vertically.

Evaluation of the impact of the groundwater collection system will include determination of the area of shallow groundwater drainage, sampling groundwater from the collection system and calculating the volume of shallow groundwater that is discharged to the stormwater pond. Inspection and video surveying of the groundwater collection system will provide information about where groundwater enters the system with respect to known sources of contamination at ground surface and what concentrations of COPC may be moving through the system. This information will be incorporated into the Groundwater in the Uppermost Aquifer AOC investigation and will also be used to assess potential locations of contingency temporary wells if sampling results indicate the potential occurrence of sources that are not already assessed with the base well network.

Typical and maximum flowrates through the stormwater and groundwater systems will be calculated based on pipe diameter, material, and slope, and depth of flow. Flow rates for less than full flow will be estimated using open-channel flow equations such as the Manning equation. Flow rates for full-flowing pipes will be estimated using tools such as the Hazen-Williams equation. Transport of COPC through the piping networks can be evaluated using a mass balance, taking into account sample locations, flowrates, and connections between piping systems.

Leakage of surface water from the pond into the underlying bedrock will be evaluated through calculation of mass balance and performance of a pond drawdown test. Mass balance of water input and outflow from the pond will be calculated using site-specific parameters that include assessment of the volume of water contributed by the stormwater and groundwater collection systems, and records of periodic pumping of water from the pond to the Industrial Sump. A drawdown test is proposed that would measure response in nearby monitoring wells to lowering of the pond water level by pumping water out of the pond. The pond drawdown test will be conducted and analyzed as part of the Groundwater in the Uppermost Aquifer AOC investigation.

5.1.31.5 Characterize COPC in Stormwater Pond Sediment and Surface Water

Stormwater collected from the former plant area is discharged to the stormwater pond, which is located south of the Plant Area AOC (Figure 5.1.31-2). The stormwater pond was also used as an emergency supply of water for fire suppression. Stormwater collected in the pond is periodically pumped to the industrial sump where it was historically commingled with process waste water prior to discharge to the NPDES ponds under the NPDES permit. In 2010, a bypass line was constructed and normal discharge to the NPDES ponds subsequently ceased because waste water downstream of the Industrial Sump was redirected to the bypass line (Columbia Gorge Aluminum 2011).

The stormwater pond was constructed by excavation into basalt bedrock, and expanded to its present configuration during the early 2000s (Lockwood Green et al. 1999). The pond is unlined and likely locally recharges shallow basalt groundwater. It is used to temporarily store stormwater and settle solids out of stormwater prior to discharge. Water is discharged into the pond through two inlets; the primary inlet is located at the head of a narrow arm or flow channel at the northeast corner of the pond, and a secondary inlet is located along the northern side of the pond just east of the stormwater pump station. A delta of sediment has developed at the primary inlet. An unknown thickness of sediments has accumulated across the main portion of the pond.

Sediments within the stormwater pond were previously sampled and partially characterized in 1991 (Technico Environmental Services 1990, 1991b). Most of the pond sediment samples were determined to represent state-designated EHW based on PAH concentrations exceeding the one percent EHW PAH criteria. Previous pond sediment sampling has not included all of the COPC that have been identified for the CGA Smelter site. In addition, there is no indication of previous pond sediment removal.

Sample Pond Sediment and Surface Water

Prior to pond sediment sampling, a preliminary probe will be conducted to assess the thickness and consistency of the pond sediment. This information will be used to confirm the type of sampling equipment used and the number of samples collected. The goal of the sediment sampling will be to core through the thickness of sediment; however, if the sediment porosity is too high, then an alternate method of sampling will be used.

Sediment cores will be collected from three sampling locations in the main portion of the pond (Figure 5.1.31-2). The cores are anticipated to penetrate the full thickness of the sediments. A total of nine sediment samples will be collected; three sediment samples will be collected from each core from the upper portion, the mid-point and the bottom portion of the sediment column. One surface water sample will be collected from the bottom of the water column, above the surface of pond sediments, at each of the core locations.

Four shallow sediment samples will be collected from the primary and secondary pond water inlets. Two sampling locations will be located in the primary inlet where sediment is expected to be present at increasing thickness from the inlet toward the center of the pond. One shallow sample will be collected in each of the two sampling locations, and one deeper sediment sample will be collected at the sampling location farthest from the primary inlet (Figure 5.1.31-2). The sampling locations can be accessed from dry land adjacent to the primary inlet water channel.

The sediment and surface water samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, TPH-Dx, and TPH-Gx. A summary of the sampling program is presented in Table 5.1.31-2.

Surface Soil in Ravine Adjacent to Pond

Anecdotal information from site files indicates that the stormwater pond may have historically overflowed on one or more occasions. Overflow may have reached a shallow ravine adjacent to the pond, which is oriented southeastward and leads to a culvert beneath John Day Dam Road. The ravine is in line with Wetland K located south of John Day Dam Road.

Four surface soil samples will be collected from the ravine adjacent to the stormwater pond (Figure 5.1.31-2). The samples locations will be spaced approximately 100 feet apart along the distance between the margin of the pond and the culvert beneath John Day Dam Road. The surface soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, TPH-Dx, and TPH-Gx. The sampling program is summarized on Table 5.1.31-2.

Groundwater Characterization

Groundwater characterization activities in this area will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2). A well cluster with wells completed in BAU and BAL aquifer zones (RI-MW2-BAU and RI-MW2-BAL) will be installed on the south side of the stormwater detention pond to characterize the hydrostratigraphy and evaluate potential contaminant releases from this feature. A constant rate pumping will be performed to evaluate aquifer interconnection and aquifer zone properties at the RI-MW2 well cluster. The test will include pumping of RI-MW2-BAU with monitoring of well RI-MW2-BAL and the stormwater detention pond. A water-level characterization study will also be performed with ongoing transducer measurements recorded at the RI-MW2 well cluster and at the stormwater detention pond. This study will be performed over a several month period to better define seasonal trends and aquifer interconnection. A pond drawdown test will also be performed to evaluate the groundwater water-level response from drawing down water-levels in the pond and reducing or eliminating a likely potential source of shallow groundwater recharge.

5.1.32 Additional Investigation Area-Ditch on the Southern Side of the West SPL Storage Area

Ecology (2015b) comments on the Draft Phase 1 Work Plan identified further investigation of this feature as a RI data need for the West SPL Storage Area (SWMU 13). The ditch on the southern side of the West SPL Storage Area (SWMU 13) historically contained the scrubber slurry line leading to the WSI and there's some evidence of releases to this historically unlined drainage as summarized in detail in the Phase 1 Work Plan in the section regarding the West SPL Storage Area (SWMU 13). Because the WSI slurry lines were located in the ditch over a sustained period (WSI was operated from 1982 to 2005), there's potential for the sludge lines (or other potential sources, e.g., other miscellaneous drainage lines) to have released contaminants to this historically unlined ditch. Because the ditch represents a separate feature from the West SPL Storage Area (SWMU 13), it is described as an additional investigation area for planning purposes.

The southern surface drainage ditch was repaired and modified in both 1996 and 1997. In 1996, in response to a blocked culvert, slumped slopes, and an associated spike in shallow groundwater concentrations in nearby wells, a slope repair grading plan was prepared and repairs were made (CH2MHill 1996; Wayne Wooster, e-mail communication, May 5, 1997). Based on the design drawings for the proposed work (CH2MHill 1996), the grade of the south and west slopes was reduced and the ditch along the base of the southern slope was rebuilt, lined with 30-mil PVC liner, and covered with crushed rock. During winter 1997, a front end loader got stuck in the ditch during snow removal operations and damaged about 50 feet of the liner in the southern ditch (Wayne Wooster, e-mail communication, May 5, 1997). This damage was subsequently repaired during summer 1997. The plan was to use a 60-mil HDPE liner placed in a shingled fashion in the affected area, covering it with fabric, and installing a final crushed rock cover (CH2MHill 1997).

5.1.32.1 Investigation Objectives

Ecology (2015b) comments on the Draft Phase 1 Work Plan requested characterization of the ditch. The objective of the investigation is to determine the current layout and physical condition of the ditch, characterize chemical concentrations in ditch soils, and evaluate if a release has occurred that may serve as an ongoing source of contamination.

5.1.32.2 Investigation Scope

The southern ditch along the southern side of the West SPL Storage Area will be inspected to verify the layout of the ditch, identify areas of sediment/soil accumulation, identify any blockages or drainage problems, and to attempt to verify the lined portion of the ditch and its condition. Any observed extensions of the ditch to the east or south of the West SPL Storage Area will also be inspected for a distance of up to 300 feet. Based on the results of the visual inspection, a minimum of one soil sample will be collected from the unlined ditch extension downstream (south) of the West SPL Storage Area (refer to Figure 5.1.32-1). A surface soil grab sample will be collected with a hand-auger and analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), sulfate, PCBs, and TPH-Dx to characterize soil concentrations.

Legend

- Existing Monitoring Well
- Hand Auger Sample Location

N W E S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 5.1.32-1
Ditch on the Southern Side of
West SPL Storage Area

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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5.2 AREAS OF CONCERN INVESTIGATION OBJECTIVES, SCOPE OF WORK, AND RATIONALE

This section presents the investigation objectives, scope of work, and rationale for the RI field investigation of the AOCs listed in the Agreed Order including Columbia River Sediments, Groundwater in the Uppermost Aquifer, Wetlands, and the Rectifier Yard. A letter was submitted that notified Ecology of the discovery and premise for the Plant Area AOC (Lockheed Martin and BMEC 2014) consistent with the requirements of the Agreed Order. The Plant Area AOC RI field investigation objectives, scope of work, and rationale are also described in this section. Tables 3-3 and 3-4 summarize the investigation status and RI data needs for each AOC as identified in the Phase 1 Work Plan.

A brief summary of background information for individual AOC is also provided in this section as needed for context and clarity. Refer to the Phase 1 Work Plan for a detailed summary of available information and historical data for each AOC.

5.2.1 Columbia River Sediments

Primary features relevant to the investigation of the Columbia River Sediment AOC include the John Day Dam, the Boat Basin and associated drainages, and the NPDES outfall. Details regarding Columbia River sediments in the vicinity of the former smelter facility, including site setting, key features such as the John Day Dam and NSC NPDES outfall operations, as well as past environmental sediment investigations and summary of associated results are provided in the Phase 1 Work Plan. A brief description and summary of investigation status for this AOC is provided in Table 3-2. The features associated with the former smelter site and Columbia River Sediments AOC are shown on Figure 2-2.

The Columbia River Sediment AOC is located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation (Ecology 2014). The North Shore Treaty Fishing Access Site (TFAS) is an upland area maintained by the Yakama Nation and is located immediately upstream of the John Day Dam and west of the Boat Basin (refer to Figure 2-2). The primary use of the Boat Basin is as a public boat launch to provide access to the Columbia River. The Boat Basin also is reportedly used for recreational fishing for predominately warm water species such as bass.

The following sections include discussion regarding investigation objectives, scope of work and key work elements, as well as data assessment supplemental risk evaluation, and reporting. Field investigation methods and procedures are discussed in Section 5.3. Laboratory analytical methods and associated data quality objectives are summarized in Section 6.0.

5.2.1.1 Investigation Objectives

The regulatory framework for the Columbia River Sediments AOC, including identification of COPC and associated environmental screening levels are discussed and summarized in the Phase 1 Work Plan. The data needs for this AOC were based on the review and findings of the Phase 1 Work Plan, and are summarized in Table 3-4 of this plan.

The Agreed Order indicates that the following transport pathways will be evaluated for their potential to contaminate sediment: direct discharges, stormwater discharges, sheet flow, groundwater discharges and seeps, soil erosion, and spills, dumps, leaks and other activities at the facility (Ecology 2014). These potential pathways are being addressed through the planned investigations of SWMUs and AOCs as described in Section 5.1 and 5.2, respectively.

The focus of this investigation is on the collection of new chemical and physical sediment data to establish current sediment quality conditions associated with the Columbia River and Boat Basin areas adjacent to the former Columbia Gorge Aluminum Smelter Site. This information will be used to assess potential impacts from the former smelter site, as well as to identify if there are potential ecological and human-health risks based on current conditions.

The primary RI objectives for the Columbia River AOC RI investigation include the following:

- **Characterize Current Sediment Quality Conditions**. Although available historical data generally indicate that chemical concentrations in Columbia River sediments adjacent to the Site are relatively low compared to the screening levels identified in the Phase 1 Work Plan, the associated studies were completed over 10 years ago or more and may not represent current site conditions. As such, new data will be collected to evaluate the potential for ecological and human health risks associated with Columbia River sediments adjacent to the subject site.

- **Establish Background Sediment Quality Conditions**. Representative upstream background station locations (outside the potential influence of the project site) need to be established. Background sediment quality information is necessary for comparative review against site-specific data quality results, as well as to assess potential contribution from upstream sources, including both the Columbia River and John Day River systems.

- **Understand Sediment Transport and Deposition Dynamics**. Information is needed to better understand sediment transport and depositional environments for the Columbia River sediments in the vicinity of the site (e.g., loading rates associated with the Columbia and John Day River(s) upstream of the site, estimated rates of deposition and accumulation within the AOC, areas subject to potential re-suspension, degree of connection and circulation between the Columbia River and the Boat Basin feature, and potential maintenance dredging associated with the operation of the John Day Dam).

- **Determine Potential Ecological and Human Health Risks.** Newly collected sediment quality data will be compared against available freshwater sediment screening levels and representative background concentrations.

5.2.1.2 Scope of Work and Technical Approach

The investigation scope of work for the Columbia River Sediment AOC has been prepared in accordance with Ecology's Sediment Cleanup User's Manual (SCUM) II (Ecology 2015c), which serves as guidance for implementing the cleanup provisions of the Sediment Management Standards, Chapter 173-204 WAC (Ecology 2013).

The Phase 1 Work Plan identified preliminary ecological and human health exposure pathways for sediments. Human activities that may result in exposure to contaminated sediments identified for the Columbia River adjacent to the site include boating and recreational and tribal fishing, with access provided by a boat launch at Railroad Island Park located immediately upstream of the John Day Dam within the Boat Basin (refer to Figure 2-2). The human health and ecological exposure models for sediments identifies direct contact and ingestion as the primary potential exposure routes, and as such the RI work effort will focus on collection of representative surface sediment chemistry data associated with surface sediment collected from the biologically active zone (BAZ). The BAZ is conservatively assumed to range from 0- to 6-inches (about 15 centimeters) for this work effort. As a result, a van Veen grab sampler will be used for collection of surface sediments. Collecting surface sediment using a van Veen grab sampler will cause minimal disturbance to the surficial layer while providing sufficient capacity for collecting necessary volumes of sediment from the BAZ. Based on guidance (ITRC 2011), a 15 centimeter BAZ is appropriate for freshwater unless site-specific information is available. If during the sampling activities, deeper burrowing benthic organisms are identified in the investigation area (e.g. clams), then an evaluation will be made to determine if deeper sampling is warranted. This additional sampling would be performed as part of a separate mobilization, and summarized in a supplemental work plan addendum that would be submitted for comment and approval prior to conducting the work.

Surface sediment collection and processing will follow standardized procedures for the Puget Sound area that have been developed by Puget Sound Estuary Program (PSEP) (PSEP 1997a,b), as well as SCUM II guidance for implementing the cleanup provisions of the SMS, Chapter 173-204 WAC. Columbia River sediment sample collection and handling procedures are discussed in Section 5.3.9.

Sample Station Selection and Location

Sediment sample station locations have been selected along the shoreline adjacent to the former smelter site with emphasis to target potential contaminant migration routes (e.g., natural site drainage features, NPDES discharge area, Boat Basin feature, potential accumulation areas, potential areas of groundwater discharge) where highest potential for impacts from the site to sediment might occur. In addition, background location stations have been identified for both the Columbia and John Day River systems to document current upstream sediment quality for comparison to Site data. Table 5.2.1-1 provides a summary for the Columbia River sediments sampling program, including area of investigation, sample collection type and total number of samples, proposed analytical suite of chemicals, and rationale for sample station location selection. In addition, Table 5.2.1-1 includes a tiered sample analysis approach that is discussed in further detail below. Figure 5.2.1-1 shows the Columbia River Sediments AOC sampling station locations. Figure 5.2.1-2 identifies the upstream background station locations, including those proposed along the Columbia River and along the John Day River near its confluence. The actual background station locations may be adjusted in order to better represent site-specific physical conditions (i.e., grain size distribution).

Target sample stations will be located in the field using a differential global positioning system (DGPS). The DGPS will include a GPS receiver unit onboard the sampling vessel and a Coast Guard differential beacon receiver. The Coast Guard beacon receiver will provide differential corrections to the GPS, providing positioning accuracy to within approximately 1 meter. Surveying and station location requirements and procedures are discussed in Section 5.3.

Table 5.2.1-1
Columbia River Sediments AOC Sampling Program
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 2)

Area of Investigation	Type and Number of Samples[a]	Analytical Suite[b]	Sample Area Description and Sample Rationale
Boat Basin and Adjacent Columbia River Frontage	12 (Tier 1) 4 (Tier 2[c])	<u>COPC</u>: -- Cyanide[s] -- Fluoride[c] -- Sulfate[c] -- PAHs -- PCBs[d] -- TPH-Dx -- Metals Other <u>Constituents</u>: -- TOC -- Grain Size	The Boat Basin is separated from the Columbia River by a railroad dike. A large culvert provides access to the Columbia River for boaters and is the only direct connection between the Boat Basin and the River. The Boat Basin includes a public boat launch and is located about 0.25 miles from the North Shore Treaty Fishing Access Site (TFAS). Intermittent drainage from the former aluminum smelter facility periodically discharges to The Boat Basin during storm events. Sample station locations are positioned in areas most likely to receive site runoff and in areas of high use (e.g., drainage paths, Boat Basin entrance and launch areas). Additional Columbia River station locations are positioned to provide coverage across the reach of The Boat Basin and to address areas where sediment is likely to accumulate. An additional upland site (the John Day Dam Burn Pile, FSID, 16820) (USACE 1994) that represents a potential source of sediment contamination is located on the southern side of the island that forms the southern shore of the Boat Basin. Operations at the John Day Lock and Dam are independent and are unrelated to the former smelter. Refer to the Phase 1 Work Plan for further description. Three stations in this investigation area (SD15, SD21, and SD22) will be analyzed for PCB congeners (in addition to the standard analytical suite) including a location adjacent to the boat ramp, and two stations outside the Boat Basin in suspected sediment accumulation areas.
Columbia River at NPDES Outfall and Mixing Zone	6 (Tier 1) 2 (Tier 2[c])		Sample station locations are positioned to capture discharge from the NPDES outfall diffuser, and primary mixing zone area associated with the NPDES outfall. Three stations (SD7, SD9, and SD11) will be analyzed for PCB congeners (in addition to the standard analytical suite) near the NPDES Outfall.
Columbia River Upstream of NPDES Outfall to Eastern Boundary Below John Day River	6 (Tier 1) 6 (Tier 2[c])		Sample station locations are positioned along the shoreline in the vicinity of potential drainage and groundwater discharge pathways, as well as in areas where sediment is likely to accumulate. One station location (SD05) will be analyzed for PCB congeners (in addition to the standard analytical suite) in an assumed backwater depositional area near the surface water intake for the former plant and down slope from the eastern portion of the former smelter.
Columbia River and John Day River Background Station Locations	12 (Tier 1)		Nine background sample station locations are positioned in the Columbia River between 1-2 miles upstream of the John Day River confluence for the purpose of evaluating baseline background conditions and potential upstream contributions. Three background sample station locations are positioned along the John Day River adjacent to confluence with the Columbia River. The purpose of these samples is to assess contribution from the John Day watershed. Background station locations may be adjusted in order to better represent actual Site-specific physical conditions (i.e., grain size distribution). All 12 background stations will be analyzed for PCB congener (in addition to the standard analytical suite) to provide an adequate data set for comparison.

Table 5.2.1-1
Columbia River Sediments AOC Sampling Program
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 2 of 2)

a All samples to be collected from the biologically active zone (0- to 6-inches) as discrete grab samples. The sediment sampling program includes collection and full (comprehensive) laboratory analysis of thirty (30) Tier 1 samples. In addition, twelve (12) Tier 2 samples will be collected and archived for select laboratory analysis (if required) based on results of the Tier 1 sample group.

b The full analytical suite will be collected and analyzed for all Tier 1 samples. Tier 1 sample results will determine the need for Tier 2 sample analysis.

c Tier 2 samples for total cyanide, fluoride, and sulfate will not be archived and will be analyzed with the Tier 1 samples due to holding time limits for these analyses.

d All samples will be analyzed for PCB Aroclors by EPA method 8082. Select samples will be analyzed for PCB congeners (list of 209 congeners), including all background locations and select samples from each investigation area (refer to Figures 5.2.1-1 and 5.2.1-2).

Notes:

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

AOC Area of Concern
COPC Chemicals of Potential Concern
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
TOC Total Organic Carbon
TPH-Dx Total Petroleum Hydrocarbons (Diesel- and Oil-Range)
Metals Includes Aluminum, Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Selenium, and Zinc. The select list of metals represents those associated with the Washington State Sediment Management Standards, as well as those common to the aluminum reduction and smelter operations.

Legend

SD01 Tier 1 - Sediment Samples Collected for Full Suite Analysis

SD25 Tier 2 - Sediment Samples Collected and Archived Pending Tier 1 Results

Sample to be Analyzed for PCB Congeners

BKG01 - Background Station Location

SD01 - Sediment Sample Station Location

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000

Feet

Figure 5.2.1-1

Columbia River Sediment AOC

Sediment Sampling Location Map

Columbia Gorge Aluminum Smelter Site

Goldendale, Washington

Legend

BKG01
Tier 1 - Sediment Samples Collected for Full Suite Analyses Including PCB Congeners

BKG01 - Background Station Locations
May be adjusted in order to represent actual site-specific physical characteristics (i.e. grain size distribution).

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 5.2.1-2
Columbia River Sediment AOC
Background Sediment Station Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Sample Analytical Program Summary

A comprehensive analytical suite has been selected to characterize the COPC that were identified for the Columbia River sediment investigation as part of the Phase 1 Work Plan, including PAHs, PCBs, TPH-Dx, selected metals (aluminum, arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc), and aluminum reduction-related chemicals (cyanide, fluoride, and sulfate). For PCBs, all samples will be analyzed for PCB Aroclors and a select set of locations will also be analyzed for PCB congeners (Figures 5.2.1-1 and 5.2.1-2). The list of metals represents those associated with the Washington State SMS, as well as those common to aluminum reduction and smelter operations. In addition to sample collection for COPC, routine sampling will include grain size and total organic carbon (TOC) analysis.

Grain size and TOC analyses will provide information regarding sediment physical characteristics and depositional environment associated with the collected samples. The laboratory analytical methods and associated data quality objectives for sediment analysis are provided in Section 6.0.

Tiered Analytical Approach

Sample analyses will be conducted using a tiered approach, with thirty-six (36) priority (Tier 1) samples being collected and analyzed for the full suite of analysis (refer to Table 5.2.1-1). Additionally, twelve (12) supplemental (Tier 2) samples will also be collected and archived as part of the same mobilization, with the archived samples being analyzed only as necessary based on the Tier 1 sample results (refer to Table 5.2.1-1 and Figures 5.2.1-1 and 5.2.1-2). An exception to the Tier 2 archiving of samples includes automatic analyses of total cyanide, fluoride, and sulfate due to holding time limits.

A total of 24 Tier 1 sampling stations were selected based on proximity to areas of historical plant operations, potential transport pathways between the site and the Columbia River, and areas of current use and potential exposures. Areas that will be targeted for initial Tier 1 sediment sample collection and analyses include: the NPDES discharge point and associated mixing zone, potential discharge areas for intermittent drainages leading to the Columbia River, and the Boat Basin including the public boat launch area. Areas of potential overland flow and runoff, as well as potential groundwater discharge are also addressed by the Tier 1 sampling program (refer to Table 5.2.1-1 and Figure 5.2.1-1).

Twelve (12) upstream Tier 1 background sample station locations have been identified, including three from the John Day River at the confluence with Columbia River, and nine from the Columbia River between 1-2 miles above the John Day River confluence (refer to Figure 5.2.1-2). The 12 upstream background station locations will provide information regarding contaminant levels associated with watershed-wide sources associated with the Columbia River and John Day River systems for comparative review against site-specific chemical data results. To collect representative background data, the background sediment characteristics (i.e., grain size distribution) should be similar to the Site sediment samples collected. Site sediment samples will be collected first to establish the physical sediment characteristics to be used to assess the background station sediments. Site sediment sample and background sample physical characteristics will be evaluated using 1) standard practice for description and identification of soils (visual-manual procedure, ASTM D 2488), and/or 2) field wet-screening procedure for grain size (USACE 2014). If the initial background sediment physical characteristics do not match Site sediment physical characteristics, then background station locations will be adjusted accordingly.

A total of 12 Tier 2 sampling stations have been included to supplement the Tier 1 sampling program (refer to Table 5.2.1-1 and Figure 5.2.1-1). Tier 2 samples will be collected as part of the same sampling event as the Tier 1 samples and archived, pending the Tier 1 sample results. The Tier 2 samples have been included in the sampling program to provide additional coverage to address the extent of contamination, as necessary based on review of the Tier 1 sample results. For example, if Tier 1 sediment sample results show elevated concentrations of PAHs and metals along the shoreline then the adjacent Tier 2 sample(s) would be analyzed for the same elevated compounds found in the Tier 1 sample(s). The need to perform Tier 2 sample analyses will be coordinated with Ecology based on review of Tier 1 sample results.

<u>Sediment Transport and Deposition Assessment</u>

The reach of the Columbia River in the site vicinity is thought to be a depositional area due to the presence of the John Day Dam downstream of the site and the confluence of the John Day River with the Columbia River on the Oregon shoreline southeast of the site. Maintenance dredging doesn’t appear to be ongoing for the reach of the Columbia River extending upstream from John Day Dam to the confluence with the John Day River based on initial conversations with the U.S. Army Corps of Engineers (Tetra Tech, personal communication, August 13, 2014).

The John Day River flows into the Columbia River on the Oregon side on the opposite river bank about one mile upstream of the former smelter site. The John Day River is free flowing and drains a fairly large area of central Oregon high desert (5,090 square miles) and contributes sediment to the Columbia River, particularly during high water periods (refer to Phase 1 Work Plan).

To gain a better understanding regarding sediment transport and depositional environment associated with the Columbia River sediments in the vicinity of the site, a literature search will be conducted to evaluate available information (if any) regarding: 1) loading rates associated with the Columbia and John Day River(s) upstream of the site, 2) estimated rates of deposition and areas subject to sediment accumulation and re-suspension, 3) the results of any bathymetric surveys performed in this reach of the Columbia River, and 4) degree of connection and circulation between the Columbia River and Boat Basin feature. In addition to the literature search, communications with USACE and USGS will be conducted to identify and obtain available information regarding surface water flow and discharge in the site vicinity, as well as to confirm that no routine maintenance dredging is performed within the AOC. Grain size distribution and TOC analysis will provide the primary evidence used to assess sediment transport and deposition. No other studies or sample collection is proposed for assessment of sediment transport dynamics is support of this RI work effort.

5.2.1.3 RI Sediment Data Assessment and Supplemental Risk Evaluation

Tier 1 analytical results will be compared on a dry-weight basis against the freshwater sediment screening levels developed in the Phase 1 Work Plan, as well as screened against background concentrations collected as part of the RI work effort. COPC associated with aluminum reduction and smelter operations not covered by the Washington State SMS (e.g., aluminum, cyanide, sulfate and fluoride) will be evaluated by comparative review of chemical concentrations with site-specific background concentrations, as well as screening with literature values, as a means to assess the potential for ecological and human health risks.

The screening of Tier 1 sample results will be used to determine if Tier 2 sample analyses are required, including which COPC will be included for analysis. An initial assessment of ecological and human health risks will be based on review of the laboratory analytical results for both Tier 1 and Tier 2 samples, and associated comparison against established screening levels and background concentrations.

If sediment concentrations in the analyzed Tier 1 and Tier 2 samples exceed the SMS levels, background concentrations, and/or other ecologic screening levels, the data will be further evaluated to determine if collection of bioassay samples and deeper sediment samples is needed to complete the RI/FS. This additional sampling would be performed as part of a separate mobilization, and summarized in a supplemental work plan addendum that would be submitted for comment and approval prior to conducting the work.

If elevated concentrations (i.e., those detected above established COPC screening levels and background levels) in site sediments suggest ecological and/or human risks may be present, a supplemental work plan addendum will be prepared that will describe the objectives, approach, and method(s) for risk evaluation, as appropriate, and in accordance with SCUM II guidance (Ecology 2015c). The supplemental work would require Ecology and Yakama Nation review and Ecology approval prior to implementation.

5.2.2 Groundwater in the Uppermost Aquifer

This section summarizes the scope and rationale for the groundwater RI. The identified data needs as described in Section 3.0 and the Phase 1 Work Plan were used to develop the overall investigation scope and work element details. The following sections include: a brief summary of site hydrostratigraphy an overview of the investigation scope, a detailed summary of the proposed work elements, and associated rationale.

5.2.2.1 Site Hydrostratigraphy

Site hydrogeology and historical groundwater contaminant data are presented in detail in the Phase 1 Work Plan. A brief summary of site hydrostratigraphy is provided as background for evaluation of the scope of work. Conceptually, the hydrostratigraphy at the site consists of an unconsolidated aquifer zone that is underlain by a series of water-bearing zones within the basalt bedrock. Groundwater flow is conceptualized to be toward the Columbia River to the southwest. A downward vertical gradient has been documented between the aquifer zones. The following aquifer zones have been defined at the site and this terminology is used in the scoping of the groundwater in the Uppermost Aquifer AOC:

- **Unconsolidated Aquifer (UA)**. The UA Zone includes the shallow water-bearing zone in the colluvium, alluvium, and fill that overlies the basalt bedrock at the site. This unit is thicker and more laterally extensive on the western side of the site than in the eastern portion. At some locations, shallow groundwater occurs within the first 2 to 3 feet of weathered and fractured basalt bedrock, and is considered part of this zone. A French-drain groundwater collection system is present in the vicinity of the former plant and discharges shallow groundwater to the stormwater system and NPDES Pond A.

- **Basalt Aquifer Upper (BAU)**. The BAU Zone is consistently present beneath the first basalt flow/interval/bed at both the ESI and WSI. At the ESI a second, deeper, water-bearing zone within the BAU has been identified at around 49 to 68 feet bgs.

- **Basalt Aquifer-Lower (BAL)**. The BAL zone includes all of the saturated zones beneath the BAU. The BAL extends below the interpreted BAU zone to the surface elevation of the Columbia River, which conceptually represents a constant head boundary for the site basalt aquifer system. It is currently unclear how many discrete water-bearing zones are present in the BAL.

5.2.2.2 Investigation Scope Overview

The investigation includes a site-wide drilling and well installation program to complete RI groundwater site characterization activities. The investigation scope includes construction of additional wells to be screened in each aquifer zone. A total of 22 wells will be installed at the site including: 2 UA zone wells, 14 BAU-aquifer zone wells, and 6 BAL-aquifer zone wells. In addition, up to 10 temporary wells will be installed in the UA-zone if shallow groundwater is encountered to evaluate if releases to groundwater have occurred at specific SWMUs and other investigation areas. Figure 5.2.2-1 shows the existing and proposed new well locations and Figure 5.2.2-2 shows the proposed well locations.

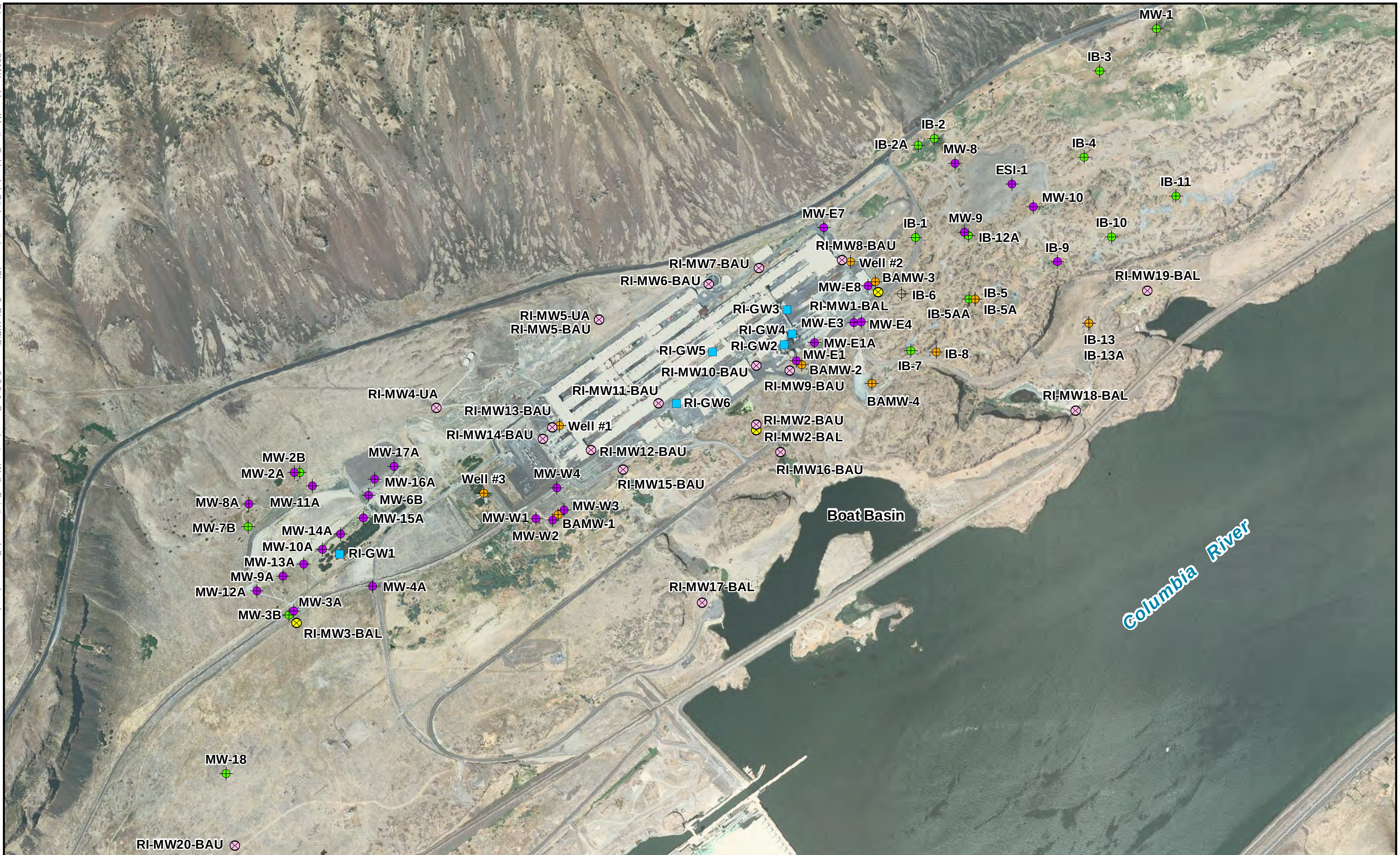
Aquifer testing will include:

1. Packer testing of permeable and impermeable zones in three cored boreholes
2. Slug tests at all newly constructed and existing wells
3. A water-level characterization study to evaluate seasonal variability and potential interconnection (two well cluster locations will be instrumented with water level data loggers to assess seasonal variation in recharge and water level response in adjacent aquifer zones over a several month period)
4. Constant-rate pumping tests of wells completed in the BAU and BAL zones to evaluate aquifer properties and aquifer zone interconnection
5. A pumping test of facility production wells to evaluate aquifer interconnection
6. A stormwater detention pond drawdown test to evaluate interconnection between the pond and nearby bedrock aquifer zone wells.

Four comprehensive rounds of water-levels and groundwater chemical data collection will be performed site-wide from all available existing and newly constructed monitoring wells. The sampling will be conducted semiannually during a wet and dry season.

5.2.2.3 Investigation Approach and Work Elements

The following section provides an overview of the investigation approach and work elements to address the identified data needs. A detailed summary of the field program, including characterization data needs, investigation objectives, work elements, and rationale is provided in Table 5.2.2-1.



Legend

Existing Wells
- Unconsolidated Aquifer Well
- Uppermost Basalt Aquifer Well
- Lower Basalt Aquifer Well
- Undesignated Well

Proposed Wells
- Deep Well with Coring (BAL)
- Shallow Well (UA or BAU as labeled)
- Temporary Shallow Well (to be Installed if Shallow Groundwater is Encountered during Drilling)

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.2.2-1
Existing and Proposed Groundwater Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Legend

Proposed Wells

- Deep Well with Coring (BAL)
- Shallow Well (UA or BAU as labeled)
- Temporary Shallow Well (to be Installed if Shallow Groundwater is Encountered during Drilling)

N W E S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 5.2.2-2
Proposed Groundwater Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table 5.2.2-1
Groundwater in the Uppermost Aquifer Area of Concern Data Needs and Scope Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 3)

Data Need	Investigation Area	Investigation Objectives	Proposed Groundwater Investigation Work Element	Rationale and Additional Description
Existing well inspection and survey	All existing monitoring wells	Verify well condition and suitability, verify surveying datum.	Review well construction logs, Inspect all existing wells prior to inclusion in remedial investigation (RI) program; repair, re-survey and re-develop wells as appropriate.	Ensure accurate and representative RI groundwater results.
		Identify wells that are not usable and that require physical modification or decommissioning.	Modify or decommission wells as appropriate.	
Hydrostratigraphic characterization	Site-wide	Identification and hydraulic testing of fracture zones and flow interiors. Characterization and confirmation of water-bearing zones. Characterization of groundwater flow direction and gradients.	Coring with packer testing at up to three borings (RI-MW1-BAL, RI MW2-BAL, RI-MW3-BAL). Well RI MW1-BAL is proposed for near well BAMW-3, well RI-MW2-BAL is proposed to be located south of the stormwater detention pond, and well RI-MW3-BAL is proposed to be located at the MW-3A/3B well cluster downgradient of the West Surface Impoundment (WSI).	Up to three core holes will be drilled at the beginning of the groundwater characterization activities.
			Installation of three deep wells paired with existing shallower wells where practicable.	Deep wells will be installed at these three locations after the coring is completed. The RI-MW1 location (RI-MW1-BAL) is proposed to be completed in the Basalt Aquifer-Lower (BAL) Zone below the BAMW-3 screen interval [111-133 feet below ground surface (bgs)] in a permeable water-bearing zone above the elevation of the Columbia River Pool at about 215 to 240 feet bgs. Based on water-level elevations, it appears that well BAMW-3 may in a shallower zone than some of the other BAL-designated wells and the vertical extent of contamination is not characterized in this area. At the RI-MW2 location, two wells are proposed: one in the Basalt Aquifer-Upper (BAU) Zone and one in the BAL within about 10 feet in elevation of the Columbia River pool (RI-MW2-BAU and RI-MW2-BAL). A third deep BAL-zone well is proposed for the WSI area (RI-MW3-BAL). This well will be paired with the existing MW-3A/MW-3B well cluster that is downgradient of WSI and will also be completed in this same vertical zone.
			Four rounds of water-level elevation data (wet and dry season) to evaluate groundwater hydrostratigraphic zones, gradients, and seasonal differences.	Measurements will be collected at all wells deemed usable based on review and inspection will be included in the water-level program.
			Two cluster well location will be outfitted with water-level data loggers to better define seasonal trends and aquifer interconnection over a several-month period. The well cluster proposed include the RI-MW1-BAL/BAMW-3/MW-8 well cluster and the RI-MW2-BAU/RI-MW2-BAL well cluster. At the MW-2 well cluster, a data logger would also be placed at the nearby stormwater detention pond.	Klickitat County PUD will be consulted to determine the pumping schedule and anticipated amount of withdrawal for the production wells at the facility for the study period.
Aquifer characteristics	Site-wide	Hydraulic conductivity characterization.	Slug tests of all existing and new wells.	A combination of pneumatic and rising head tests are proposed.
		Aquifer zone interconnection and other aquifer characteristics.	Aquifer tests to determine interconnection between the BAU and BAL aquifer zones, characterize hydraulic conductivity, and transmissivity.	
			Monitoring Well Pumping Tests. Aquifer tests will be completed at the R1-MW1 and RI-MW2 well clusters to evaluate interconnection and aquifer zone properties.	• The RI-MW1 test will include with pumping of R1-MW1-BAL, with monitoring of well BAMW-3, RI-MW8-BAU, and at least one background well. • The RI-MW2 test will include pumping of RI-MW2-BAU with monitoring of RI-MW2-BAL, RI-MW16 BAU and RI-M9-BAU, and hand measurement of the stormwater detention pond water-level elevations.
			Production Well Pumping Tests. Two supplemental tests will be performed to evaluate aquifer interconnection through pumping of the production wells and measurement of the response in nearby wells completed in the BAL and BAU units. Two tests are planned:	• Pumping of Production Well 2 with monitoring of new wells MW1-BAL, RI-MW8-BAU, existing well BAMW-3 and RI-MW2-BAL. • Pumping of Production Well 1 and/or Production Well 3 with monitoring of new well RI MW18-BAU (to be located adjacent to Production Well 1), BAMW-1 (where there was previously a hydraulic response reported during the URS [2011] production well tests), and RI-MW2-BAL. During these tests, the production wells will be cycled on and run for a period of 2-3 days with water level data logger measurement in selected monitoring wells. Because of the lack of physical control of the pumping rates, and wide screen interval of the production wells, no attempt will be made to determine aquifer zone properties from the production well pumping tests.
			Stormwater Detention Pond Drawdown Test. A drawdown test of the Stormwater Detention Pond will be performed to assess interconnection between the pond and shallow (BAU) and deep (BAL) aquifer zones. The pond and the RI-MW2 well cluster will be monitored during the test.	Test will be performed during the late spring to allow for significant reduction of water levels in the pond and limited influx of stormwater into the pond over an extended period. Pond drawdown test should coincide with the water-level characterization study.

Table 5.2.2-1
Groundwater in the Uppermost Aquifer Area of Concern Data Needs and Scope Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Data Need	Investigation Area	Investigation Objectives	Proposed Groundwater Investigation Work Element	Rationale and Additional Description
Characterization of current groundwater quality	Site-wide	Characterize current conditions for site chemicals of potential concern (COPC). Characterize geochemistry to help define hydrostratigraphic zones.	Scope of work includes four quarterly rounds of groundwater sampling to address seasonal variability. Initial round to include geochemistry (major ions (Ca, Mg, Na, K, and Cl), and conventional parameters (hardness, total dissolved solids [TDS], and total alkalinity), and full COPC suite: total cyanide, weak acid dissociable (WAD) cyanide, free cyanide, fluoride, sulfate, selected metals (Al, As, Cd, Cr, Cu, Ni, Pb, and Zn. ESI wells will also include Fe), PAHs, and PCBs.	All new and usable existing monitoring wells and the three facility production wells will be included in the analytical program.
			During the initial sampling round, a subset of the wells and temporary wells (RI-MW2-BAU, RI-MW10-BAU, RI-GW-4, RI-GW-6, RI-MW11-BAU, RI-MW12-BAU, RI-MW13-BAU, RI-MW14-BAU, RI-MW15-BAU, and RI-GW1) will also be analyzed for VOCs, TPH-Gx, and TPH-Dx.	TPH-Dx, TPH-Gx, and VOC analyses will be performed at wells selected based on historical data and historical use information.
			The subsequent 3 quarterly sampling rounds will include targeted COPC list consisting of: total and WAD cyanide, fluoride, and sulfate. Additional chemicals detected above screening levels during the initial sampling round will be included as appropriate in selected wells during the subsequent sampling rounds.	
Plant Area AOC Groundwater Characterization	Cast House Pits	Determine if a release to groundwater has occurred. Characterize groundwater flow and hydrologic affects.	Cast House Pits. One well (RI-MW11-BAU) on southern side.	Evaluate potential connection between the Cast House Pits and shallow groundwater.
	Groundwater French Drain System		Groundwater French Drain System. Sample Paste Plant Unloading Area Sump, if accessible, determine elevation of water in sump. Determine amount of water conveyed by individual lines if the system is accessible.	Determine if the drain system eliminates most of the perched water at the UA/BAU contact. Determine amount of water conveyed by the conveyance system. The French Drains, stormwater, and waste water conveyance systems will be evaluated as part of SWMU 32 and Plant Area AOC investigations (refer to Sections 5.1.31 and 5.2.5).
	Electrostatic Precipitation Lines/Groundwater Collection Line (eastern end)		Electrostatic Precipitation Lines/Groundwater Collection Line (eastern end). Water at the outfall near NPDES Pond A will be sampled and the discharge will be estimated during wet and dry periods.	Estimate amount of discharge and determine chemical concentration range. Sample of discharge to be collected as part of Plant Area AOC investigation.
	Industrial Sump		Industrial Sump. One well (RI-MW10-BAU).	Determine if the sump represents a source of infiltrating water or groundwater contamination. Determine if a release to shallow groundwater has occurred. Characterize shallow groundwater flow directions in this area.
	Equipment Wash Station and Oil Change Pit		Equipment Wash Station and Oil Change Pit. One well (RI-MW12-BAU) on south side.	Determine if a release to groundwater has occurred at this location. Characterize groundwater flow.
	Friction Weld Press Pit		Friction Weld Press Pit. Shallow temporary well sample (RI-GW2).	Determine if a release to shallow groundwater has occurred.
	Fuel handling and storage areas (Compressor Building)		Fuel Handling and Storage Areas (Compressor Building). Temporary well sample (RI-GW6).	Underground storage tanks (UST) were formerly located at western end of Compressor Building and subsequently replaced by above-ground storage tanks (AST). Petroleum hydrocarbons were routinely handled at this building.
Characterization of potential groundwater releases at selected SWMUs and other areas lacking historical groundwater chemical data	National Pollutant Discharge Elimination System (NPDES) Ponds (SWMU 1)	Determine if a release has occurred to groundwater. Characterization of site-wide nature and extent of groundwater contamination.	One shallow well near Pond D (RI-MW18-BAL).	Characterize groundwater concentrations at NPDES Pond D; evaluate groundwater to surface water pathway; well will be completed in the shallowest water-bearing zone that is likely interconnected with BAL unit in this area.
	Line A Secondary Scrubber Recycle Station (SWMU 5)		One shallow temporary well on southwest (downgradient) side of unit (RI-GW5).	
	Line B, C, D Secondary Scrubber Recycle Stations (SWMU 6)		One shallow well on southwest (downgradient) side of unit (RI-MW6-BAU). One shallow temporary well on southwest (downgradient) side of unit (RI-GW7).	
	Tertiary Treatment Plant (SWMU 8)		One shallow well on southwest (downgradient) side of unit (RI-MW6-BAU).	
	Paste Plant Water Recycle System (SWMU 9)		One shallow temporary well at sump location (RI-GW4).	
	North and South SPL Soaking Stations (SWMUs 10 and 11)		One shallow well (RI-MW8-BAU) on downgradient (south) of units and upgradient of Production Well 2.	Groundwater chemical data from the downgradient side of the units was not collected during the initial 2008 field effort because of the lack of shallow (UA) groundwater.
	North SPL Containment Building (SWMU 14)		One shallow well southwest (downgradient) of SWMU with historical drainage problems (RI-MW7-BAU).	
	Caustic Spill (SWMU 29)		One shallow temporary well at spill site (RI-GW3).	
	Paste Plant Spill (SWMU 30)		One well to evaluate filled depression in spill area (RI-MW9-BAU).	Well MW-E1 has been historically dry with total depth of 13 feet bgs. At nearby well BAMW-2, a water-bearing zone was reported from 10 to 35 feet bgs in the base of the alluvium and top of basalt that yielded about 50 gal/min. BAMW-2 was completed in a deeper zone (220 to 240 feet bgs screen interval) and a suitable well has not been completed in the shallow water-bearing zone. The backfilled depression is expected to contain water and the fill has not been adequately characterized.
	Stormwater Pond and Appurtenant Facilities (SWMU 32)		See hydrostratigraphic characterization aquifer characteristics, and stormwater detention pond data needs (proposed wells RI-MW2-BAU and RI-MW2-BAL).	
	Rectifier Yard AOC-AST, oil house, oil conveyance lines		Two wells (RI-MW13-BAU and RI-MW14-BAU) to determine if a release to groundwater has occurred near the oil conveyance lines, AST, or oil house.	Note that well RI-MW13-BAU is also located near production well 1.
	R&D septic drain field		One shallow temporary well completed in (UA) with groundwater sampling to evaluate if a release has occurred (RI-GW1). Boring will also provide additional downgradient groundwater chemical data for WSI and West SPL Storage Area.	
	Plant Area AOC		Up to three additional temporary wells with locations determined based on 1) field screening and observations, 2) occurrence of shallow groundwater, 3) proximity to suspected sources, 4) proximity to groundwater collection lines, and 5) spacing consideration with other shallow temporary wells.	

Table 5.2.2-1
Groundwater in the Uppermost Aquifer Area of Concern Data Needs and Scope Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 3 of 3)

Data Need	Investigation Area	Investigation Objectives	Proposed Groundwater Investigation Work Element	Rationale and Additional Description
Characterization of lateral extent of groundwater contamination (downgradient extent)	Areas between site and Columbia River	Determine lateral extent of contamination. Evaluate groundwater to surface water and groundwater to sediment pathway as warranted.	Well located near Boat Launch and Treaty Fishing Access Site (TFAS) at mouth of gulley that drains into Boat Basin (RI-MW17-BAL).	Well will be completed in first water-bearing zone within basalt to evaluate groundwater conditions near the Boat Basin and TFAS and evaluate the groundwater to surface water migration pathway. The gulley represents fault trace (refer to KPUD 2014) that could represent a preferential groundwater flow pathway. Shallow groundwater in bedrock at locations along the Columbia River shoreline is expected to be interconnected with the BAL zone.
			Well located on southern side of NPDES Pond D (per Ecology Phase 1 Work Plan Comments) (RI-MW18-BAL).	Well targeted for first water-bearing zone within basalt. Well will also characterize potential releases to groundwater at downstream end of NPDES Ponds (Pond D).
			Well located east of IB-13/IB-13A well cluster (RI-MW19-BAL).	Well will be completed in first water-bearing zone in the basalt with depth likely similar to IB-13A (89-95 feet bgs). Well will characterize conditions near the edge of the fluoride and sulfate plume associated with well IB-13/IB-13A.
			Well located downgradient of MW-18 (per Ecology Phase 1 Work Plan Comments) (RI-MW20-BAU).	`
			Site reconnaissance of hillslopes near Columbia River to confirm absence of groundwater seeps and springs.	
Characterization of Vertical Extent of Contamination near suspected source areas	Site-Wide	Determine if deeper aquifer zones have been impacted.	Deep borings completed near the elevation of the Columbia River. Completion of deep wells in different areas of site (east, central, west) and near or downgradient of potential sources (at locations RI-MW1-BAL, RI-MW2-BAL, and RI-MW3-BAL). See also hydrostratigraphic characterization data needs.	The vertical extent of groundwater contamination near the Former Production Area represents an important consideration in evaluation of the groundwater to surface water pathway and for evaluation of the contamination potential for the facility production wells.
Characterization of potential effects of stormwater detention pond on groundwater	Stormwater Detention Pond	Determine if a release to groundwater has occurred. Characterize groundwater flow and hydrologic relationship between the pond and groundwater.	Installation and sampling of two wells near detention pond (RI-MW2-BAU and RI-MW2-BAL). Measurement of water levels in proposed well pair near detention pond. Study using transducers/data loggers in the pond and well pair to evaluate and compare water level fluctuations in the pond and nearby wells over a several-month period extending from around the first quarterly sampling event to the fourth quarterly groundwater sampling event . Pond drawdown test will also be performed in association with the water-level characterization study.	The stormwater detention pond is a long-term feature that represents a potential source of contamination and groundwater recharge that is currently uncharacterized.
Characterization of groundwater interaction and potential impacts with wetland areas	Near larger wetland areas and along likely flow paths to Columbia River	Characterize groundwater flow and hydrologic relationship with wetlands. Determine if contaminated groundwater is impacting wetlands. Evaluate groundwater to surface water pathway for intermittent drainages that both include wetlands.	Installation of new wells (RI-MW15- BAU and RI-MW16-BAU). Well RI-MW15-BAU is located adjacent to Wetland F and RI-MW-16-BAU is adjacent to Wetland K.	Well RI-MW15-BAU is proposed at the head of the main intermittent drainage to the Boat Basin. This drainage reportedly represents a fault line (KPUD 2014) that could potentially represent a preferential flow pathway. Well RI-MW16-BAU is proposed for the area south (downgradient) of the stormwater detention pond that may recharge Wetland K.
			Evaluation of water-level elevations in wetlands and nearby wells.	Gauging of existing piezometers (B1, B2, B3, B4, and B11) and surface water elevation in Wetland D. Gauging of new well water-level elevations and surface water elevations in Wetlands F, J, and K. Water-level elevation data for other nearby wells collected during groundwater sampling will also be evaluated.
			Groundwater and wetland sediment/soil sampling. Site reconnaissance of two intermittent drainages leading to Boat Basin to identify seeps	Groundwater sampling at wells near the wetlands will be conducted to evaluate potential impacts to wetland sediment and surface water. Wetlands soil/sediment sampling will be addressed as part of the Wetlands Area of Concern investigation.
Characterization of background concentrations in groundwater	Upgradient areas	Address lack of up gradient wells near West SPL Storage Area and the Former Production Area.	Well installation and sampling (RI-MW4-UA, RI MW5-UA, and RI-MW5-BAU).	RI-MW4-UA will serve as an up gradient well for the West SPL Storage Area (SWMU 13). Wells RI-MW5-UA and RI-M5-BAU will be used to provide water-level elevations and chemical data up gradient of the Former Production Area.
		Identify wells that represent background. Determine if background concentrations are elevated for site COPC.	Evaluation of water-level elevations. Evaluation of up gradient well geochemistry. Establishment of background concentrations under the Washington State Model Toxics Control Act (MTCA).	Chemical data from the new wells will be statistically evaluated with existing up gradient WSI wells (likely wells MW-2A/2B and MW-8A) and ESI wells (likely wells MW-1 and IB-3) to determine background concentrations for the Unconsolidated Aquifer (UA) and BAU Zones. Note that determination of background concentrations in the BAL Zone is not currently planned.
Development of Soil Screening Levels Protective of Groundwater	Site-Wide	Evaluate and confirm screening levels for fluoride and cyanide calculated through three phase partitioning model	Up to 10 previously collected soil samples will be analyzed for SPLP fluoride and SPLP cyanide chemical. These samples will be selected for leaching tests based on the fluoride and cyanide soil results for SWMU and AOC investigations as well the fluoride and cyanide screening levels calculated from the three phase partitioning model. SPLP fluoride results for wastes collected from the Smelter Sign Area and NESI (SWMU 31) and EELF (SWMU 17) will also be used in the evaluation.	During preparation of the Phase 1 Work Plan, it was noted that the MTCA Method B formula values for two of the main groundwater COPC have been lowered. The MTCA Method B formula values for fluoride and free cyanide are 640 µg/L and 9.6 µg/L, respectively. These values are below the MCLs previously adopted for groundwater at the site for fluoride (4,000 µg/L) and free cyanide (200 µg/L).

Existing Well Inspection and Surveying

Prior to the implementation of the main portion of the field program, the existing monitoring well network will be inspected to verify well condition, suitability, and the available survey datum. Any wells that may require maintenance, repairs, or decommissioning will be identified. The overall purpose of this work element is to ensure that representative groundwater data is collected as part of the RI.

Deep Coring and Packer Tests

Continuous coring with packer testing will be performed at three core hole locations (RI-MW1-BAL, RI-MW2-BAL, and RI-MW3-BAL) to characterize lithology, the occurrence of groundwater, and fracture patterns in the basalt bedrock. The core holes will be drilled to the depth of the approximate elevation of the Columbia River about 215 to 240 feet bgs at locations RI-MW1-BAL and RI-MW2-BAL. At RI-MW3-BAL, coring will be performed to a depth of 150 bgs to evaluate the BAU-zone hydrostratigraphy near the WSI. These core holes will be the initial locations drilled in order to provide guidance on final monitoring intervals at subsequent well locations. The corings will be performed using a wire-line coring rig and recommended size NQ™ core barrel that produces approximately 2-inch diameter core holes. Monitoring wells will be completed near the coring locations with air-rotary drilling as part of a later and separate phase of work. Based on review of background materials and discussions with local drillers, it does not appear to be practical to use temporary casings to seal off the water-bearing zones as the coring is drilled downward. Each core hole will be abandoned with a bentonite-cement grout.

The vertical interval of permeability tests also commonly referred to as “packer tests” will be determined based on the continuous core log from each borehole and the observed occurrence of water in the target zones. The objective of the packer tests is to test hydraulic characteristics of the water-bearing zones in the fractured bedrock. The packer tests will also be used to verify the location of low permeability zones. Inflatable packers will be used to seal off the borehole across fractured near the base of the borehole as the boring is advanced. Based on results of the coring and packer tests, the hydrostratigraphic conceptual model will be refined, and the proposed screen interval for the new wells will be adjusted as appropriate. A total of about 20 packer tests are estimated at the three core hole locations.

Well Installation

All wells and borings will be constructed consistent with the requirements and specifications in Washington Administrative Code (WAC) Chapter 173, Division 360, Minimum Standards for Construction and Maintenance of Wells. These regulations are administered by Ecology Water Resources.

The RI field investigation includes installation of 22 monitoring wells (6 BAL wells, 14 BAU wells, and 2 UA wells) and up to 10 temporary wells as described in the following sections. The potential need for additional monitoring wells (in particular sentinel wells near the Columbia River as identified in Ecology [2015d] comments) will be evaluated based on results from the initial round of chemical and water-level monitoring.

BAL Wells: Deep wells will be installed within the BAL zone near each of the core hole locations (at wells RI-MW1-BAL, RI-MW2-BAL, and RI-MW3-BAL). In all three cases, the intent is to complete the well in a deep water-bearing zone that is relatively close to the elevation of the Columbia River above John Dam (anticipated to be about 215 to 240 feet bgs depending on surface topography, 257 to 268 feet mean sea level). The Columbia River surface elevation has been conceptualized as a constant head boundary for the basalt aquifer system, and appears to represent the discharge point for basalt aquifer groundwater. Further description of these wells is follows:

- The RI-MW1 location (RI-MW1-BAL) is proposed to be completed in the Basalt Aquifer-Lower (BAL) Zone below the screen interval of the nearby BAMW-3 well (111-133 feet bgs). Based on water-level elevations, it appears that well BAMW-3 may in a shallower zone than some of the other BAL-designated wells and the vertical extent of contamination is not characterized in this area. The RI-MW1-BAL well will be completed as a 4-inch well to be used as a pumping well in aquifer testing with other nearby wells.

- At the RI-MW2 location, two wells are proposed: one in the BAL within about 10 feet in elevation of the Columbia River Pool (RI-MW2-BAL) and a. one in the Basalt Aquifer-Upper (BAU) Zone. The RI-MW2-BAL well will be completed at a 2-inch diameter and used as an observation well during aquifer testing with pumping at well RI-MW2-BAU.

- A third deep BAL-zone well is proposed for the WSI area (RI-MW3-BAL). This well will be paired with the existing MW-3A/MW-3B well cluster that is downgradient of WSI and will also be completed in this same deep vertical zone.

Three additional BAL wells will be installed in areas between the site and the Columbia River (RI-MW-17, RI-MW-18, Refer to Figures 5.2.2-1 and Figure 5.2.2-2) to better define the lateral extent of contamination and evaluate the groundwater to surface water pathway. The wells will target the first water-bearing zone within the basalt. Shallow groundwater in the basalt bedrock at locations along the Columbia River shoreline is expected to be interconnected with the BAL zone based on elevation, cross-sections and topography. For example, existing well IB 13A that is completed in the BAL is screened from 89 to 94 feet bgs, and water-levels for this well have been within a few feet in elevation of the Columbia River.

Well RI-MW18-BAL will be installed near NPDES Pond D with shallow groundwater in the basalt bedrock as the targeted screen interval. As mentioned previously, water in this zone is anticipated to represent the BAL-zone or to be significantly interconnected with the BAL zone. The occurrence of shallow groundwater within UA-zone is not anticipated because of the thinness of the alluvium/fill in this area (likely less than 5 to 10 feet). If a shallow water-bearing zone is encountered in the UA-zone or in the underlying uppermost shallow fractured zone in the basalt, an additional shallow well will be completed at this location.

<u>BAU Wells</u>: Fourteen monitoring wells to be completed in BAU zone are proposed to address groundwater data needs identified in the Phase 1 Work Plan (refer to Table 5.2.2-1). The proposed BAU monitoring wells and associated rationale are briefly summarized in Table 5.2.2-2. Refer to Figures 5.2.2-1 and 5.2.2-2 for the well locations.

<u>UA Wells</u>: Two wells will be installed in the UA zone (wells RI-MW4-UA and RI-MW5-UA, refer to Figures 5.2.2-1 and 5.2.2-2). These wells will be used to help define background water quality and geochemistry and provide additional characterization of water-level elevations for the UA zone across the site.

Table 5.2.2-2
Proposed Monitoring Wells to be Completed in the BAU Zone
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Well Number	Rationale
RI-MW2-BAU	Characterize groundwater quality near Stormwater Detention Pond (SWMU 32); Well will be constructed as 4-inch diameter pumping well and included for constant rate aquifer test. This well will also be included in water-level data logger study.
RI-MW5-BAU	Help define background water quality and geochemistry and provide additional characterization of water-level elevations for the BAU zone across the site.
RI-MW6-BAU	Characterize water quality on downgradient site of the Line B, C, D Secondary Scrubber Recycle Stations (SWMU 6) and Tertiary Treatment Plant (SWMU 8).
RI-MW7-BAU	One shallow well southwest (downgradient) of North SPL Containment Building in area with historical drainage problems.
RI-MW8-BAU	Characterize water quality on southwest (downgradient) side of North and South Potliner Storage Areas (SWMUs 10 and 11). Well will also be monitored as part of production well pumping test.
RI-MW9-BAU	Characterization of water quality in backfilled depression in Paste Plant Spill Area (SWMU 30). Well MW-E1 has been historically dry with total depth of 13 feet bgs. At nearby well BAMW-2, a water-bearing zone was reported from 10 to 35 feet bgs in the base of the alluvium and top of basalt that yielded about 50 gal/min.
RI-MW10-BAU	Plant Area AOC groundwater characterization at Industrial Sump.
RI-MW11-BAU	Plant Area AOC groundwater characterization at Cast House Pits.
RI-MW12-BAU	Plant Area AOC groundwater characterization in vicinity of Equipment Wash Station and Oil Change Pit.
RI-MW13-BAU	Rectifier Yard AOC groundwater characterization near oil conveyances lines, AST, and oil house. Well located near Production Well 1 and will be monitored during production well aquifer tests.
RI-MW14-BAU	Rectifier Yard AOC groundwater characterization near oil conveyances lines, AST, and oil house.
RI-MW15-BAU	Characterization of groundwater interaction and potential impacts to wetland areas. Well is located near fault zone near Wetland K and at the head of one of the main intermittent drainages to the Boat Basin.
RI MW16-BAU	Characterization of groundwater interaction and potential impacts to wetland areas. Well is located downgradient (south) of the Stormwater Detention Pond that may recharge Wetland K. Well is at the head of one of the main intermittent drainages leading to the Boat Basin.
RI-MW20-BAU	Characterization of groundwater quality downgradient (southwest) of existing well MW-18 in response to Ecology (2015b) comments on the Draft Phase 1 Work Plan.

Temporary Wells: Up to 10 shallow temporary wells will be installed as part of investigation of specific SWMUs and AOC features to determine if a contaminant release to groundwater has occurred. The locations of 7 of the 10 wells (RI-GW1 through RI-GW7) are shown on Figures 5.2.2-1 and 5.2.2-2. The remaining three locations will be selected in the Plant Area AOC footprint based on:

1. Field screening and observations of potential contamination.
2. Occurrence of shallow groundwater and bedrock topography.
3. Proximity to suspected source area(s).
4. Proximity to groundwater collection lines (French drain system).
5. Spacing considerations with other shallow temporary wells.

The temporary wells will be installed during investigations of the specific SWMUs if enough shallow groundwater is found during drilling to reliably collect a sample and based on field screening and observations. Perched groundwater on top of the basalt bedrock is the targeted vertical screen interval for the wells with the exception of well RI-GW1 that will be installed in the UA zone at the R&D laboratory septic drain field.

The temporary wells will be installed using hollow-stem drilling techniques, and will be constructed as conventional flush-mounted 2-inch wells consistent with Washington monitoring well construction regulations, and developed to ensure collection of representative samples. The wells are considered as "temporary" in that the intention is to sample the wells only once during the initial baseline groundwater sampling round. If COPC are found at concentrations above screening levels in a given temporary well, the well will be considered for retention in the RI monitoring program. If no COPC are detected above screening levels in a temporary well, the well will be decommissioned and abandoned after approval by Ecology.

Aquifer Testing

This section briefly summarizes the scope of planned aquifer testing activities:

- **Slug Tests**. Slug tests will be performed at all existing usable wells as well as newly constructed monitoring well to characterize the hydraulic conductivity ranges for the various aquifer zones. The tests will consist of a combination of rising head and pneumatic tests as appropriate based on field observations and anticipated hydraulic conductivity.

- **Water-Level Characterization Study.** Two cluster well locations will be outfitted with water-level data loggers to better define seasonal trends and aquifer interconnection. The period of investigation is proposed for several months to include a wet and dry season. The water-level data logger study will be performed following the baseline comprehensive sampling round and conclude by approximately the fourth quarterly groundwater sampling round. Transducers for the seasonal water-level study will also be used during the other aquifer tests.

  The well clusters proposed for the water-level characterization study include: 1) the RI-MW1-BAL/BAMW-3/MW-8 well cluster, and 2) the RI-MW2-BAU/RI-MW2-BAL well cluster. At the MW-2 well cluster, a data logger/transducer will also be placed at the stormwater detention pond if feasible. Klickitat County PUD also will be consulted to determine the pumping schedule and anticipated amount of withdrawal for the production wells at the facility for the study period.

- **Constant Rate Pumping Tests.** Two 24-hour constant rate pumping tests are planned to evaluate: 1) aquifer interconnection, and 2) determine aquifer characteristics for the BAU and BAL zone. Two tests are planned. The RI-MW1-BAL test will include pumping of RI-MW1-BAL with transducer monitoring of well BAMW-3, RI-MW8-BAU, and at least one background well. The RI-MW2-BAU test will include pumping of RI-MW2-BAU with transducer monitoring of RI-MW2-BAL, RI-MW16-BAU and RI-MW9-BAU. Periodic hand measurements will also be collected at the stormwater detention pond. The stormwater detention pond will also already be equipped with a transducer for the seasonal water-level study.

- **Production Well Pumping Tests.** Two supplemental tests will be performed to evaluate aquifer interconnection through pumping of the production wells and measurement of the response in nearby wells completed in the BAL and BAU units. Two tests are planned that include: 1) Pumping of Production Well 2 with monitoring of new wells RI-MW1-BAL, RI-MW8-BAU existing well BAMW-3, and RI-MW2-BAL; and 2) Pumping of Production Well 1 and/or Production Well 3 with monitoring of new well RI MW13-BAU (to be located adjacent to Production Well 1), BAMW-1 (where there was previously a hydraulic response reported during the URS [2011] production well tests), and RI-MW2-BAL.

  During these tests, the production wells will be cycled on and run for a period of 2-3 days with water-level data logger measurement in selected monitoring wells. Because of the lack of physical control of the pumping rates, and wide screen interval of the production wells, no attempt will be made to determine aquifer zone properties from the production well pumping tests. The primary goal will be to evaluate the degree of relative response in particular aquifer zones to production well pumping.

- **Stormwater Detention Pond Drawdown Test.** A drawdown test of the Stormwater Detention Pond will be performed to evaluate interconnection between the pond and the basalt aquifer zones. The objective of the pond drawdown is to reduce or eliminate a likely source of shallow groundwater recharge and characterize the basalt bedrock aquifer zone(s) response.

  Wells RI-MW2-BAU and RI-MW2-BAL will be monitored for water-level elevation changes while the pond is drawn down and for a period of months following drawdown of the pond. The pond drawdown test will be scheduled to overlap with the water-level characterization study at this location. The test will likely be scheduled for a period (e.g., late spring) where water-levels in the pond can be significantly reduced through pumping with a limited influx of stormwater over an extended period.

Based on the results of the coring, packer testing, and initial well drilling, the monitoring locations for aquifer testing and test layout will be adjusted and finalized.

Groundwater Monitoring

Four quarterly rounds of water-level gauging and groundwater sampling will be conducted as part of the RI. The rounds of sampling will be conducted on a quarterly basis (3 months apart)) to address seasonal variability. All new and usable existing monitoring wells and the three facility production wells will be included in the RI chemical sampling program.

The project team plans to submit a proposal for Ecology review and approval to reduce the number of wells in the RI chemical sampling program for specific chemical analyses following the second quarterly sampling event. Proposed reductions to the chemical sampling program will include wells with no detections of COPC or low detections of COPC below screening levels during the first two sampling rounds.

Note that consistent with MTCA, the purpose of the RI groundwater monitoring program is to adequately characterize groundwater current conditions to allow for selection of a cleanup action as appropriate. The long-term groundwater monitoring program will be determined based on the results of the RI/FS and will include a smaller subset of the existing and newly constructed wells.

Table 5.2.2-3 summarizes the monitoring well sampling program. The initial comprehensive round of chemical sampling will include:

- **Full COPC Suite:** total cyanide, WAD cyanide, free cyanide, fluoride, sulfate, selected dissolved metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PAHs, and PCBs. Note that ESI wells will also include iron because of its past inclusion in the ESI long-term groundwater monitoring program).

- **Geochemistry:** major ions (Ca, Mg, Na, K, and Cl), and conventional parameters [hardness, total dissolved solids (TDS)], and total alkalinity.

TPH-Dx, TPH-Gx, and volatile organic compound (VOC) analyses will be analyzed for wells selected based on historical data and historical use information. During the initial sampling round, a subset of the wells and temporary well samples (RI-MW2-BAU, RI-MW10-BAU, RI-GW-4, RI-GW-6, RI-MW11-BAU, RI-MW12-BAU, RI-MW13-BAU, RI-MW14-BAU, RI-MW15-BAU, and RI-GW1) will be analyzed for VOCs, TPH-Gx, and TPH-Dx.

At a minimum, the quarterly rounds will include chemical sampling of a targeted COPC list consisting of: total and WAD cyanide, fluoride, and sulfate unless there is a requested reduction for some wells following the second round of sampling based on the analytical results Additional chemicals detected above screening levels during the initial sampling round will be included during the subsequent sampling rounds. Temporary wells with chemical concentrations above screening levels will also be included in the subsequent rounds of sampling.

Soil Chemical Analyses to Develop Soil Screening Levels for Protection of Groundwater

As described in Section 4.1, SPLP soil leaching tests will be performed to evaluate soil screening levels for protection of groundwater for cyanide and fluoride. Up to 10 previously collected soil samples will be selected for follow-up testing of SPLP fluoride and cyanide based on the results of soil samples collected from SWMU and AOC investigations. The fluoride and cyanide soil screening levels calculated from the three-phase partitioning model will be used to help determine the concentration range to include in the follow-up testing.

Table 5.2.2-3
Well Sampling Program
Groundwater in the Uppermost Aquifer AOC
Columbia Gorge Aluminum Smelter Site, Goldendale, Washington

Well/Sample Type	Initial Sampling Round	Initial Sampling Round Analytical Program	Second Sampling Round	Quarterly Sampling Round Analytical Program	Description and Rationale
Existing Monitoring Wells (a,b)	48	All Wells Total cyanide WAD cyanide Free Cyanide Fluoride Sulfate Metals(c) Filtered Metals (c) PAHs PCBs Geochemistry (e) Additional Analyses at 10 Selected Wells VOC (d) TPH-Dx(d) TPH-Gx(d)	48	Total cyanide WAD cyanide Fluoride Sulfate Other chemicals that exceed screening levels in one or more wells during the initial sampling round will be included in subsequent sampling rounds	Characterize current conditions and determine nature and extent of contamination.
Production Wells	3		3		Determine water quality in deeper aquifer zones. Determine water quality in water supply wells.
New Monitoring Wells	22		22		Characterize current conditions and determine nature and extent of contamination.
Temporary Monitoring Wells	Up to 10		5		Determine if COPC have been released to shallow groundwater during SWMU and AOC specific investigations if sufficient shallow groundwater is present during drilling. Up to 10 temporary wells are planned. It is assumed that only 5 of these wells will contain COPC above screening levels during the initial sampling round to warrant sampling in the second round.
Total Samples	**83**		**78**		

a Existing wells previously reported as dry are not included in the sample estimate.

b Sample estimate assumes that all existing wells are usable pending well inspection activities.

c For metals, both field-filtered and unfiltered samples will be collected. Metals analytical suite to include: Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn. ESI wells to include Fe.

d A subset of 10 locations will be sampled for VOCs, TPH-Dx, and TPH-Gx including wells: RI-MW2-BAU, RI-MW10-BAU, RI-GW-4, RI-GW-6, RI-MW11-BAU, RI-MW12-BAU, RI-MW13-BAU, RI-MW14-BAU, RI-MW15-BAU, and RI-GW1.

e Geochemistry suite to include major ions (Ca, Mg, Na, K, and Cl) and conventional parameters (hardness, TDS, and total alkalinity).

Notes:

The four RI groundwater sampling rounds are scheduled 3 months apart to characterize potential seasonal effects on contaminant concentrations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

AOC Area of Concern
COPC Chemicals of Potential Concern
Metals Metals analytical suite to include: Al, As, Cd, Cr, Cu, Ni, Pb, Se, and Zn. ESI wells to include Fe.
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
SWMU Solid Waste Management Unit
TDS Total Dissolved Solids
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
TPH-Gx Gasoline-range petroleum hydrocarbons
WAD Weak-acid dissociable

5.2.3 Wetlands

The main data need for the Wetlands AOC is soil quality data sufficient to evaluate impacts from former smelter emissions as indicated in the Agreed Order. Therefore, the objective of the wetlands sampling program is to characterize the nature and extent of surface soil contamination in wetland-designated areas. A field survey resulted in delineation of 13 wetlands, designated Wetlands A through M (refer to the Phase 1 Work Plan for a more detailed summary). A fourteenth wetland was identified by Lockheed Marin northeast of the Plant Area AOC that will be investigated as part of the Smelter Sign Area (SWMU 31) and is discussed separately in Section 5.1.30. Figure 5.2.3-1 shows the location of the 13 wetlands and the proposed sampling locations.

The 13 wetlands consist primarily of palustrine emergent and/or scrub shrub wetlands that have been delineated as Category III and IV wetlands. Palustrine wetlands represent a category of inland, non-tidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water, but grows above the surface). Category III and IV wetlands represent wetlands with moderate to low-level functions that generally have been disturbed in some ways and are often smaller, less diverse, and/or more isolated from other natural resources than other higher functional category wetlands. The site wetlands have generally been used for livestock grazing and have been historically disturbed by grading, clearing, and other activities. Of the 13 delineated wetlands, three of the wetland areas (Wetlands A, B, and C) are less than 2,500 square feet, and are therefore too small to be regulated for development under the Klickitat County jurisdictional definition of a wetland and have not been included in the sampling program.

The largest wetland, Wetland D, is approximately 17 acres and is located immediately south of the Plant Construction Landfill (SWMU 19) and west of the West End Landfill (SWMU 18). Wetland D also appears to be immediately adjacent to the proposed footprint of the John Day Pool Pumped Storage Hydroelectric Project Lower Reservoir footprint (KPUD 2014) and wetlands A, B, C, and H are also in close proximity to the proposed location of the Lower Reservoir.

In addition to historical smelter emissions, surface soil in the wetlands areas could also potentially have been impacted by stormwater runoff or shallow groundwater discharges. Aluminum, lead, and zinc were detected in surface water samples collected in the wetlands above freshwater chronic surface water screening levels and fluoride was consistently detected. Low-level concentrations of

Legend

- Wetland Area
- Buffer
- Surface Water
- Culvert
- Wetlands Not Regulated
- Surface Soil Sample

Source: PGG 2013

Figure 5.2.3-1

Wetlands Area of Concern
Surface Soil Sample
Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

PAHs have also been detected in wetland surface water. These findings are discussed in more detail in the Phase 1 Work Plan. The hydrologic relationship between shallow groundwater and the wetlands will be further characterized as part of the Groundwater in the Uppermost Aquifer AOC investigation.

Figure 5.2.3-1 shows the planned soil sampling locations. The sampling program focuses on the largest wetland feature (Wetland D) as well as the wetlands closest to the former production area, including potential flow pathways toward the Columbia River. The soil samples will generally be collected with a hand auger. If a hand-auger is impractical because of the presence of water, a manually operated clam-shell style sediment sampler (e.g., Ponar™) will be used to collect the samples.

Table 5.2.3-1 summarizes the sampling program for the wetlands. A total of 19 surface soil samples will be collected. Samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and sulfate. Three samples (SS02, SS08, and SS18) will also be analyzed for PCBs and TPH-Dx.

Wetlands F and K are located in the two main intermittent drainages that lead to the Boat Basin. There were reportedly seeps or springs in these drainages in the past; however, during the 2013 wetland work, no seeps were found. During wetland sampling activities, a field reconnaissance of the two intermittent drainages will be conducted to identify evidence of seeps and springs for assessment of the groundwater to surface water transport pathway. Any spring or seeps found during the field reconnaissance will be documented and evaluated for potential supplemental sampling. The hillsides between the Former Production Area and the Columbia River will also be inspected to verify the absence of groundwater seeps. This field reconnaissance activity will be done as a separate effort in conjunction with well installation and sampling activities.

Soil sample results will be compared with the soil screening levels presented in Section 3.0 of the Phase 1 Work Plan. For inorganic chemicals in soil, sample results will also be compared against the range of background soil concentrations that was compiled in the Phase 1 Work Plan and from the Ecology (1994) soil natural background concentration study and the PGG (2013a) site investigation to determine if the sample results are elevated with respect to background.

Table 5.2.3-1
Wetlands AOC Sampling Program
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Area of Investigation	Number of Samples[a]	Analytical Suite	Sample Rationale
Wetland AOC (Sampling in Wetlands D, E, F, G, H, I, K, L, and M)	19	All Stations PAHs Total Cyanide Fluoride Metals Sulfate Additional Chemical Analyses at 3 stations[b] PCBs TPH-Dx	Characterize COPC concentrations in Wetlands AOC soil to determine if the wetlands have been impacted by historical smelter emissions[a].

a All samples to be collected from top 6 inches of soil beneath the root zone (if present).

b Additional analyses for PCBs and TPH-Dx to be conducted at SS02, SS08, and SS18.

Notes:

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

AOC Area of Concern
COPC Chemicals of Potential Concern
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
Metals Includes Aluminum, Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Selenium, and Zinc.

5.2.4 Rectifier Yard AOC

The Rectifier Yard AOC is defined as the area where the former rectifiers, transformers, and associated oil piping, and tanks used in plant operations were located. Rectifiers, primary, and auxiliary transformers were located in an area bounded to the east by the Plant Area AOC, south by the plant entrance road, west by the Bonneville Power Administration (BPA) Harvalum Substation, and to the north by the north plant access road. The BPA facility is not part of Columbia Gorge Aluminum Smelter Site and is owned and maintained by BPA. This AOC includes both the Rectifier Yard and the associated Rectifier Building. In addition, 27 smaller transformer substations (termed the interior transformer substations) were located throughout the area of the main plant and are also included in the Rectifier Yard AOC.

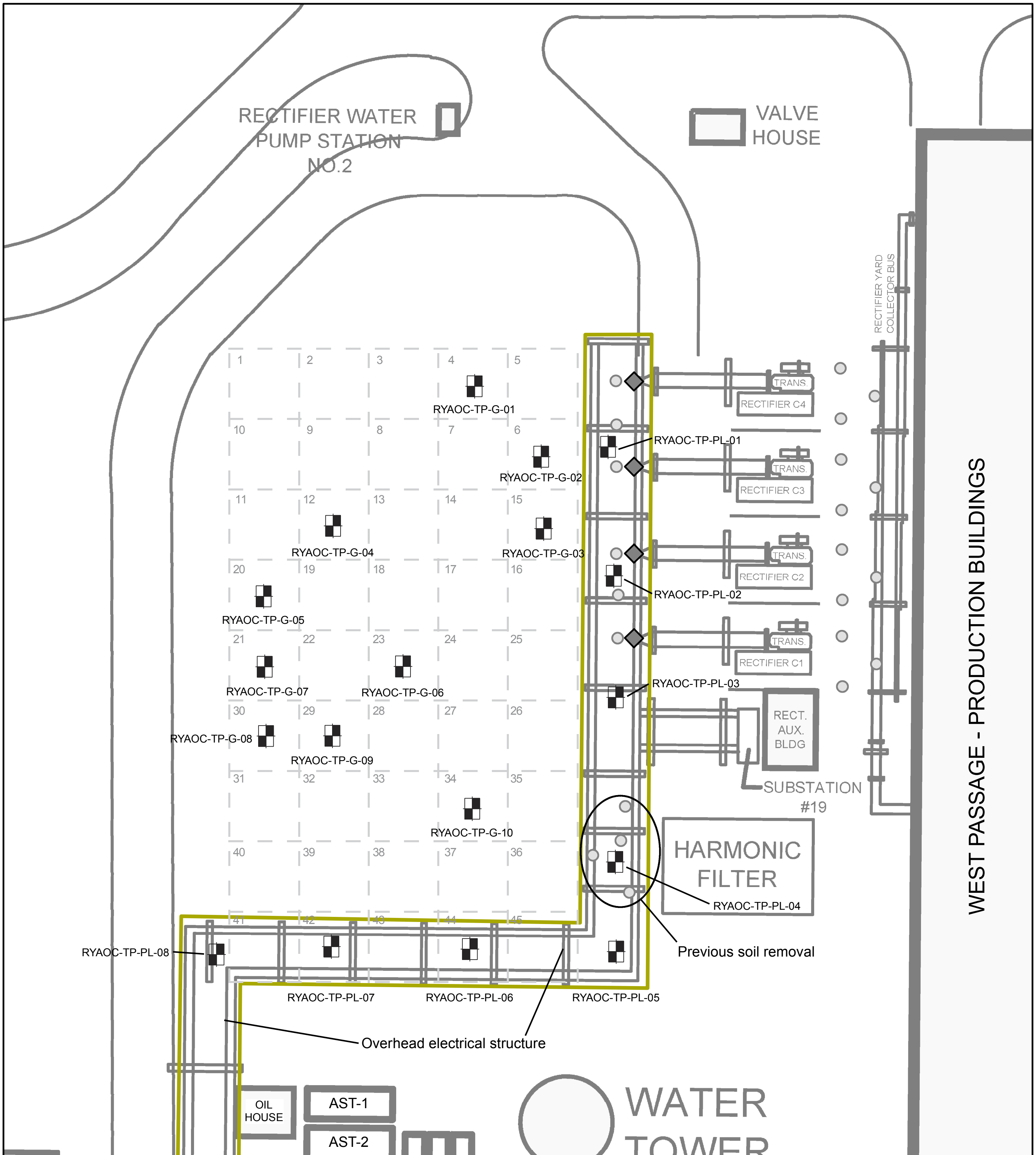
Structures in this AOC include the Rectifier Building, main and auxiliary transformers, transformers for Production Buildings A through D, 27 interior transformer substations, three aboveground storage tanks (ASTs) for transformer oil storage, associated underground oil conveyance piping, and oil circuit breakers (OCBs) for servicing transformers (Figures 5.2.4-1 and 5.2.4-2).

The following sections describe investigation objectives for the Rectifier Yard AOC, the proposed investigation scope and evaluations that will be conducted for the resultant investigation data.

5.2.4.1 Investigation Objectives

Data needs and data gaps for the Rectifier Yard AOC were summarized in Table 3-4 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and gaps for the Rectifier Yard AOC.

- Characterize the nature and extent of COPC in surface and subsurface soil at oil pipelines, Oil House, and oil storage ASTs.
- Confirm oil pipelines have been removed.
- Characterize the nature and extent of COPC in subsurface soil beneath Rectifier Building transformer bays and the Rectifier Building foundation.
- Characterize the nature and extent of COPC in surface and subsurface soil at select transformer substations that were either not sampled or not accessible during previous investigations.



Legend

- Proposed Test Pit Location (RYAOC-TP-PL-07)
- Previous Sample Location (See Figure 2 PGG 2012b)
- Oil Circuit Breaker Pad
- Random Sample Grid with Cell Numbers. Cell dimensions approximately 30' x 30'.
- Approximate alignment of transformer oil pipelines.

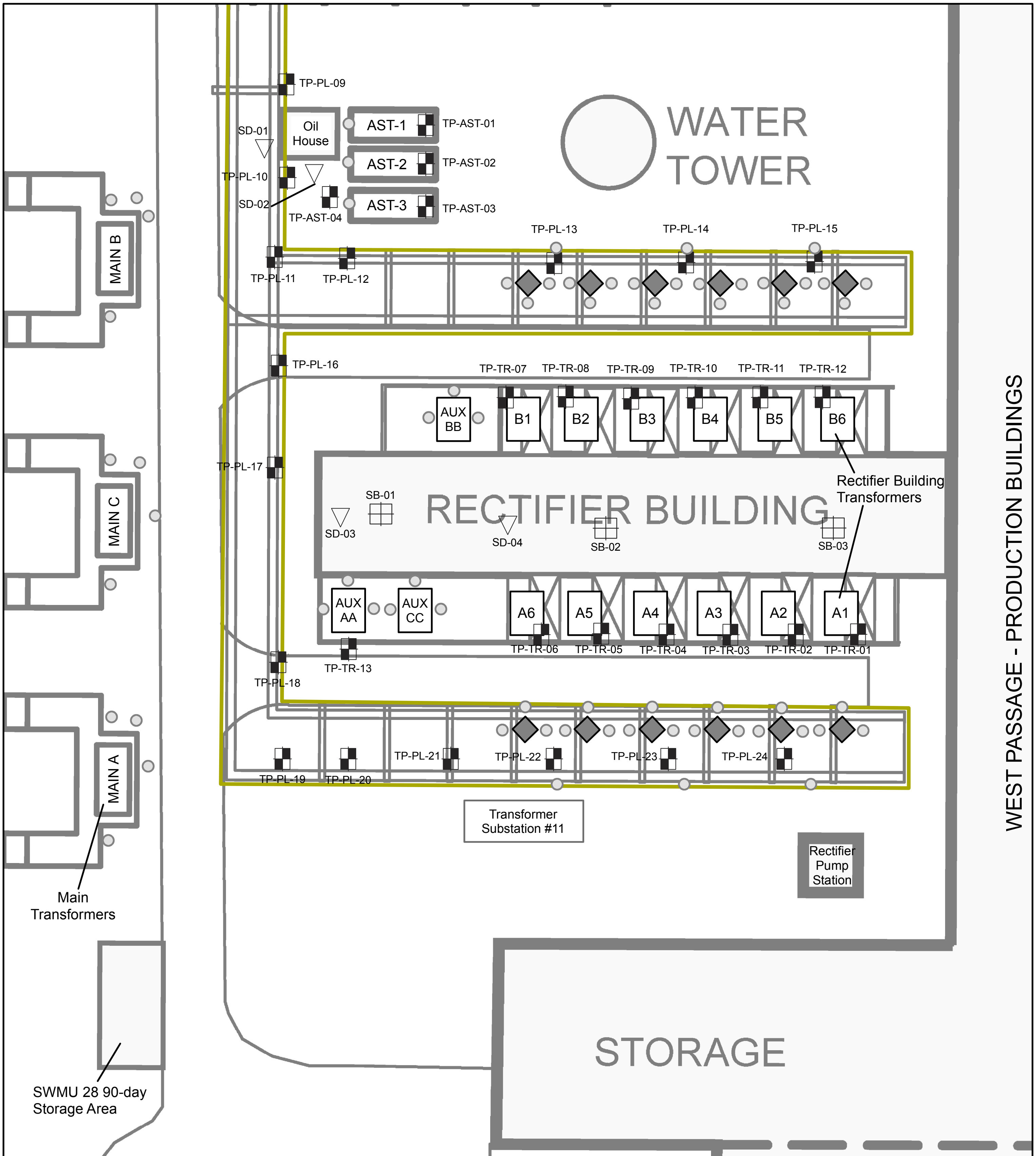
0 25 50
Feet

Source: GAC (1996f)

Figure 5.2.4-1

Sample Locations
North Part - Rectifier Yard AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

- TP-PL-07 Proposed Test Pit Location
- SD-01 Proposed Sediment Sample
- SB-01 Proposed Soil Boring
- Previous Sample Location (See Figure 2 PGG 2012b)
- Oil Circuit Breaker Pad
- Approximate alignment of transformer oil pipelines.

(all Rectifier Yard AOC labels include the prefix "RYAOC-")

Source: GAC (1996f)

N W E S

0 25 50
Feet

Figure 5.2.4-2

Sample Locations
South Part - Rectifier Yard AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- Evaluate whether additional soil removal is warranted at Transformer Substation 5.
- Characterize the nature and extent of COPC in surface soil in the north portion of the Rectifier Yard which was previously inaccessible as a result of demolition debris storage.
- Characterize extent of COPC in sediment in newly identified miscellaneous features including catch basins near the Oil House, and sumps in the Rectifier Building basement, and at the Rectifier Yard pump station.

5.2.4.2 Investigation Scope

The structures, oil storage and conveyance lines, and transformers in the Rectifier Yard AOC will be investigated to determine the extent of COPC present in surface and subsurface soil. Shallow groundwater is not anticipated to be encountered and is not anticipated to be collected for the Rectifier Yard AOC. The following subsections describe the scope of investigation for the structures and features located in the Rectifier Yard AOC. Table 5.2.4-1 summarizes the sampling program for the Rectifier Yard AOC.

Transformer Oil ASTs

Three ASTs used for transformer oil storage were located northwest of the Rectifier Building and set on concrete supports. Oil was delivered to transformers through the OCBs via underground piping. A-series OCBs are located opposite the A-series transformers, and likewise for the B- and C-series transformers.

Three discrete soil samples were previously collected adjacent to the west end of the three ASTs where leakage was most likely to occur at piping leading from the tanks (PGG 2012b). The samples were analyzed for PCBs only and low concentrations of PCBs (Aroclor 1260) were detected (range of 0.12 to 0.43 mg/kg) in all three of the samples. The detected concentrations were below MTCA Method B formula values.

The former transformer oil ASTs will be investigated using four test pits. One test pit will be excavated at the western end of the former tank locations, which would be a longer test pit to evaluate valves and/or pipe connections that may have leaked, and where previous samples were collected. Three other test pits will be excavated near the eastern end the former AST locations. Transformer oil AST test pit locations are shown on Figure 5.2.4-2.

Table 5.2.4-1
Summary of Soil Sampling in Rectifier Yard AOC

Investigation Feature	Sample Method	Media Sampled	Number of Samples	Sample Depth	Sample Type	Analytes	Sample Rationale
Oil ASTs (3)	Test Pit (4)	Surface Soil	4	0.5 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in surface soil.
		Subsurface Soil	4	1-2 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Metals	Characterize COPC in subsurface soil. If visual soil staining is observed below targeted sampling depth, additional samples may be collected.
Oil Pipeline/Oil House	Test Pit (24)	Surface Soil	24	0.5 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in surface soil.
		Subsurface Soil	24	3 feet bgs	Composite	PCBs, PAHs, TPH-Dx, Metals	Characterize COPC in subsurface soil. Verify oil pipelines are removed. If visual soil staining is observed below expected pipeline depth, additional samples may be collected.
	Grab (1)	Sediment in catch basin	1	NA	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in sediment in newly identified miscellaneous features.
	Grab (1)	Sediment in drainage basin	1	NA	Composite		
Rectifier Building Transformer Bays	Test Pit (13)	Subsurface Soil	13	0.5 to 1 foot bgs	Discrete	PCBs, PAHs, TPH-Dx, Metals	Characterize COPC in subsurface soil. If visual soil staining is observed below targeted sampling depth, additional samples may be collected.
Rectifier Building Foundation	Soil Borings (3)	Subsurface Soil	6	1 foot bgs 3 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Metals	Characterize COPC in subsurface soil. If visual soil staining is observed below targeted sampling depth, additional samples may be collected.
	Grab (2)	Sediment in Sumps	2	NA	Discrete		Characterize COPC in sediment in newly identified miscellaneous features.
Transformer Substations	Test Pits (28)	Surface Soil	28	0.5 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in surface and subsurface soil. If visual soil staining is observed below targeted sampling depth, additional samples may be collected.
		Subsurface Soil	28	1.5 to 2 feet bgs			
Transformer Substation T5	Test Pits (3)	Surface Soil	3	0.5 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in surface and subsurface soil. If visual soil staining is observed adjacent to or below targeted sampling depth, additional samples may be collected.
		Subsurface Soil	3	2 to 3 feet bgs			
Northwest Area of Rectifier Yard	Test Pit (10)	Surface Soil	10	0.5 feet bgs	Discrete	PCBs, PAHs, TPH-Dx, Total Cyanide, Fluoride, Metals	Characterize COPC in surface soil where demolition debris was stockpiled.

Notes:

See Figures 5.2.4-1 through 5.2.4-4 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
NA Not applicable
PAHs Polycyclic Aromatic Hydrocarbons
PCBs Polychlorinated Biphenyls
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
Test Pit (4) Total of 4 Test Pits

The test pits will be excavated to a nominal depth of two feet. The test pit at the western end of the ASTs will be excavated to a length of up to 10 feet. One discrete surface soil sample will be collected in one sidewall of each of the four test pits. One discrete subsurface soil sample will be collected from the floor of the three eastern test pits, and one composite subsurface soil sample will be collected from the floor of the western test pit.

If oil staining is observed at the final depth in a test pit, and to assist in determining the vertical extent of contamination, the excavation will continue until no further oil staining is observed and an additional subsurface soil sample(s) will be collected at the final test pit depth that is anticipated to be a maximum depth of 10 feet bgs. If oil staining is observed to potentially extend beyond the horizontal limits of a test pit, and to assist in determining the horizontal extent of contamination, the test pit excavation will be expanded or a new test pit will be excavated to determine the extent of visible oil staining. Backfilling of test pits will be conducted pursuant to field methods and procedures described in Section 5.3.

Surface soil samples will be analyzed for PCBs, PAHs, TPH-Dx, total cyanide, fluoride, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Subsurface soil samples will be analyzed for PCBs, PAHs, TPH-Dx, and metals. Table 5.2.4-1 presents a summary of the sampling program for the transformer oil ASTs.

Oil Pipelines/Oil House

An oil house is located northwest of the Rectifier Building and to the west of the three ASTs. The oil house includes associated oil conveyance pipelines located throughout the Rectifier Yard AOC. Oil was delivered to transformers through the OCBs via underground piping. A-series OCBs are located adjacent to the A-series transformers, and likewise for the B- and C-series transformers. Plant demolition contractors reportedly removed all oil pipelines, but this has not been well documented.

Sixteen discrete soil samples were previously collected along the oil pipelines leading from the ASTs to the OCBs (Figure 7.4-1; Phase 1 Work Plan). Twelve initial samples were analyzed for PAHs and petroleum hydrocarbons and four follow-up samples located along the pipeline near the Buildings C/D transformers were analyzed for mineral oil only. PAHs were detected in soil at a maximum concentration of 20 mg/kg for benzo(b)fluoranthene. Mineral oil was detected at a maximum concentration of 25,000 mg/kg.

An initial investigation step for the oil pipelines is to conduct a geophysical survey, using GPR technology, to determine whether, and where, oil pipelines have been removed. The pipelines are anticipated to have been installed to a nominal depth of about 3 feet bgs. Additional lines are likely present in the general Rectifier Yard, including electrical lines and water lines. All detected lines will be compared to plant design plans to interpret geophysical survey findings, and the lines will be marked at the time of the survey.

Oil pipelines and the oil house will be investigated using backhoe test pits to access surface and subsurface soil. Twenty-four test pits will be excavated along the oil pipeline up to 10 feet ln length and a nominal depth of three feet, the expected depth of the oil pipeline, and perpendicular to the alignment of the oil pipeline to assist in determining whether all lines have been removed. Test pit locations are shown on Figures 5.2.4-1 and 5.2.4-2. Test pits associated with transformer oil pipelines are designated “TP-PL-nn” where nn is a sequential number assigned to each test pit. Additional test pits may be added at the time of sampling, in areas where surface staining is observed.

One discrete surface soil sample will be collected from a sidewall in each of the 24 test pits. One composite subsurface soil sample, consisting of three subsamples, will be collected from the floor in each of the 24 test pits. Where a test pit exceeds 10 feet in length, the test pit floor will be divided into two areas and one composite subsurface soil sample will be collected from each area. If oil staining is observed at the final excavation depth, and to assist in determining the vertical extent of contamination, the excavation will continue until no further oil staining is observed and additional subsurface soil samples will be collected at the final test pit depth.

Sample density is based on minimum soil sampling recommendations described in “Ecology Guidance for Site Checks and Site Assessments for Underground Storage Tanks” (Ecology 2003). Those minimum guidelines are summarized as follows:

- Soil samples should be collected from around piping adjacent to joints or elbows.
- One soil sample should be collected from around the piping system for every 50 feet of piping.

UST soil sampling guidance is referred to because the transformer oil lines conveyed oil products similar to those typically contained in USTs, and because piping materials and construction methods are presumed to have been similar to those of a typical UST piping system.

During a recent site visit, a catch basin, potentially for stormwater (water was present at the bottom), was observed located to the south of the oil house. An approximately 15-foot long north-south oriented drainage grate and basin was also observed at the west end of the oil house. One sediment sample will be collected from each of the newly observed features at the oil house. One discrete sample of sediment will be collected from the apparent stormwater catch basin located to the south of the Oil House. One composite sediment sample will be collected from the drainage basin.

The catch basin near the Oil House will be investigated and sampled. These features may further be investigated as part of SWMU 32 Stormwater, if the features are determined to be connected to the stormwater system.

Surface and subsurface soil, and sediment samples will be analyzed for PCBs, PAHs, TPH-Dx, total cyanide, fluoride, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Table 5.2.4-1 presents a summary of soil sampling and analysis for the oil pipeline and Oil House.

Areas of known previous pipelines will be investigated with a GPR unit and records of subsurface conditions depicting status of removal generated. Results of the GPR survey of the Rectifier Yard AOC will be evaluated to determine the status of oil pipeline removal and whether additional pipeline removal would be warranted.

Two wells (RI-MW13-BAU and RI-MW14-BAU) will be installed in the BAU to characterize chemical concentration and determine if a release to groundwater has occurred from the oil conveyance lines, Oil House, or oil AST. The well installation and sampling activities will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2).

Rectifier Building Transformer Bays

The Rectifier Building is bordered to the north and south by fifteen transformer bays (Figure 5.2.4-2). Six transformers (Series A) along the south side serve Production Building A, and six transformers (Series B) along the north side serve Production Building B. Three auxiliary transformers also are adjacent to the rectifier building with AUX-AA and AUX-CC to the south and AUX-BB to the north. Soil beneath the twelve Series A and B transformer bays were not sampled previously because of inaccessibility during demolition. Sampling subsurface soil beneath the Series A and B transformer bays will require removal of the pad structures to provide access. The transformer bays are constructed with three concrete walls averaging 4 feet in height, forming a "box" against the Rectifier Building foundation, and with medium rounded gravel backfilled around the transformer pad centered in the box. Auxiliary transformer bays were previously sampled and PCBs were detected in surface soil at transformer AUX-AA.

If feasible, subsurface soil beneath the Series A and B transformer bays will be investigated using backhoe test pits. Test pits are proposed because of the constraints posed by the construction of the transformer bays. Limiting construction aspects include 4- to 5-foot high surrounding walls of concrete, 4- to 5-foot high transformer pads that occupy most of the space inside the surrounding walls, and 4 to 5 feet of heavy rounded gravel between the transformer pads and the concrete walls. To gain access, the outer concrete wall and backfill would need to be removed. Use of a backhoe would allow reach into a narrow space to reach exposed soil. If the outer concrete wall cannot be removed, then the gravel backfill would need to be removed with a backhoe. If successful, the exposed soil would be essentially in a confined space and a backhoe would be needed to sample soil.

Thirteen total test pits will be excavated to investigate the transformer pads in the transformer bays and auxiliary transformer AUX-AA. Twenty-four discrete soil samples will be collected within the upper 12 inches of soil beneath the transformer bays. Two discrete samples will be collected at Auxiliary transformer AUX-AA. At each sample location, soil samples will be collected from 0 to 0.5 feet bgs and 1 foot bgs. If soil staining is observed at final sampling depth in a test pit, and to assist in determining the vertical extent of contamination, the excavation will continue until no soil staining is observed and additional soil samples will be collected.

Surface and subsurface soil samples will be analyzed for PCBs, PAHs, TPH-Dx, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Table 5.2.4-1 presents a summary of soil sampling and analysis for the Rectifier Building transformer bays.

Rectifier Building Foundation

The Rectifier Building has been demolished and only the foundation remains in place. The foundation consists of the main floor that is elevated about four feet above the surrounding ground surface, and a basement with its floor approximately 8 to 10 feet bgs. Access to the basement area is through the eastern end of the rectifier building where it connected to the western end of the Production Buildings that are in the Plant Area AOC, and beneath the former West Passage. The foundation basement floor construction is anticipated to be reinforced concrete and potentially three or more feet thick. Further evaluation of rectifier building plans will be required to confirm the rectifier building floor construction details including thickness and rebar density.

Access to the Rectifier Building's basement for drilling soil borings will be constrained by width and height limitations. Vertical clearance of approximately 10 feet may preclude use of most common drilling equipment (truck-mounted with raised mast). Concrete coring equipment is anticipated to be able to access the basement to reach proposed soil boring locations. If concrete coring is successful in providing access to soil beneath the building, soil sampling may be conducted using low-profile mechanized equipment, if feasible, or hand augers. These limitations may affect feasibility to complete soil borings beneath the rectifier building foundation.

If feasible, the Rectifier Building foundation will be investigated with three soil borings spaced along the west-east length of the floor (Figure 5.2.4-2). The borings will be drilled to maximum depths of 10 feet bgs. Subsurface soil samples will be collected in each boring at depths of 1 foot bgs and a second sample between depths of 3 and 5 feet bgs, for a total of six subsurface soil samples. If visual soil staining is observed, additional soil samples will be collected.

During a recent site visit, a total of five sumps were observed located in the basement of the Rectifier Building. A large L-shaped sump is located in the eastern portion of the basement and is approximately 40-foot by 30-foot with an approximate width of four feet and a depth of five feet. This sump contained approximately 12 to 18 inches of standing water. Four smaller L-shaped sumps are located in a central and western portion along the north and south walls of the basement. These sumps are approximately 10-foot by 10-foot features with an approximate depth and width of 3 feet. Three of the sumps contain approximately 6 to 12 inches of standing water and the northeast sump was filled with backfill material. Whether the sumps have outlets or connections to other site stormwater or effluent lines is unknown and will be evaluated.

The sumps in the Rectifier Building will be investigated and sampled. Review of site plans for the rectifier building will be conducted to determine function of the sumps, and potential connections with other lines. Two sediment samples will be collected from sumps that contain sediment. .

Subsurface soil, and sediment samples will be analyzed for PCBs, PAHs, TPH-Dx, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Table 5.2.4-1 presents a summary of soil sampling and analysis for the Rectifier Building foundation.

Interior Transformer Substations

A total of 28 interior transformer substations are located throughout the site with most located in the Plant Area AOC (Figure 5.2.4-3). Two of these transformer substations (substations 11 and 19) were located in the Rectifier Yard: substation 11 was located south of transformers C1 through C4, and substation 19 was located near the southwest corner of the Rectifier Building. Transformer substation 7 is located near the Columbia River at the NPDES outfall (Figure 5.2.4-3). The 28 transformer substations are incorporated into the Rectifier Yard AOC because they are associated with PCBs present in transformer oil.

Typically, the transformer substations contained two transformers; one transformer located on each side of a larger concrete pad with common controls in the center. Maintenance records indicate past leaks for many of the transformers. Visible staining was noted around the concrete pads of several of the interior transformer substations. Soil samples were previously collected adjacent to one or more sides of the pad near each transformer particularly where visible staining occurred.

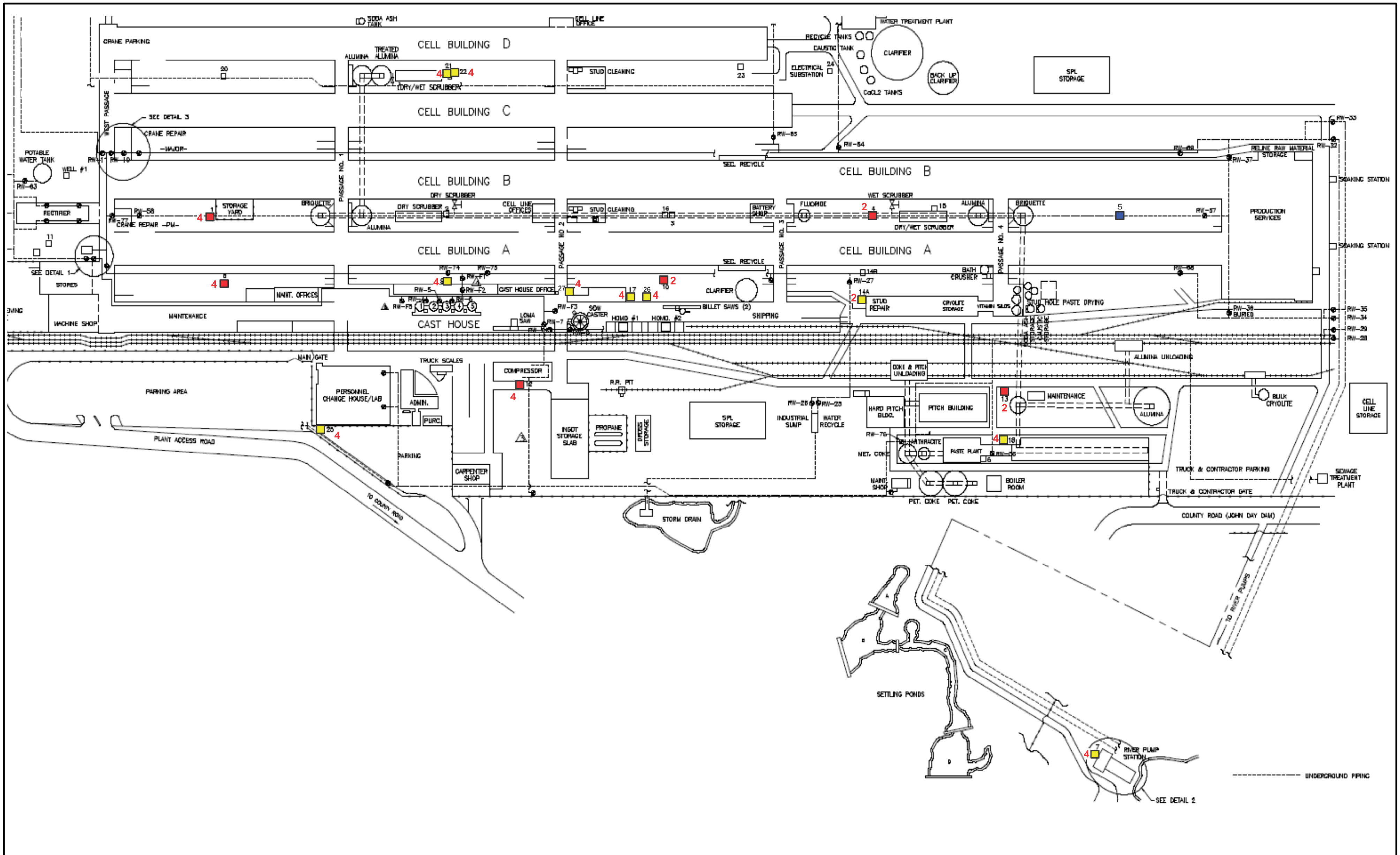
Previous soil sampling at interior transformer substations included a total of 37 composite soil samples representing 18 of the 28 substations (PGG 2012b). PCBs were detected in soil at Transformer Substations 1A/B, 4A, 8A/B, 5A, 10A, 12A/B, and 13B (ten transformers). Soil samples were not collected at Substations 7A/B, 9A/B, 14A, 17A/B, 18A/B, 21A/B, 22A/B, 25A/B, 26A/B, and 27A/B (19 transformers) because of inaccessibility during demolition.

Twenty-eight test pits will be excavated to investigate the 28 transformers substations (excluding Transformer 5A) that were not previously investigated, or where PCBs were detected in soil (Figure 5.2.4-3). Transformer Substation 5A/B will be discussed in the following paragraph. At each of the 28 transformers, discrete surface and subsurface soil samples will be collected at depths of 0 to 0.5 feet bgs and 1.5 feet bgs. At substations with two transformers, such as Substation 21A/B, a total of four samples will be collected (two for each transformer). At substations with a single transformer, such as Substation 4A, two samples will be collected. If visible soil staining is observed in a test pit at final sampling depth, and to assist in determining vertical extent of contamination, the excavation will continue until soil staining is no longer observed and additional discrete soil samples will be collected. At locations where the surface is asphalt paved, the asphalt paving will be repaired, and the excavated soil will be managed according to field procedures described in Section 5.3.13.

A spill occurred near Transformer 5A during demolition activities in April 2011 (Figure 5.2.4-4). Soil samples were collected and Aroclor 1260 was detected at concentrations ranging from 0.63 to 27 mg/kg, and mineral oil was detected at concentrations ranging between 30,000 and 260,000 mg/kg (PGG 2012b). Contaminated soils above MTCA Method B screening levels were documented on the eastern (5B) and western (5A) sides of the common control unit, but a soil removal was conducted only for 5A.

The status of cleanup at interior Transformer Substation 5 will be investigated with backhoe test pits located at the western and eastern sides of the transformer pad. Three discrete surface soil samples and three discrete subsurface soil samples will be collected at each side of the transformer pad. Soil samples will be collected at depths of 0 to 0.5 feet bgs and 2 to 3 feet bgs. If visible soil staining is observed in a test pit at final sampling depth, and to assist in determining vertical extent of contamination, the excavation will continue until soil staining is no longer observed and additional discrete soil samples will be collected.

Surface and subsurface soil samples will be analyzed for PCBs, PAHs, TPH-Dx, total cyanide, fluoride, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Table 5.2.4-1 presents a summary of soil sampling and analysis for the interior transformer substations.



Legend

Proposed Sample Locations:

- 21 / 4 (yellow): Transformer substation not previously sampled, number of proposed samples shown in red
- 4 / 2 (red): Transformer substation where PCB's were detected in soil, number of proposed samples shown in red
- 5 (blue): Confirmation Sample Locations See Figure 5.2.4-4 for sample locations.

Source: CAC (1996b)

0 300 600
Feet

Figure 5.2.4-3

Sample Locations

Transformer Substations
Rectifier Yard AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

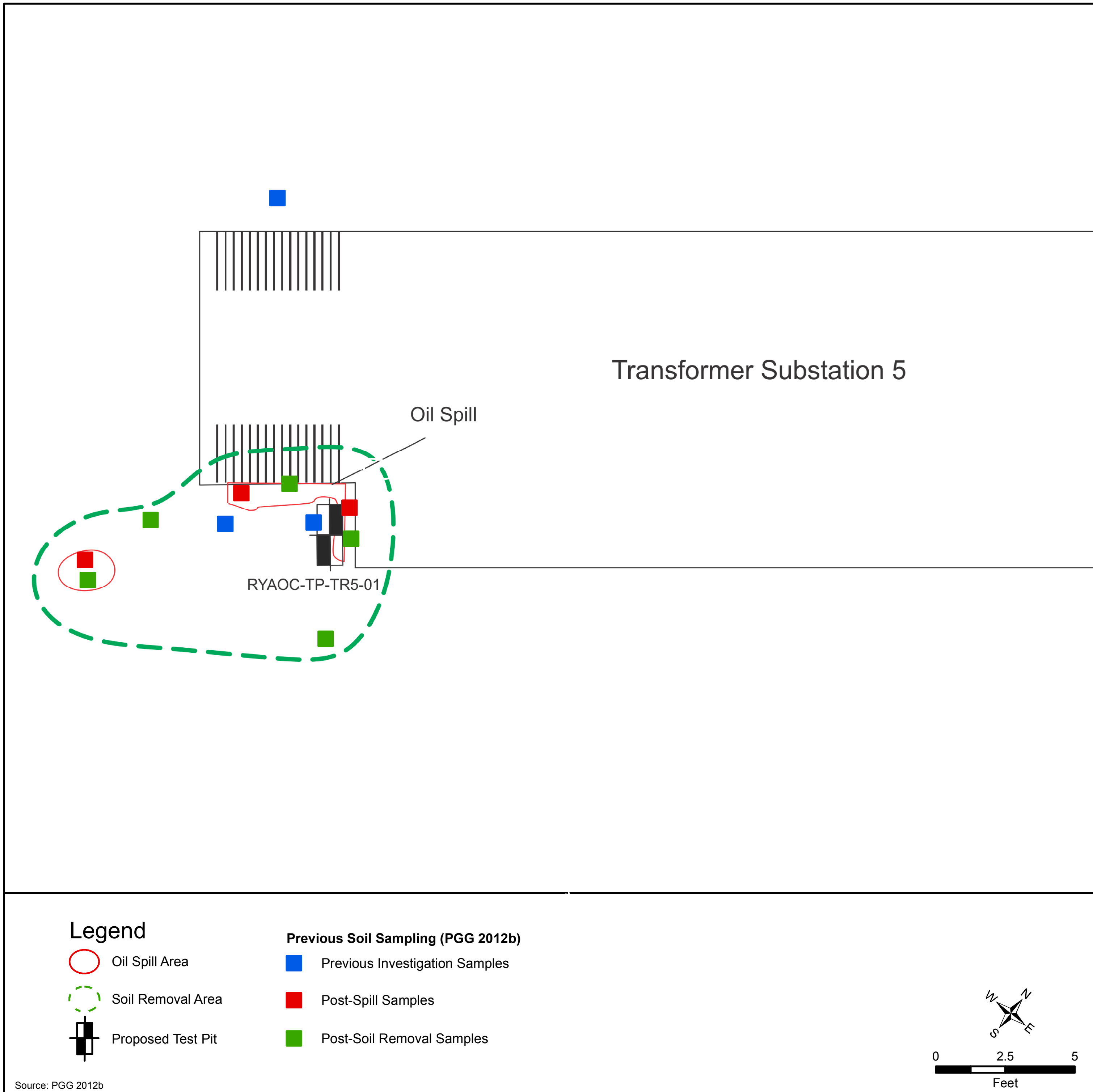


Figure 5.2.4-4

Proposed Confirmation Sample Locations
Transformer Substation 5

Rectifier Yard AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Rectifier Yard – Northwest Portion

During demolition of the plant, the northwest portion of the Rectifier Yard AOC was used for storage of recovered rebar. The 2014 Agreed Order states that any disposal site for demolition debris would be further evaluated under SWMU 21, Construction Rubble Storage Area; however, because of the physical proximity and for convenience in reporting, the northwest portion of the Rectifier Yard, used for storage during demolition of the plant, is investigated as part of the Rectifier Yard AOC.

Surface soil will be investigated utilizing a sampling grid following the Washington State Department of Ecology Toxic Cleanup Program Guidance on Sampling and Data Analysis Methods January 1995 (Ecology 1995a). The northwest area to be sampled is about 150 feet wide and 270 feet long, and is divided into 45 cells that are approximately 30 feet by 30 feet. Each cell is consecutively numbered, beginning at the northwest cell, and moving left to right, then right to left to the last numbered cell at the southeast corner of the area. A random number generator was used to randomly select 10 cells to be sampled. The sampling grid, and the 10 cells selected for sampling, is shown on Figure 5.2.4-1.

Surface soil in the randomly selected cells will be investigated using backhoe test pits. Ten discrete surface soil samples will be collected at the approximate center point of each cell, at a depth interval of 0 to 6 inches. A backhoe is proposed for this sampling because the surface in this portion of the Rectifier Yard AOC consists of large compacted gravel. The objective for collection of these samples is to investigate the impact on surface soil from demolition activities, but, if soil staining or other unusual conditions are observed at the final test pit depth, and to assist in determining vertical extent of contamination, the excavation will continue and additional subsurface soil samples will be collected. Utility line location will be conducted prior to the investigation to locate several types of utilities that may traverse this area, including sewer, water, and potentially electrical.

Surface and, if collected, subsurface soil samples will be analyzed for PCBs, PAHs, TPH-Dx, total cyanide, fluoride, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). Table 5.2.4-1 summarizes the sampling program for the northern portion of the Rectifier Yard.

5.2.5 Plant Area AOC

The Plant Area AOC consists of approximately 140-acres that include the main production area and the hillside to the north of the Highway 14. The main production area extends northeast from the eastern end of the Rectifier Yard AOC to the John Day Dam Road and northward from the south fenced margin of the plant parking and production area to the access road north of Production Building D. The hillside includes the area north of the main production area and east of the water towers to Highway 14. The hillside area is not included in the investigation of the Plant Area AOC because it contains SWMUs that will be investigated separately.

Structures and features within the Plant Area AOC include the Production Buildings Foundations A through D, associated courtyards, the Cast House building foundation with the Machine Shop, Maintenance, and Shipping Areas, and associated ancillary features and buildings where materials containing site COPC were used, routinely handled, and temporarily stored.

Four SWMUs are located in the Plant Area AOC that include the Decommissioned Air-Pollution Control Equipment (SWMU 7), the Carbon Waste Roll-Off Areas (SWMU 24), the Solid Waste Collection Bin and Dumpsters (SWMU 25) and the HEAF Filter Roll-Off Bin (SWMU 26). Because the exact locations of these SWMUs are not well documented, and/or may have changed through time, these SWMUs are addressed under the Plant Area AOC. Descriptions of these SWMUs are presented in the Phase 1 Work Plan and Section 5.1.

Historical operations within the plant footprint had a potential to create fugitive emissions or dust not captured by the air pollution control systems, which may have been deposited on the ground on the courtyard soils within the Plant Area AOC footprint. Additionally, plant operations required practices using mobile units within the Plant Area AOC such as transport trucks and temporary material storage facilities. These temporary storage and handling operations and associated locations are difficult to clearly define, but could have potentially contributed to contamination of the soil within the Plant Area AOC.

Many of the buildings and structures in the former production area were demolished during 2010 through 2012. Foundations and concrete slabs remain in many locations. The major focus of investigation in the Plant Area AOC is surface and subsurface soil, and for certain other structures such as waste lines and sumps.

5.2.5.1 Plant Area AOC Investigation Objectives

Data needs and data gaps for the Plant Area AOC are summarized in Table 3-4 of this plan and described in detail in the Phase 1 Work Plan. The following investigation objectives are based on the identified data needs and data gaps for the Plant Area AOC:

- Characterize the nature and extent of COPC in surface and subsurface soil for source features identified for the Plant Area AOC.
- Determine the extent of COPC, particularly PAHs, in soil in Courtyards that exceed MTCA Method C screening criteria.
- Inspect the construction of the Coke and Pitch Unloading Structure and associated sump and evaluate potential contaminant releases.
- Evaluate potential releases from low-lying features such as DC Casting Pits associated with the Machine Shop/Maintenance Shop/Cast House, Friction Weld Press Pit, Production Buildings foundations, and Industrial Sump.
- Determine volume of contaminated sediment in the Industrial Sump.
- Confirm construction and layout of the southeast portion of the groundwater collection system and its tie-in with other area conveyance lines.
- Determine the status of cleanup for the scrubber effluent line system.
- Determine whether cleanup of the industrial and monitoring line system is warranted.
- Evaluate the interactions of the industrial and maintenance lines, scrubber effluent lines, and southeast segment of the groundwater collection system and their impact on shallow groundwater.
- Determine source of water discharging to NPDES Pond A.
- Characterize soil chemical concentrations and potential releases to soil at USTs and ASTs.
- Characterize surface and subsurface soil at the cryolite as well as bath storage and handling structures where potential leaching of fluoride is of particular concern for shallow groundwater.
- Characterize surface and subsurface soil in the Paste Plant and other carbon handling, storage, and manufacturing features.

5.2.5.2 Plant Area AOC Investigation Scope

Structures, features and potential sources of contamination within the Plant Area AOC have been identified for further investigation. These structures and features were presented and discussed in the Phase 1 Work Plan as three main focus areas: 1) Carbon Manufacturing, Handling, and Storage Features, 2) Cryolite and Bath Handling and Storage Features, and 3) the Cast House, Production Buildings and Ancillary Features. These features are complexly juxtaposed with respect to each other throughout the plant area. For example, most of the carbon manufacturing and storage features are located in the southeastern portion of the former plant; however, several other handling, storage features and structures are located in segments of the Courtyards between and adjacent to the Production Buildings.

To simplify the approach and presentation of the scope of the investigation, the structures and features identified for further investigation have been reorganized into seven field investigation groups based upon similarity of actions required for preliminary field tasks, similarity of constituents investigated, and/or because they are co-located. Field investigation groups for Plant Area AOC structures and features are presented on Table 5.2.5-1, Focus Category Field Investigation Groups.

The structures and features in the left column of the table are in order of their presentation in the Phase 1 Work Plan. In the table, columns to the right indicate how those structures and features have been reorganized into seven field investigation groups. The Courtyard Soil Investigation Group includes Courtyard soil and all structures or features which are located within segments of the plant courtyards. For example, three diesel ASTs were located in two of the Courtyard segments. Therefore, the scope of investigation for each of the courtyard segments considers all structures and features that are co-located in that Courtyard segment. Courtyard segments are generally bounded by the plant buildings and the passages that connect them (e.g., Segment A1 is bounded by the Cast House, Production Building A, West Passage, and Passage No. 1).

Table 5.2.5-1
Focus Category Field Investigation Groups, Plant Area AOC
(Page 1 of 2)

PLANT AREA AOC FOCUS CATEGORY FEATURES AND STRUCTURES	Phase 1 Reference Figures	Focus Category Field Investigation Groups						
		Courtyard Soil	Carbon Manufacturing	Cryolite and Bath	Petroleum Storage	Maintenance and Ancillary	Cast House and Production Buildings	Industrial Lines
		Phase 2 Figure Number						
		5.2.5-2	5.2.5-3	5.2.5-4	5.2.5-5	5.2.5-6	5.2.5-7	5.2.5-9
CARBON MANUFACTURING, HANDLING, AND STORAGE								
SWMU 7 WESPs	7.5-2	✓	✓					
SWMU 24 Carbon Waste Bins	7.5-2	✓						
SWMU 25 Solid Waste Bins	App A-25			✓				
SWMU 26 HEAF Filter Bins	7.5-2		✓					
Hard Pitch Storage Building	7.5-2		✓					
Pitch Building	7.5-2		✓					
Coke & Pitch Unloading Structure & sump	7.5-2		✓					
Paste Plant	7.5-2		✓					
Petroleum Coke Silos (2)	7.5-2		✓					
Metalurgical Coke Silo	7.5-2		✓					
Anthracite Coal Silo	7.5-2		✓					
Briquette Storage Slab	7.5-2		✓					
HEAF Building	7.5-2		✓					
East/West Briquette Silos (2)	7.5-2	✓						
Vitamin Silos and Stud Hole Paste Drying Area	7.5-2	✓						
CRYOLITE AND BATH HANDLING AND STORAGE FEATURES								
Bath Storage Building (investigated as SWMU 12)	7.5-3							
Bath Recycle Building	7.5-3			✓				
Bulk Cryolite Tank/Silo	7.5-3			✓				
Aluminum Fluoride Silo	7.5-3	✓						
Treated Alumina Silos (3)	7.5-3	✓						
Bath Crusher	7.5-3	✓						
CAST HOUSE, PRODUCTION BUILDINGS, AND ANCILLARY FEATURES								
Cast House/Foundry								
◦ Cast House Foundation	7.5-4						✓	
◦ DC Casting Pits	7.5-4						✓	
Production Buildings A-D								
◦ Production Buildings A-D Foundations	7.5-4						✓	
◦ Courtyard Soil	7.5-6	✓						
◦ Subsurface ducts	Figure 1-5						✓	
◦ Bag Houses (8)	Figure 1-5	✓						
◦ Under Floor Trenches	Figure 1-5						✓	
Industrial Lines								
◦ Industrial Monitoring Lines	7.5-5							✓
◦ Electrostatic Precipitator Lines	7.5-5							✓
◦ Groundwater Collection Lines	7.5-5							✓
◦ Sewage Treatment System Sump	7.5-5							✓
◦ Industrial Sump	7.5-5							✓
◦ Pond A Discharge	7.5-5							✓

Table 5.2.5-1
Focus Category Field Investigation Groups, Plant Area AOC
(Page 2 of 2)

PLANT AREA AOC FOCUS CATEGORY FEATURES AND STRUCTURES	Phase 1 Reference Figures	Focus Category Field Investigation Groups						
		Courtyard Soil	Carbon Manufacturing	Cryolite and Bath	Petroleum Storage	Maintenance and Ancillary	Cast House and Production Buildings	Industrial Lines
		Phase 2 Figure Number						
		5.2.5-2	5.2.5-3	5.2.5-4	5.2.5-5	5.2.5-6	5.2.5-7	5.2.5-9
CAST HOUSE, PRODUCTION BUILDINGS, AND ANCILLARY FEATURES (Continued)								
Petroleum Storage Handling								
◦ Maintenance Area ASTs (3)	7.5-4						✓	
◦ Maintenance Area Oil/Water Separator & Sump	NA						✓	
◦ Gasoline UST (west of BPA)	7.5-4				✓			
◦ Compressor Building USTs (3)	7.5-4				✓			
◦ Compressor Building AST (1)	7.5-4				✓			
◦ Cast House Oil Storage Room	7.5-4						✓	
◦ Diesel ASTs in Courtyards (3)	7.5-4	✓						
◦ Diesel ASTs in southeast plant area (3)	7.5-4				✓			
◦ Heating Oil AST near Admin Bldg	7.5-4				✓			
Shops, Maintenance, and Repair Areas								
◦ Cast House Machine Shop	7.5-4						✓	
◦ Cast House Maintenance Area	7.5-4						✓	
◦ Cast House Oil Change Pit	7.5-4						✓	
◦ Cast House Wash Area	NA						✓	
◦ Stud Repair/Friction Weld Sump	7.5-4						✓	
◦ Paste Plant Maintenance Shop	7.5-4		✓					
◦ Crane Repair Areas (2)	7.5-4	✓						
◦ Crucible Cleaning Room	7.5-4						✓	
◦ Stud Cleaning and Repair Areas	7.5-4	✓						
◦ Carpenter Shop	7.5-4					✓		
Ancillary Features								
◦ Plant Laboratory	7.5-4					✓		
◦ Dross Storage	7.5-4					✓		
◦ Compressor Building	7.5-4					✓		
◦ Battery Storage Areas	7.5-4						✓	
◦ Battery Storage Shop Building	7.5-4	✓						

Notes:

Focus Category Structures and Features are listed in the order they were presented and discussed in Section 7.5, Phase 1 Work Plan.

Phase 1 Reference Figures are found in Phase 1 Work Plan, and Figure 1-5 Air Emissions Control Systems in Part B Permit Application (Goldendale Aluminum Company 1997).

AST Aboveground Storage Tank
NA Not Applicable
SWMU Solid Waste Management Unit
UST Underground Storage Tank
(3) Total number of features

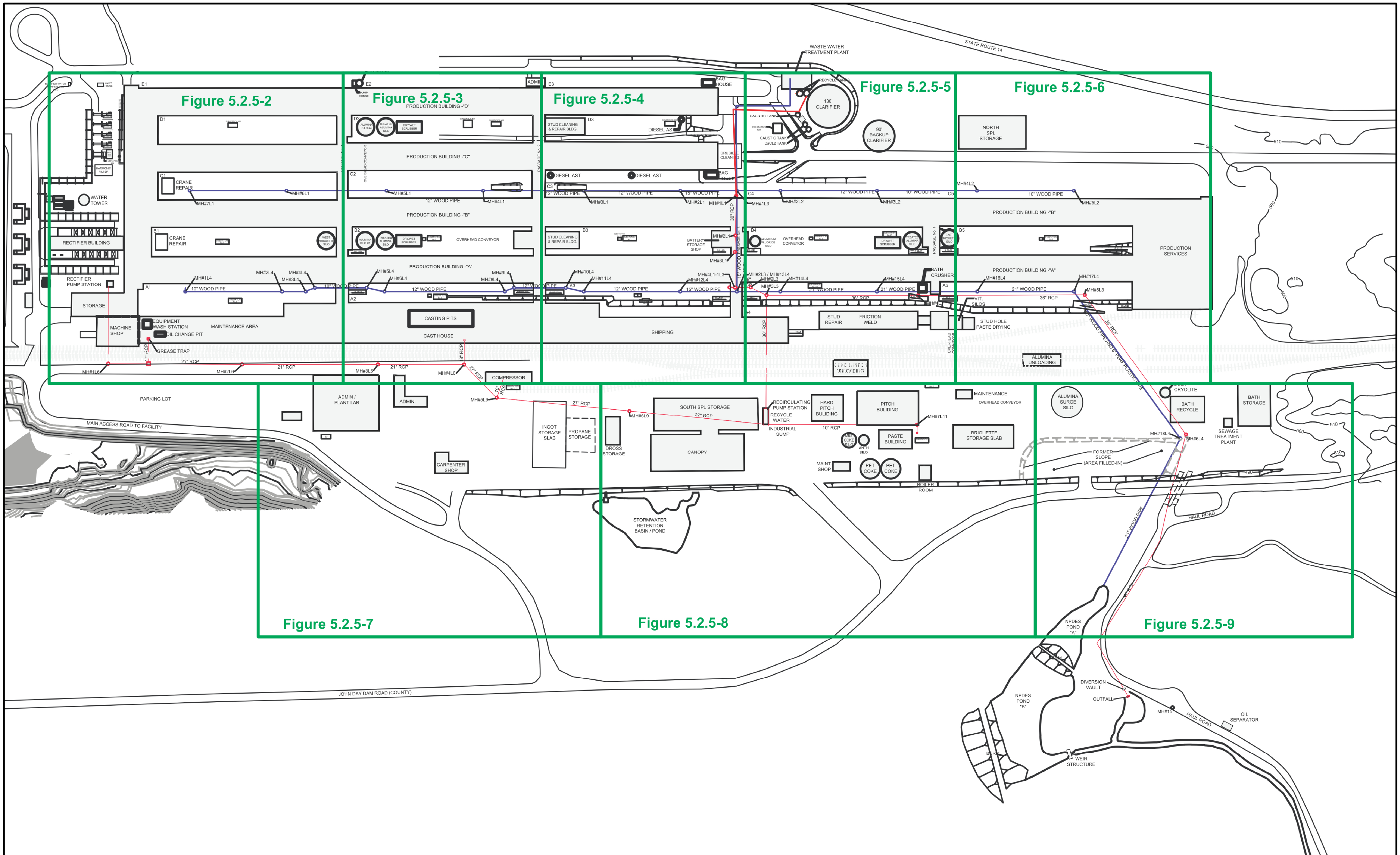
Figure 5.2.5-1 shows the layout for the sample location figures for each of the seven focus category field investigation groups. The seven investigation group figures are listed below.

- Figures 5.2.5-2 through 5.2.5-6 shows sample locations for the Courtyard Soil Group, with Petroleum Storage Groups on Figure 5.2.5-6.
- Figure 5.2.5-7 shows sample locations for the Maintenance and Ancillary, and Petroleum Storage Groups.
- Figure 5.2.5-8 shows sample locations for the Carbon Manufacturing and Petroleum Storage Groups.
- Figure 5.2.5-9 shows sample locations for the Cryolite and Bath, and Petroleum Storage Groups.
- Figure 5.2.5-10 shows sample locations for the UST west of the BPA Station.
- Figure 5.2.5-11 shows sample locations for the Industrial Lines Group.

5.2.5.3 Scope for Courtyard Soil Group

The purpose of the investigation of the Courtyard Soil Group is to characterize COPC in soil and to determine distribution of COPC, particularly PAHs, which exceed MTCA Method C criteria. The Courtyard Soil Group includes Courtyard soil and several other structures and features (Figures 5.2.5-2 to 5.2.5-6). The following are SWMUs and features included in the Courtyard Soil Group:

- Courtyard Soil.
- SWMU 7 Decommissioned Air Pollution Control Equipment.
- SWMU 24 Carbon Waste Bins.
- West/East Briquette Silos (2).
- Vitamin Silos and Stud Hole Paste Drying Area.
- Aluminum Fluoride Silo.
- Treated Alumina Silos (3).
- Bath Crusher.
- Bag Houses (5) located generally at ground surface.



Legend

Figure 5.2.5-2 (green box)	Approximate Field Investigation Area
Red line	Industrial Drain Lines
Blue line	Scrubber Effluent Lines

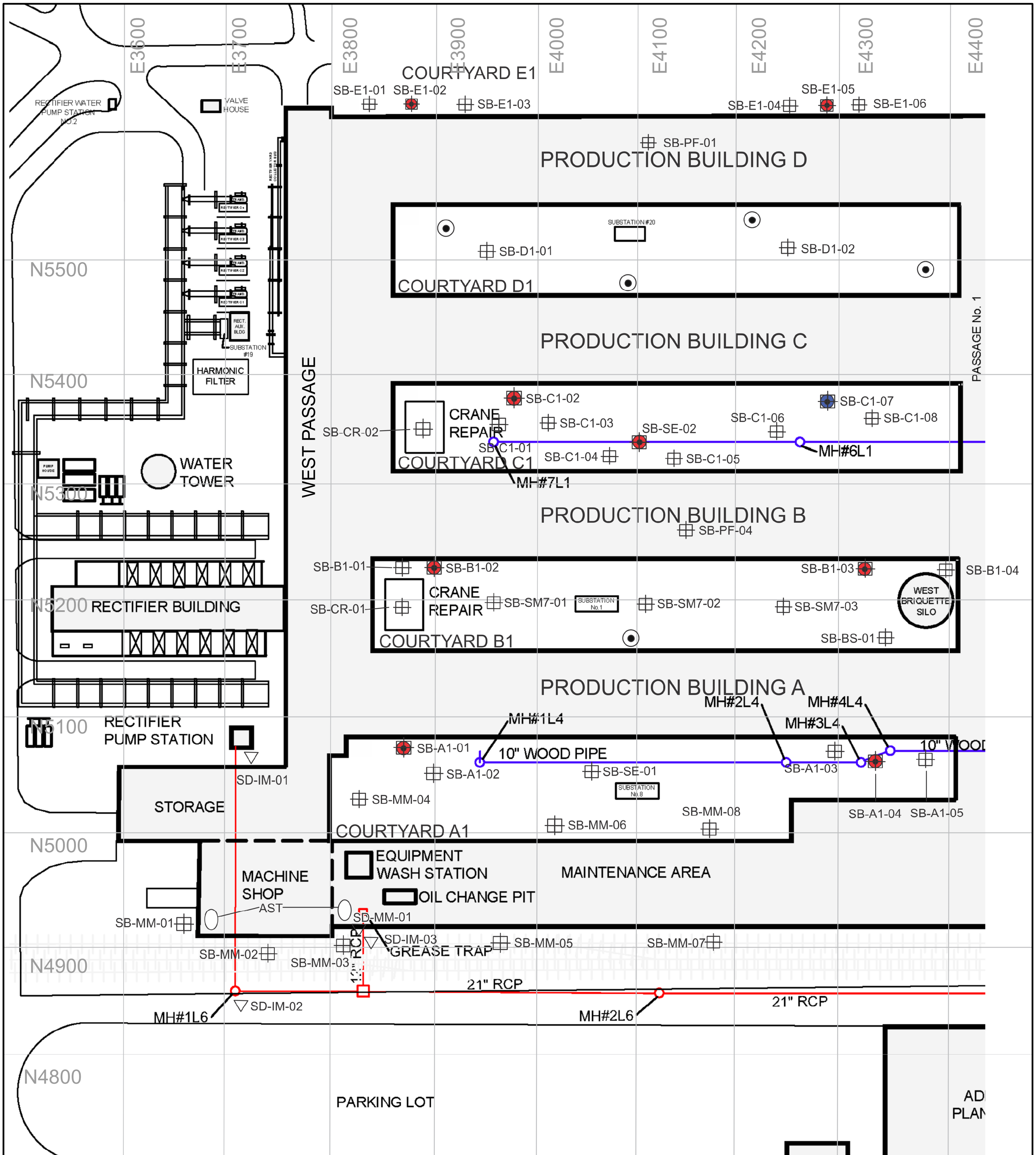
0 300 600
Feet

Source: Modified from GAC 1996f

Figure 5.2.5-1

Plant Area AOC Focus Category Field Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

2010 Sample Locations

- SB-A1-01 — Proposed Soil Boring
- SD-IM-01 — Proposed Sediment Sample
- PAH not elevated
- PAH exceeds MTCA to 3 feet depth
- PAH exceeds MTCA to 6 feet depth
- Industrial Drain Lines
- Scrubber Effluent Lines

(all Plant Area AOC labels will include the prefix "PAAOC-")

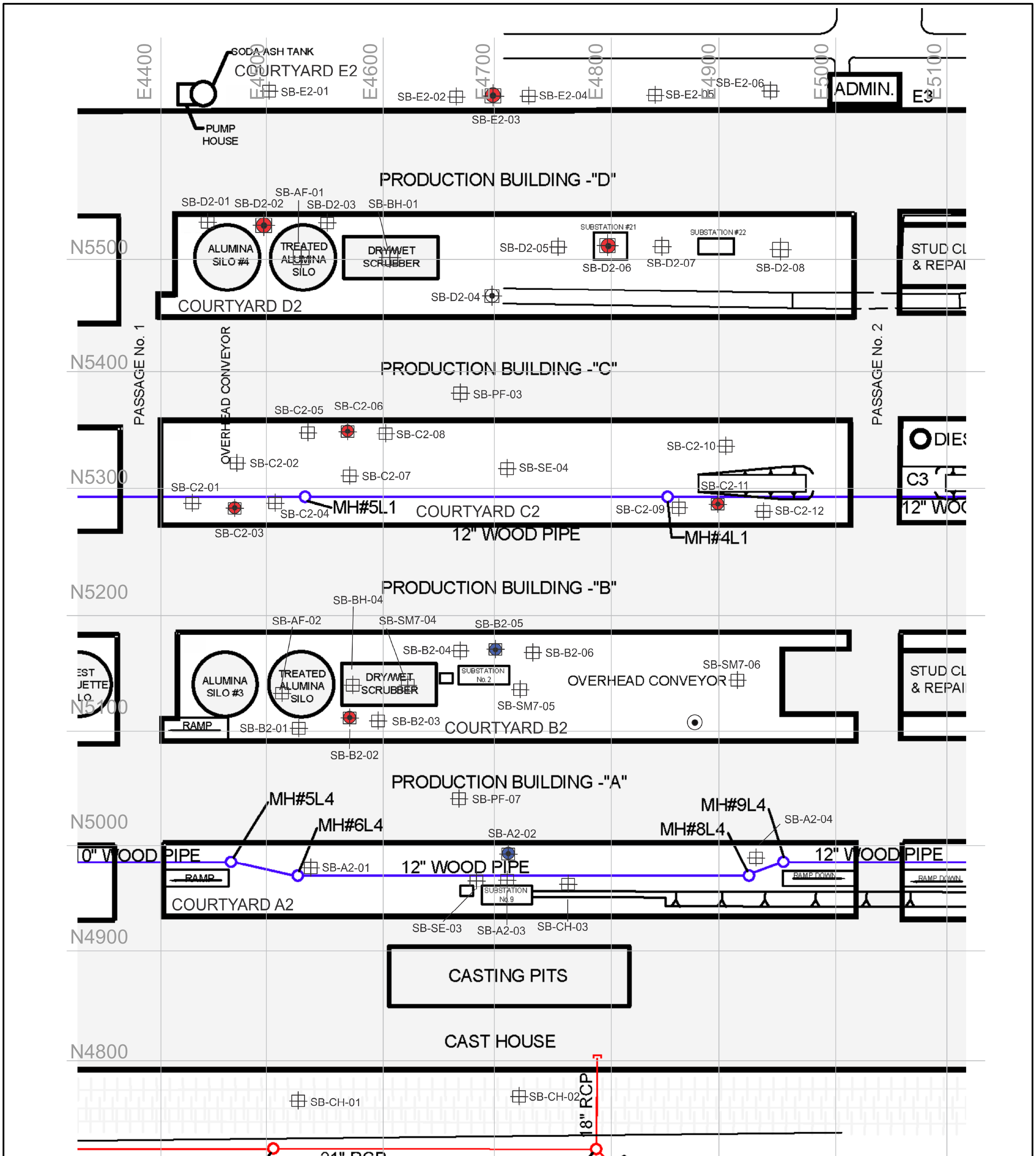
0 25 100
Feet

Source: Modified from GAC 1996f

Figure 5.2.5-2

Sample Locations in Series 1
Courtyard Segments
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

SB-A2-01 — Proposed Soil Boring

2010 Sample Locations

- PAH not elevated
- PAH exceeds MTCA to 3 feet depth
- PAH exceeds MTCA to 6 feet depth

- Industrial Drain Lines
- Scrubber Effluent Lines

W N S E

0 25 100
Feet

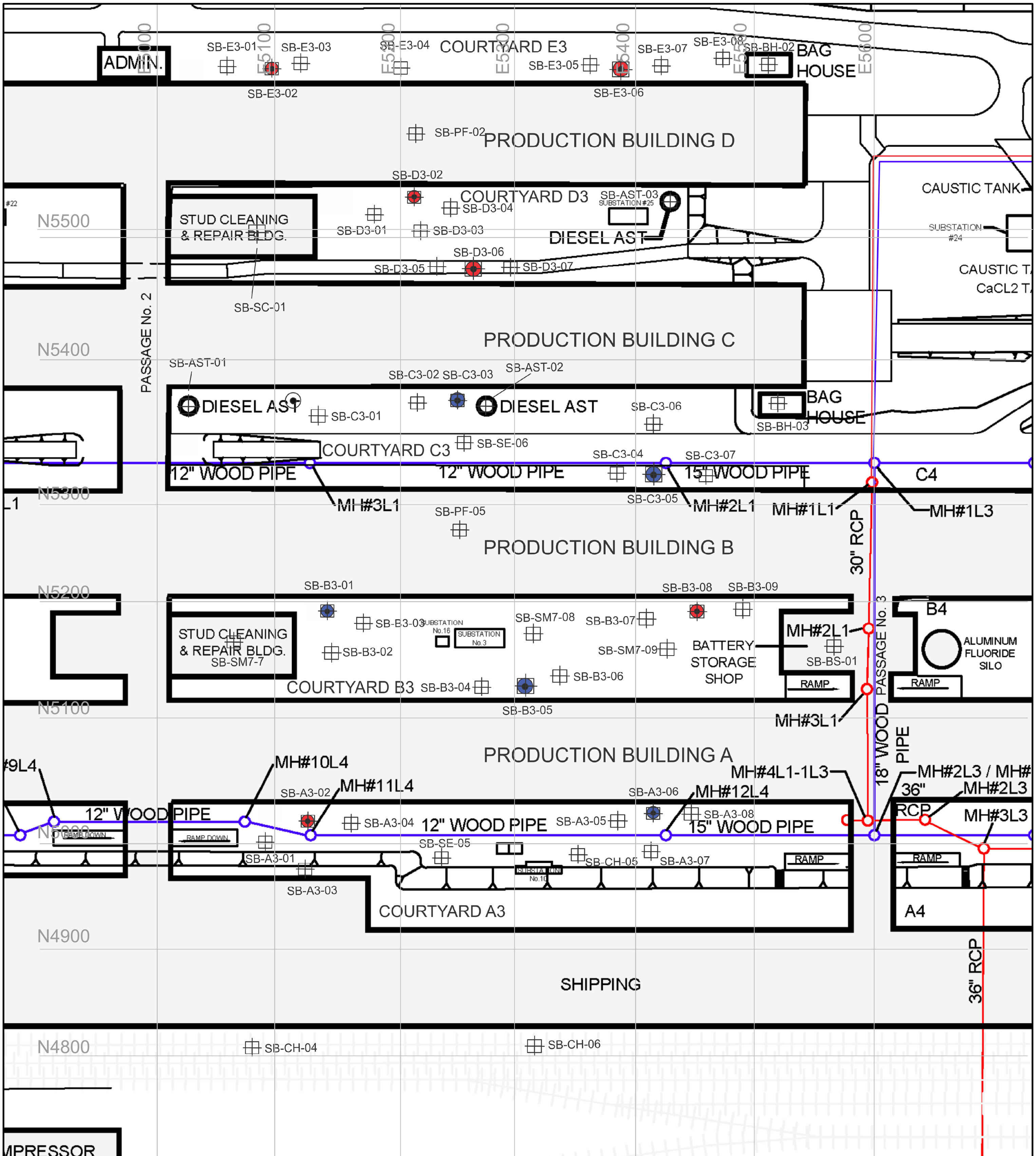
(all Plant Area AOC labels will include the prefix "PAAOC-")

Source: Modified from GAC 1996f

Figure 5.2.5-3

Sample Locations in Series 2
Courtyard Segments
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

2010 Sample Locations

Proposed Soil Boring (SB-E3-01)	PAH not elevated	Industrial Drain Lines	
	PAH exceeds MTCA to 3 feet depth	Scrubber Effluent Lines	
	PAH exceeds MTCA to 6 feet depth		

0 25 100
Feet

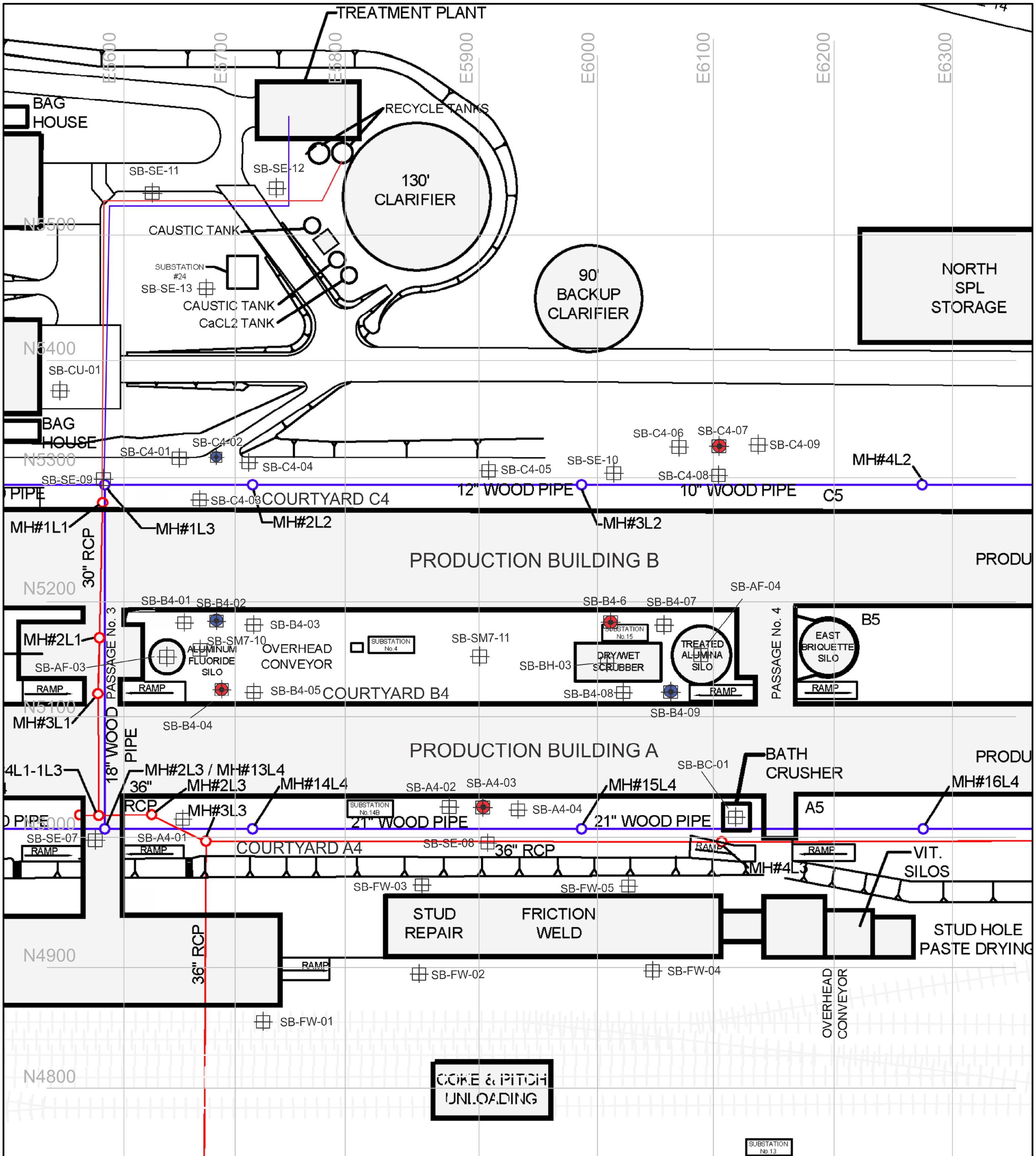
(all Plant Area AOC labels will include the prefix "PAAOC-")

Source: Modified from GAC 1996f

Figure 5.2.5-4

Sample Locations in Series 3 Courtyard Segments Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

Proposed Soil Boring

SB-A4-01

2010 Sample Locations

PAH not elevated

PAH exceeds MTCA to 3 feet depth

PAH exceeds MTCA to 6 feet depth

Industrial Drain Lines

Scrubber Effluent Lines

W N S E

0 25 100

Feet

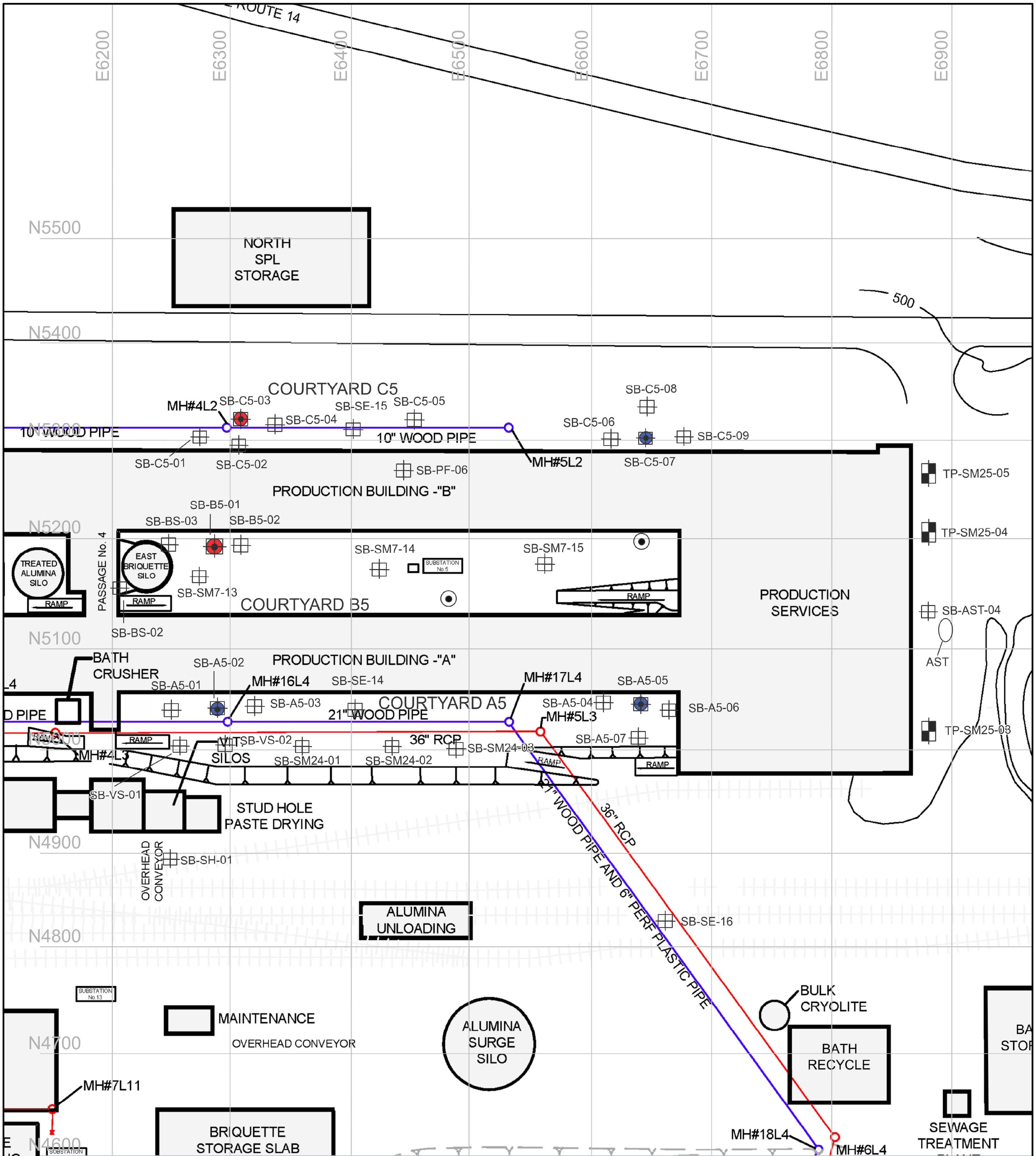
(all Plant Area AOC labels will include the prefix "PAAOC-")

Source: Modified from GAC 1996f

Figure 5.2.5-5

Sample Locations in Series 4
Courtyard Segments
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

2010 Sample Locations

- Proposed Soil Boring (SB-A5-01)
- Proposed Test Pit (TP-SM25-01)
- PAH not elevated
- PAH exceeds MTCA to 3 feet depth
- PAH exceeds MTCA to 6 feet depth
- Industrial Drain Lines
- Scrubber Effluent Lines

(all Plant Area AOC labels will include the prefix "PAAOC-")

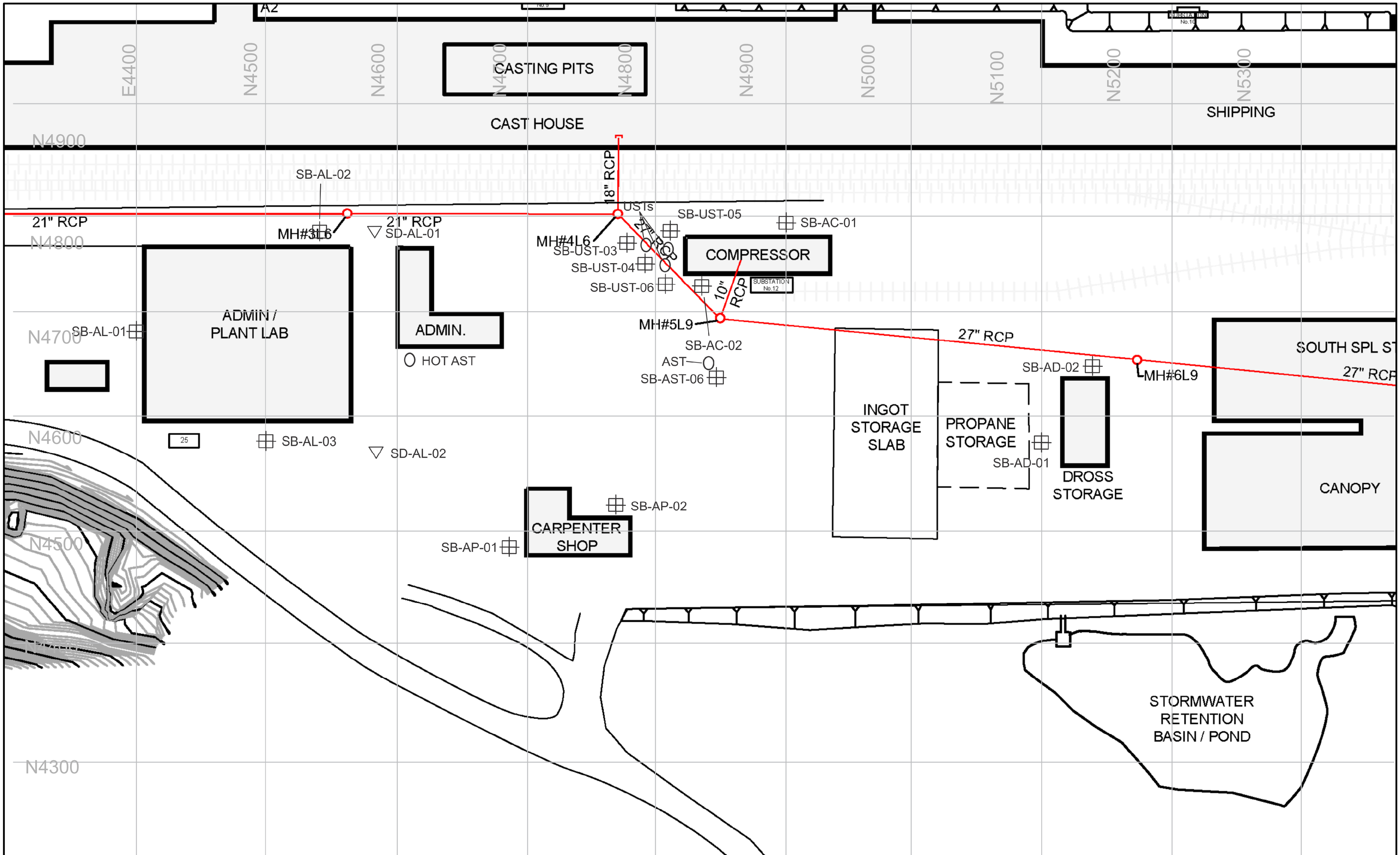
Source: Modified from GAC 1996f

0 25 100
Feet

Figure 5.2.5-6

Sample Locations in Series 5
Courtyard Segments
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

- Proposed Soil Boring (SB-AST-06)
- Proposed Sediment Sample (SD-AL-02)
- Industrial Drain Lines
- Scrubber Effluent Lines

(all Plant Area AOC labels will include the prefix "PAAOC-")

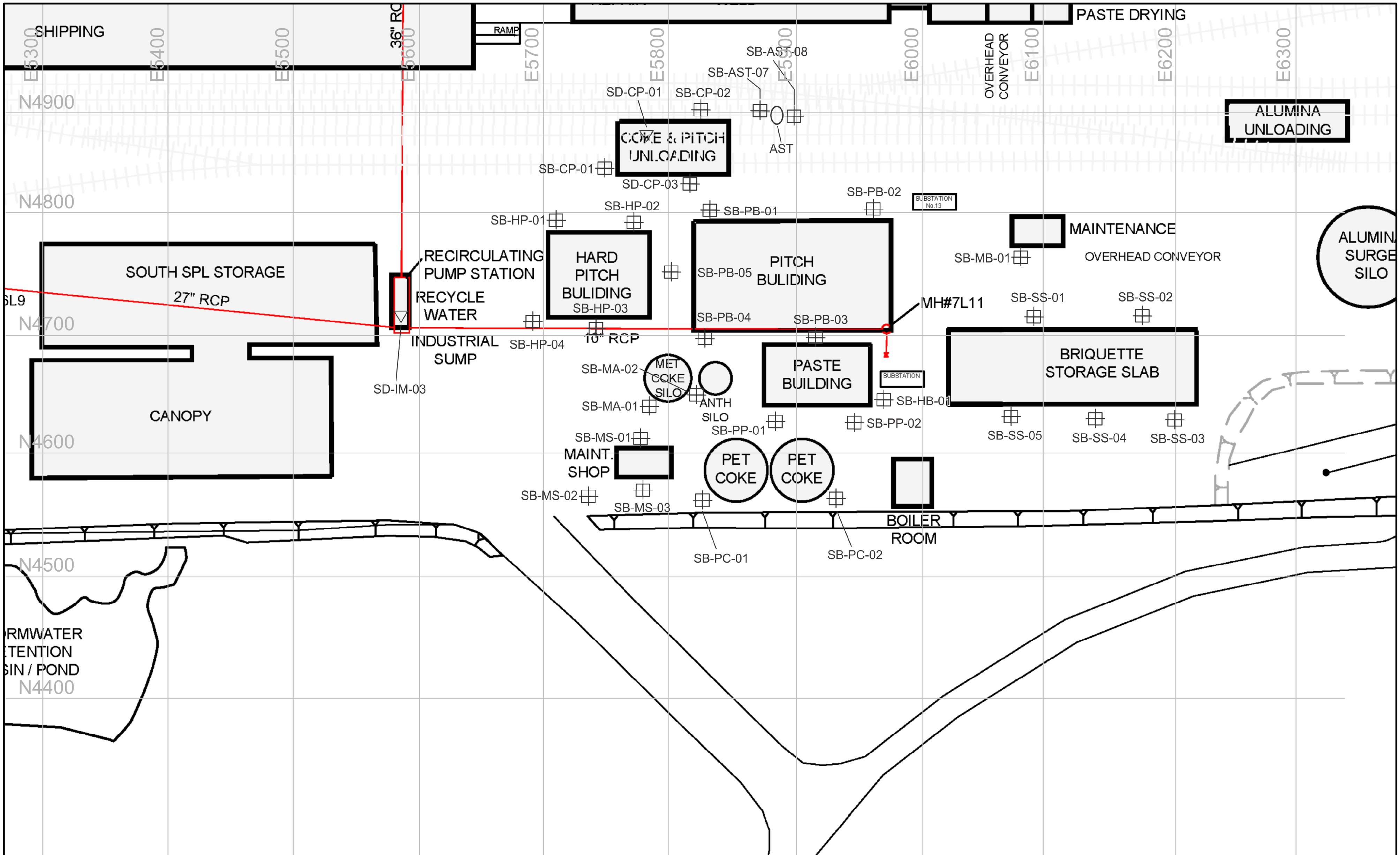
Source: Modified from GAC 1996f

0 25 100
Feet

Figure 5.2.5-7

Sample Locations for Shops Maintenance and Ancillary Features Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

- Proposed Soil Boring (SB-MS-01)
- Proposed Sediment Sample (SD-IM-03)
- Industrial Drain Lines
- Scrubber Effluent Lines

(all Plant Area AOC labels will include the prefix "PAAOC-")

W N S E

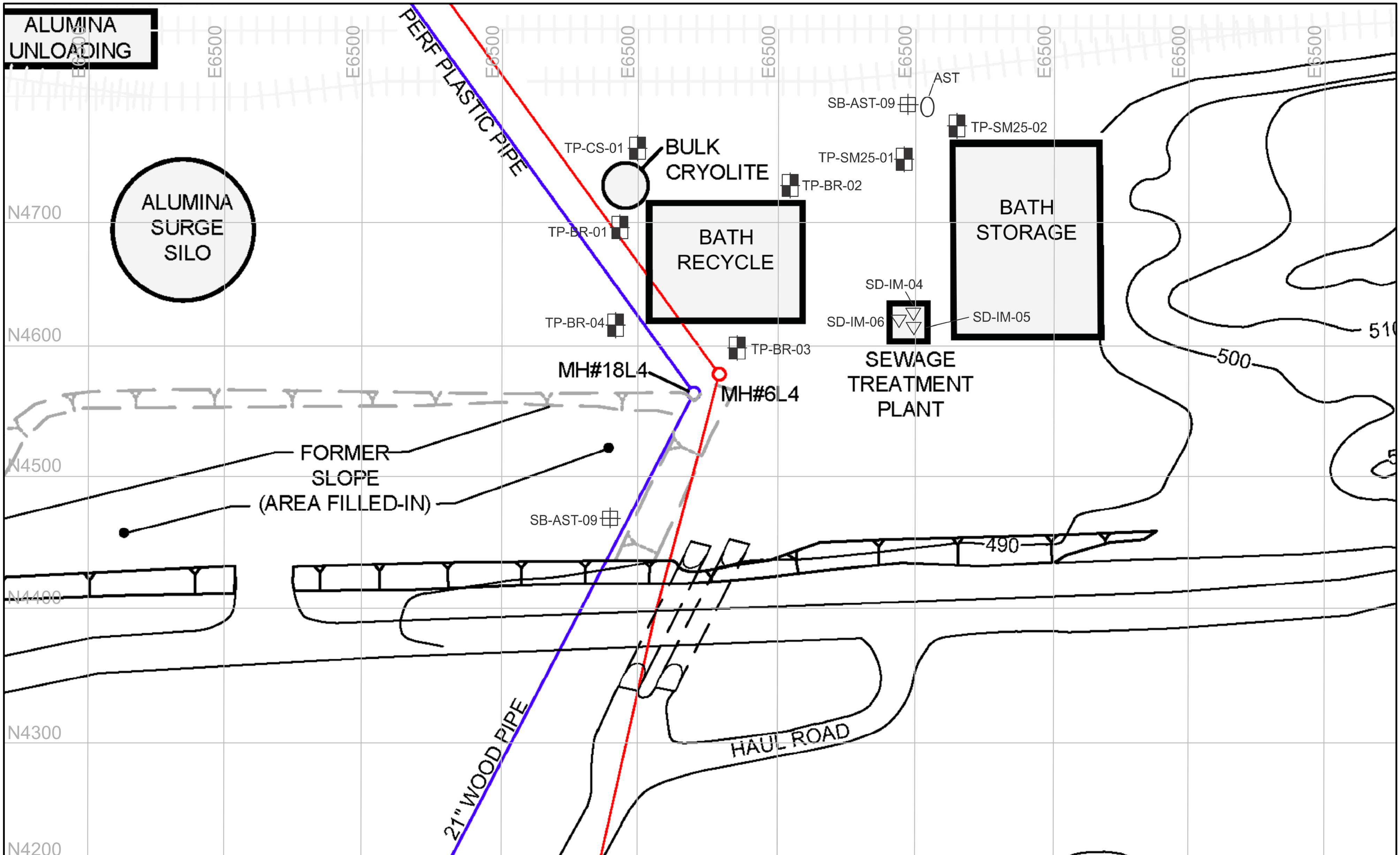
0 25 100 Feet

Source: Modified from GAC 1996f

Figure 5.2.5-8

Sample Locations for Carbon Manufacturing Features
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

- Proposed Soil Boring (SB-AST-09)
- Proposed Sediment Sample (SD-IM-04)
- Proposed Test Pit (TP-BR-01)
- Industrial Drain Lines
- Scrubber Effluent Lines

(all Plant Area AOC labels will include the prefix "PAAOC-")

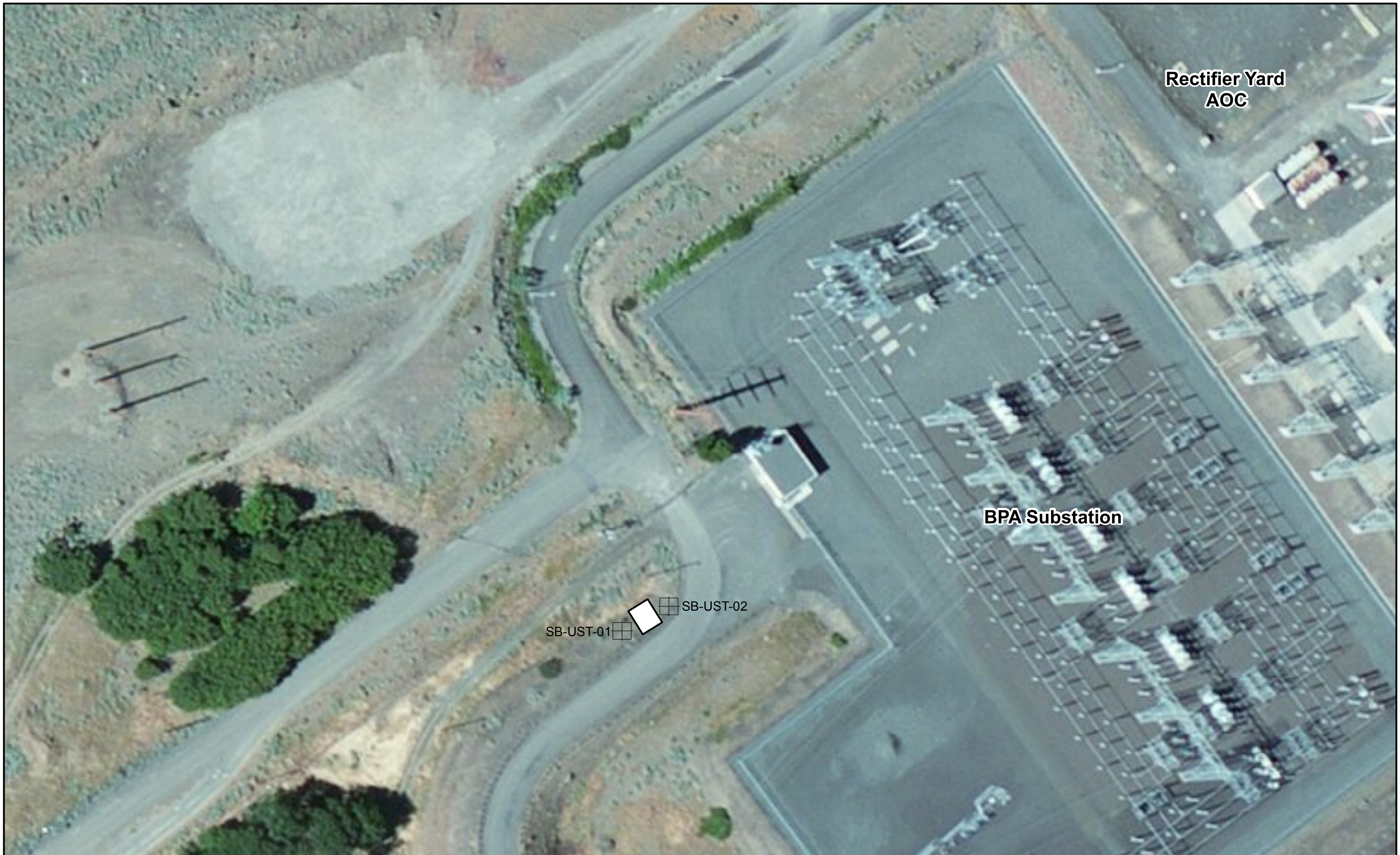
Source: Modified from GAC 1996f

0 25 100
Feet

Figure 5.2.5-9

Sample Locations for Cryolite Handling Features
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

Former Underground Storage Tank

SB-UST-01 Soil Boring (all Plant Area AOC labels will include the prefix "PAAOC-")

Source: Google 2010, Westinghouse 1990

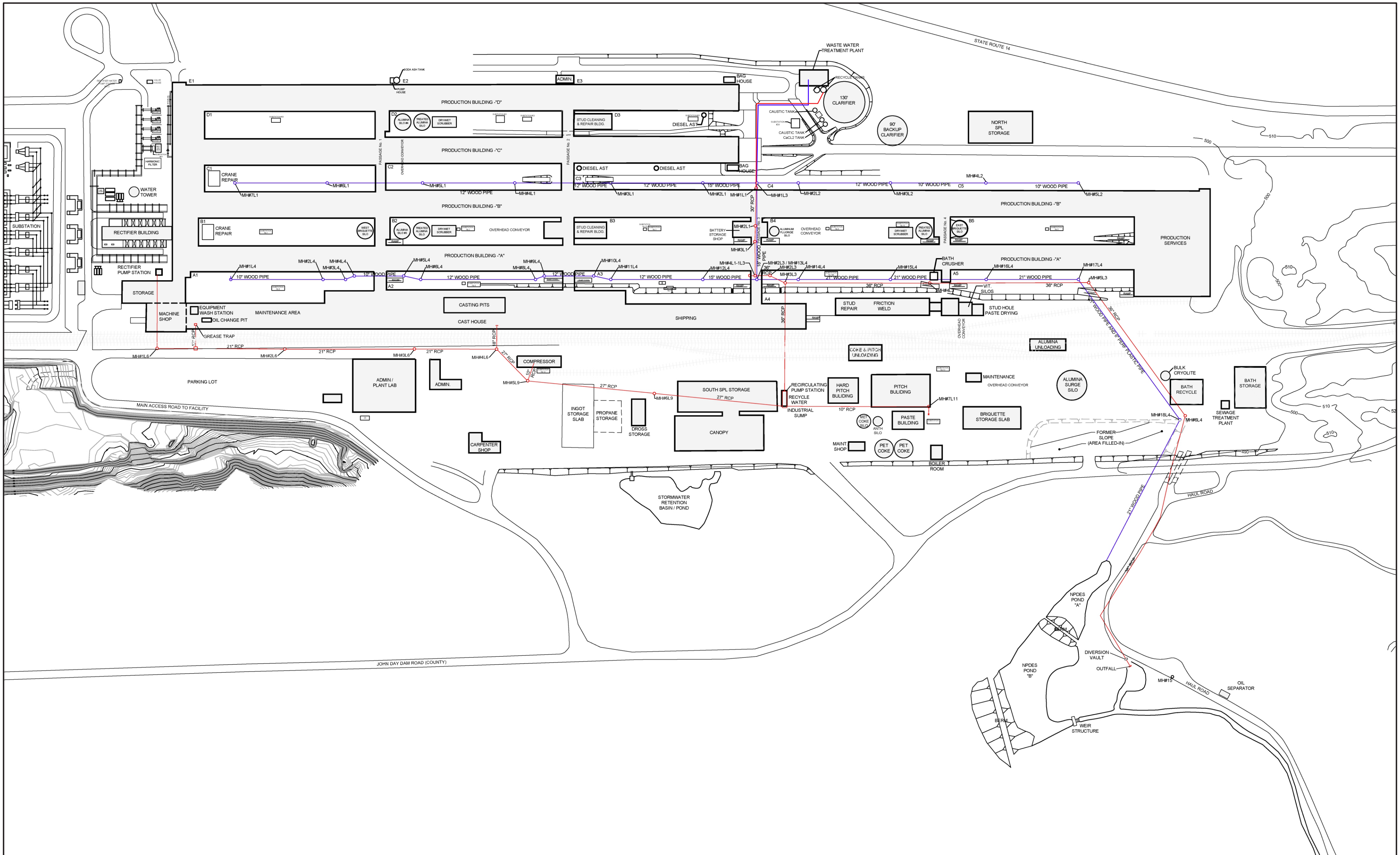
N W E S

0 75 150
Feet

Figure 5.2.5-10

Gasoline UST West of BPA Substation
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

Industrial Drain Lines

Scrubber Effluent Lines

Source: Modified from GAC 1996f

0 150 300
Feet

Figure 5.2.5-11

Layout of Industrial Lines
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- Diesel ASTs in courtyards (3).
- Crane Repair Areas (2).
- Stud Cleaning and Repair Areas.
- Battery Storage Building.
- Scrubber Effluent Line (subsurface soil investigation only).

Previous investigation of the production area courtyards was performed during 2010 (PGG 2010) prior to start of demolition activities. Surface and subsurface soil samples were collected as part of this investigation. Soil samples were analyzed for metals, fluoride, total and free cyanide, carcinogenic PAHs, and were also analyzed for Toxic Characteristic Leaching Procedure (TCLP) metals. Chemicals detected above one or more of MTCA Methods A, B, or C screening levels include total and free cyanide, fluoride, arsenic, cadmium and carcinogenic PAHs. TCLP results indicated the soil did not exhibit toxicity for the purpose of waste disposal. The locations of soil borings completed during the 2010 investigation are also shown on Figures 5.2.5-2 through 5.2.5-6.

Highest chemical concentrations were detected in the samples collected from the shallowest interval in each boring but extended to the deepest interval sampled above the bedrock contact in some borings. Some of the highest concentrations of PAHs at the site (refer to boring B-45, Appendix A-25, Phase 1 Work Plan) were detected on the southern side of Production Building A in the general area of a carbon duct waste unloading area noted by Ecology inspectors in 1995 that appears to represent part of SWMU 24. The Ecology inspector noted that this area had historically been a problem for spilled primary emission carbon dust and had been recently paved at the time of the 1995 inspections. No other investigation of the features and associated SWMUs in the Courtyards has been conducted.

The following subsections describe the proposed scope for the soil, features, and SWMUs located in the Courtyards.

Courtyard Soil

Fifty-one soil borings were completed in courtyards in the 2010 investigation. PAHs detected in soil samples from these borings were below MTCA screening levels in nine borings, above MTCA screening levels to depths of up to 3 feet bgs in 27 borings, and above MTCA screening levels to depths of up to 6 feet bgs in 15 borings. The locations of the 2010 borings, and borings proposed for this investigation, are shown on Figures 5.2.5-2 through 5.2.5-6. Investigation of Courtyard soil will focus on locations of the 2010 soil boring locations, discussed in this section, as well as soil borings for other features located in the courtyards that are discussed in the following sections.

Courtyard soil will be investigated with 147 soil borings that are co-located with the previous 51 2010 boring locations. Where PAHs were detected above MTCA screening levels in 2010 borings, one soil boring will be completed at, and two or three soil borings will be located in the vicinity of, the 2010 boring location. Where PAHs were not detected above MTCA screening levels in 2010 borings, one soil boring is proposed to confirm low PAH concentrations in soil. The purpose of the proposed soil boring placement is to define the vertical and horizontal extent of PAHs that may exceed MTCA screening levels.

Discrete soil samples will be collected at depths of 2 feet bgs and the base of the boring. Soil samples will be analyzed for PAHs, total cyanide, fluoride, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and TPH-Dx. Table 5.2.5-2 summarizes the Courtyards sampling program.

SWMU 7 Decommissioned Air Pollution Control Equipment

Air pollution control units associated with SWMU 7 were situated on the roofs of Production Buildings A and B and are interpreted to impact primarily Courtyard B (Courtyard Segments B1 through B5). Sample locations that directly address SWMU 7 are located along the centerline of Courtyard Segments B1 through B5. Samples locations that address other features located in each of those courtyard segments are situated throughout other portions of the Courtyard segments and will provide additional information to assess potential impact of SWMU 7 on Courtyard soil.

The general alignment of SWMU 7 along courtyard B will be investigated with 15 soil borings (Figures 5.2.5-2 through 5.2.5-6). The soil borings will be completed to depths up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Other soil borings in the vicinity of SWMU 7 soil borings will provide additional soil for evaluation of SWMU 7. Surface and subsurface soil samples will be analyzed for site COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 1 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT A1						
Courtyard Soil	Soil Boring (5)	Surface Soil	5	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil. Determine distribution of PAHs above screening criteria.
		Subsurface Soil	10	2 feet bgs, and base of boring		
Scrubber Effluent Line	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line. Includes one additional soil sample below invert if >5 feet above shallow groundwater.
		Subsurface Soil	3	1 above invert 2 below invert		
COURTYARD SEGMENT B1						
Courtyard Soil	Soil Boring (4)	Surface Soil	4	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	8	2 feet bgs, and base of boring		
Crane Repair	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Metals, TPH-Dx, VOCs	Characterize COPC in soil related to crane repair historic use. VOCs to be analyzed only if field indications of VOC contamination are found.
		Subsurface Soil	2	2 feet bgs, and base of boring		
SWMU 7 Air Pollution Control	Soil Boring (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of boring		
West Briquette Silo	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil related to briquette handling.
		Subsurface Soil	2	2 feet bgs, and base of boring		
COURTYARD SEGMENT C1						
Courtyard Soil	Soil Borings (8)	Surface Soil	8	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	16	2 feet bgs, and base of boring		
Crane Repair	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	TPH-Dx, Metals, VOCs	Characterize COPC in soil related to crane repair historic use. VOCs to be analyzed only if field indications of VOC contamination are found.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line. Includes one additional soil sample below invert if >5 feet above shallow groundwater.
		Subsurface Soil	3	1 above invert 2 below invert		
COURTYARD SEGMENT D1						
Courtyard Soil	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	4	2 feet bgs, and base of boring		
COURTYARD SEGMENT E1						
Courtyard Soil	Soil Borings (6)	Surface Soil	6	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	12	2 feet bgs, and base of boring		

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 2 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT A2						
Courtyard Soil	Soil Borings (4)	Surface Soil	4	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	8	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line. Includes one additional soil sample below invert if >5 feet above shallow groundwater.
		Subsurface Soil	3	1 above invert 2 below invert		
COURTYARD SEGMENT B2						
Courtyard Soil	Soil Borings (6)	Surface Soil	6	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	12	2 feet bgs, and base of boring		
SWMU 7 Air Pollution Control	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of boring		
Bag House	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic location of Air Scrubber System Bag House.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Treated Aluminum Silo	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Fluoride, Metals	Characterize COPC in soil related to historic use for storage of fluoride enriched alumina.
		Subsurface Soil	2	2 feet bgs, and base of boring		
COURTYARD SEGMENT C2						
Courtyard Soil	Soil Borings (12)	Surface Soil	12	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil.
		Subsurface Soil	24	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line. Includes one additional soil sample below invert if >5 feet above shallow groundwater.
		Subsurface Soil	3	1 above invert 2 below invert		
COURTYARD SEGMENT D2						
Courtyard Soil	Soil Borings (8)	Surface Soil	8	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	16	2 feet bgs, and base of boring		
Treated Aluminum Silo	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Fluoride, Metals	Characterize COPC in soil related to historic use for storage of fluoride enriched alumina.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Bag House	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic location of Air Scrubber System Bag House.
		Subsurface Soil	2	2 feet bgs, and base of boring		

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 3 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT E2						
Courtyard Soil	Soil Borings (6)	Surface Soil	6	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	12	2 feet bgs, and base of boring		
COURTYARD SEGMENT A3						
Courtyard Soil	Soil Borings (8)	Surface Soil	8	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil.
		Subsurface Soil	16	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	2	1 above invert 1 below invert		
COURTYARD SEGMENT B3						
Courtyard Soil	Soil Borings (9)	Surface Soil	9	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	18	2 feet bgs, and base of boring		
SWMU 7 Air Pollution Control	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil. These samples also investigate the Stud Cleaning Area.
		Subsurface Soil	6	2 feet bgs, and base of boring		
Battery Storage Building	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil related to historic use for storage of batteries.
		Subsurface Soil	2	2 feet bgs, and base of boring		
COURTYARD SEGMENT C3						
Courtyard Soil	Soil Borings (7)	Surface Soil	7	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	14	2 feet bgs, and base of boring		
Diesel ASTs (2)	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	TPH-Dx, PAHs, BTEX	Characterize petroleum-related COPC in soil related to historic use for diesel AST storage.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Bag House	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	2	1 above invert 1 below invert		

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 4 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT D3						
Courtyard Soil	Soil Borings (7)	Surface Soil	7	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	14	2 feet bgs, and base of boring		
Stud Cleaning	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic use for diesel AST storage.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Diesel AST (1)	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	TPH-Dx, Metals	Characterize COPC in soil related to historic use for diesel AST storage.
		Subsurface Soil	2	2 feet bgs, and base of boring		
COURTYARD SEGMENT E3						
Courtyard Soil	Soil Borings (8)	Surface Soil	8	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	16	2 feet bgs, and base of boring		
Bag House	Soil Borings (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic location of Air Scrubber System Bag House.
		Subsurface Soil	2	2 feet bgs, and base of boring		
COURTYARD SEGMENT A4						
Courtyard Soil	Soil Borings (4)	Surface Soil	4	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	8	2 feet bgs, and base of boring		
Bath Crusher	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Fluoride, Metals	Characterize COPC in soil related to historic location of Bath Crusher.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	4	1 above invert 1 below invert		
COURTYARD SEGMENT B4						
Courtyard Soil	Soil Borings (9)	Surface Soil	9	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	18	2 feet bgs, and base of boring		
Aluminum Fluoride Silo	Soil Boring (2)	Surface Soil	2	0.5 feet bgs	Fluoride, Metals	Characterize COPC in soil related to historic use for storage of aluminum fluoride.
		Subsurface Soil	4	2 feet bgs, and base of boring		
SWMU 7 Air Pollution Control	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil. These samples also investigate the nearby Treated Aluminum Silo.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Bag House	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic location of Air Scrubber System Bag House.
		Subsurface Soil	2	2 feet bgs, and base of boring		

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 5 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT C4						
Courtyard Soil	Soil Borings (9)	Surface Soil	9	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	18	2 feet bgs, and base of boring		
Crucible Cleaning	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil related to historic use for crucible cleaning. This sample will also investigate the scrubber effluent line at the east end of Production Buildings C and D.
		Subsurface Soil	2	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Borings (5)	Surface Soil	5	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	10	1 above invert 1 below invert		
COURTYARD SEGMENT A5						
Courtyard Soil	Soil Borings (7)	Surface Soil	7	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	14	2 feet bgs, and base of boring		
Vitamin Silos	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil related to historic use for crucible cleaning.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Stud Hole Paste Drying	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil related to historic use for crucible cleaning.
		Subsurface Soil	2	2 feet bgs, and base of boring		
SWMU 24 Carbon Waste Roll-off Area	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil related to historic use for placement of Carbon Waste Bins.
		Subsurface Soil	6	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	2	1 above invert 1 below invert		
COURTYARD SEGMENT B5						
Courtyard Soil	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	4	2 feet bgs, and base of boring		
East Briquette Silo	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil related to briquette handling.
		Subsurface Soil	4	2 feet bgs, and base of boring		
SWMU 7 Air Pollution Control	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of boring		

Table 5.2.5-2
Summary of Sampling for Courtyard Soil Group
(Page 6 of 6)

Focus Category Courtyard Soil	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
COURTYARD SEGMENT C5						
Courtyard Soil	Soil Borings (9)	Surface Soil	9	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in soil at Courtyards.
		Subsurface Soil	18	2 feet bgs, and base of boring		
Scrubber Effluent	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line.
		Subsurface Soil	2	1 above invert 1 below invert		
OTHER SCRUBBER EFFLUENT LINE SAMPLE LOCATIONS						
Scrubber Effluent Lines	Soil Boring (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil adjacent to scrubber effluent line. Sample locations in southeast plant area shown on Figures 5.2.5-6 and 5.2.5-9.
		Subsurface Soil	4	1 above invert 1 below invert		

Notes:

See Figures 5.2.5-2 through 5.2.5-6 for sample locations.

Bag houses at or near ground level were present at six locations in the Courtyards: one bag house in the center of each of three air scrubber units, one bag house on the north side of Production Building D, one bag house on the south side of Production Building C near the Crucible Cleaning Building. Two additional bag houses are located at the Pitch/Coke Unloading Structure and Alumina Unloading Structure and will be investigated as part of those features.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

BTEX	Benzene, toluene, ethylbenzene, and total xylenes
COPC	Chemicals of Potential Concern include PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.
Courtyard Segment A1	Portion of Courtyard A between West Passage and Passage No. 1. Each Courtyard segment is sequentially labeled
Invert	Lowest point inside scrubber effluent pipe
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
TPH-Dx	Diesel- and oil-range petroleum hydrocarbons
TPH-Gx	Gasoline-range petroleum hydrocarbons
VOCs	Volatile Organic Compounds
Soil Boring (1)	Total of one soil boring

SWMU 24 Carbon Waste Bins

Roll-off bins were used to collect waste carbon, Production Buildings floor sweepings, and waste paste. The specific locations of the bins are not well defined; however, Courtyard Segment A5, south of Production Building A, has been identified as a likely location for SWMU 24.

SWMU 24, in Courtyard Segment A5, will be investigated with 3 soil borings completed to depths up to 10 feet or refusal (Figure 5.2.5-6). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Surface and subsurface soil samples will be analyzed for site COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

West/East Briquette Silos

The West and East Briquette Silos, located in Courtyard Segments B1 and B5, respectively, have been demolished but their foundations remain. Briquette spills were noted in the past at both silos.

The West and East Briquette Silos will be investigated with 3 soil borings, one at the West Silo and two at the East Silo, completed to depths up to 10 feet or refusal (Figures 5.2.5-2 and 5.2.5-6). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Surface and subsurface soil samples will be analyzed for PAHs and metals.

Vitamin Silos and Stud Hole Paste Drying Area

The Vitamin Silos and Stud Hole Paste Drying Area is located south of Courtyard Segment A5, and east of the friction weld foundation. The Vitamin Silos, used for storage of wet and dry anode paste briquettes, have been demolished and there pads are located adjacent to the west of the stud hole drying structure. The area around the southern two silos is unpaved, and the other silos were previously located on pads set onto a concrete surface. The Stud Hole Paste Drying Area is a three-sided structure, with concrete walls on the north, west and south sides, and a concrete floor. The area around this feature is asphalt paved.

The Vitamin Silos and Stud Hole Paste Drying Area will be investigated with three soil borings completed to a depth up to 10 feet or refusal (Figure 5.2.5-6). Two soil borings will be located south and in the center of the group of Vitamin Silos, and one soil boring will be located south of the Stud

Hole Paste Drying Area (Figure 5.2.5-6). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and at the base of the boring. Soil samples from the vitamin silos will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination. Soil samples from the Stud Hole Paste Drying Area will be analyzed for PAHs and metals.

Aluminum Fluoride and Treated Aluminum Fluoride Silos

One aluminum fluoride silo is located in the west end of Courtyard Segment B4, and three treated aluminum silos are located in the west ends of Courtyard Segments B2 and D2 and the east end of Segment B4 (Figures 5.2.5-3 and 5.2.5-5). A soil boring co-located with a SWMU 7 boring will be used to evaluate the silo located at the east end of Segment B4. The silos have been demolished and pads for the western two silos appear to remain.

The aluminum fluoride and treated aluminum fluoride silos will be investigated with one soil boring at the center of each silo location (Figures 5.2.5-3 and 5.2.5-5). If it is not feasible drill through a silo pad, the soil boring will be moved to the southwest edge of the pad. The soil borings will be completed to the depth of first encountered groundwater. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for fluoride and metals.

Bath Crusher Building

The Bath Crusher Building is located at the east end of Courtyard Segment A4 (Figure 5.2.5-5). The building and portions of the foundation have been demolished. The Bath Crusher area will be investigated with one soil boring completed to a depth of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for fluoride and metals.

Bag Houses

Five Bag Houses were located in Courtyard Segments. Two Bag Houses were associated with Production Buildings C and D, and are located in Courtyard Segments C3 and E3. Three Bag Houses were associated with dry/wet air scrubbers located in Courtyard Segments B2, D2, and B4 (Figures 5.2.5-3 through 5.2.5-5).

The five Bag House locations will be investigated with one soil boring at each location completed to depths of up to 10 feet or refusal (Figures 5.2.5-3 through 5.2.5-5). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Diesel ASTs (3) in Courtyards

Three diesel ASTs were located in courtyards; two ASTs were located in Courtyard Segment C3 and one in Segment D3 (Figure 5.2.5-4). All of the ASTs have been removed, but no environmental investigation has been conducted.

Each former AST will be investigated with one soil boring completed to depths of up to 10 feet or refusal (Figure 5.2.5-4). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for TPH-Dx; benzene, toluene, ethylbenzene, and total xylenes (BTEX); and PAHs.

Crane Repair Areas

Two crane repair areas are located east of the West Passage, one in Courtyard Segment B1 and the second in Segment C1. The crane repair areas will be investigated with one soil boring each completed to depths of 10 feet or refusal (Figure 5.2.5-4). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs and metals. VOCs will be analyzed if there is field evidence of VOC contamination.

Stud Cleaning and Repair Areas

Two Stud Cleaning and Repair Areas are located in Courtyards; one is located in Courtyard Segment B3 and the second in Courtyard Segment D3 (Figure 5.2.5-4). The structures have been demolished and the foundations remain.

The Stud Cleaning and Repair Area in Courtyard Segment D3 will be investigated with one soil boring completed to a depth of 10 feet or refusal (Figure 5.2.5-4). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring.

The second Stud Cleaning and Repair Area, located in Courtyard Segment B3, will be investigated with one soil boring that will investigate both the stud cleaning area and the nearby scrubber effluent line. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Battery Shop Building

The Battery Shop Building is located in Courtyard Segment B3 (Figure 5.2.5-4). The structure has been demolished and the foundation remains. The Battery Shop Building will be investigated with one soil boring completed to a depth of 10 feet or refusal. Discrete soil samples will be collected at 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs and metals.

Scrubber Effluent Lines

Scrubber effluent lines are located in Courtyards A and C (Figures 5.2.5-2 through 5.2.5-6). The scrubber lines are constructed of wood with access via man holes. Some of the man holes have been impacted or damaged during demolition activities. The main tasks for investigating the scrubber effluent lines are discussed under the Industrial Lines Investigation Group. Only the investigation of subsurface soil adjacent to the lines are discussed in this Courtyards Soil Investigation Group.

The scrubber effluent lines will be investigated with one boring per courtyard segment in Courtyards A and C, along Production Building Passage No. 3, and two along the alignment between Production Building A and the south plant fenceline, for a total of 17 soil borings. Scrubber effluent borings in courtyards are shown on Figures 5.2.5-2 through 5.2.5-6, and the two borings east of Production Building A are shown on Figures 5.2.5-6 and 5.2.5-9.

The soil borings will be completed to the depth of the scrubber effluent line invert at the sample location. Discrete soil samples will be collected at depths of 0.5 feet, and above and below the line invert. If the depth to shallow groundwater is greater than 5 feet below the scrubber line invert, and unconsolidated soil is present, then one additional soil sample will be collected below the scrubber effluent line invert (up to 4 additional soil samples for all scrubber effluent borings). These additional soil samples are anticipated to be collected where the scrubber effluent line invert is shallowest and shallow groundwater is likely deepest (in southwest portion of the plant) (Figures 5.2.5-2 and 5.2.5-3). Scrubber effluent line soil will be analyzed for site COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

5.2.5.4 Scope for Carbon Manufacturing Group

The purpose of the investigation of the Carbon Manufacturing Group is to characterize COPC in soil and sump sediment and to characterize potential contaminant releases. While the primary COPC for this investigation group are PAHs and metals, a subset of collected samples investigating carbon manufacturing features will be analyzed for a more comprehensive suite of COPC. The Carbon Manufacturing Group consists of the following SWMUs, structures and features that are shown on Figure 5.2.5-8:

- SWMU 26, HEAF Filter Roll-off Bins.
- Hard Pitch Storage Building.
- Pitch Building.
- Maintenance Building (east of Pitch Building).
- Paste Plant.
- Petroleum Coke Silos (2).
- Metallurgical Coke Silo.
- Anthracite Coal Silo.
- Briquette Storage Slab.
- HEAF Building.
- Paste Plant Maintenance Shop.
- Coke and Pitch Unloading Structure and Sump.

There are potential sources of fugitive discharges from carbon manufacturing, handling, and storage that are considered part of the Plant Area AOC. Many of these features have been present since the original construction of the plant and PAH-containing materials were used, handled, and stored at these locations. Environmental investigations have not been performed with respect to the specific carbon manufacturing, handling, and storage structures identified above. However, chemical data collected from the Courtyards (PGG 2010) and various SWMUs suggest fairly widespread occurrence of PAHs in Plant Area AOC soils.

The following subsections describe the proposed scope for the soil, features, and SWMUs located in the carbon manufacturing investigation group. Table 5.2.5-3 summarizes the sampling program for the Carbon Manufacturing Group.

SWMU 26 HEAF Filter Roll-off Bins

The HEAF Filter roll-off bins (SWMU 26) were located in an area east of the Pitch Building and Maintenance Shop. The Phase 1 Work Plan concluded that no environmental investigations for this SWMU are warranted because the likelihood of a release is low and the specific location(s) are unknown. No specific investigation of this SWMU is included in the scope for the Plant Area AOC.

Hard Pitch Storage Building

The Hard Pitch Storage Building is present and located east of the Pitch Building (Figure 5.2.5-8). This structure has been present since the original construction of the plant and may have been a source of fugitive discharges related to carbon manufacturing, handling, and storage. In addition, some pitch remains between the aluminum siding and inner concrete foundation walls. This pitch will be addressed by NSC, as appropriate, and related to future development of the property.

The Hard Pitch Storage Building will be investigated with four soil borings; two will be located on each of the north and south sides of the building (Figure 5.2.5-8). The borings will be completed to a depth of 10 feet or refusal. Discrete soil samples will be collected at 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples from three of the four soil borings will be analyzed for PAHs and metals. Soil samples from the boring located at the southwest side of the building will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Table 5.2.5-3
Summary of Sampling for Carbon Manufacturing Group

FOCUS CATEGORY CARBON MANUFACTURING	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
Hard Pitch Storage Building	Soil Borings (4)	Surface Soil	3	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of the boring		
		Surface Soil	1	0.5 feet bgs	COPC	
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Pitch Building	Soil Borings (5)	Surface Soil	4	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	8	2 feet bgs, and base of the boring		
		Surface Soil	1	0.5 feet bgs	COPC	
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Maintenance Building	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	COPC	Characterize COPC in soil near the former Maintenance Building (east of the pitch building).
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Paste Plant	Soil Borings (2)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of the boring		
		Surface Soil	1	0.5 feet bgs	COPC	
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Petroleum Coke Silos	Soil Borings (2)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of the boring		
		Surface Soil	1	0.5 feet bgs	COPC	
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Metalurgical Coke Silo	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Anthracite Coal Silo	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Briquette Storage Slab	Soil Borings (5)	Surface Soil	3	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of the boring		
		Surface Soil	2	0.5 feet bgs	COPC	
		Subsurface Soil	4	2 feet bgs, and base of the boring		
HEAF Building	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	PAHs, Metals, TPH-Dx	Characterize COPC in soil.
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Paste Plant Maintenance Shop	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of the boring		
Coke & Pitch Unloading Structure	Soil Borings (3)	Surface Soil	2	0.5 feet bgs	PAHs, Metals	Characterize COPC in soil.
		Subsurface Soil	4	2 feet bgs, and base of the boring		
		Surface Soil	1	0.5 feet bgs	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	
		Subsurface Soil	2	2 feet bgs, and base of the boring		
Coke & Pitch Unloading Structure Sump	Grab (1)	Sump Water	1	NA	PAHs, Total Cyanide, Fluoride, TPH-Dx, Metals	Characterize COPC in sediment in Coke & Pitch Unloading Structure Sump.
	Grab (1)	Sediment	1	NA		

Notes:

See Figure 5.2.5-8 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern include: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.
NA Not Applicable
PAHs Polycyclic Aromatic Hydrocarbons
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
Soil Borings (3) Total of three soil borings.

Pitch Building

The Pitch Building is present and located east of the Hard Pitch Building, and similarly was present from the original plant construction, and is a source of fugitive discharges related to carbon manufacturing, handling, and storage (Figure 5.2.5-8). As with the Hard Pitch Building, the Pitch Building is in satisfactory condition, and therefore has been retained for future use.

The Pitch Building will be investigated with five soil borings; two will be located on each of the north and south, and one on the west side of the building (Figure 5.2.5-8). The borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples from four of the five samples will be analyzed for PAHs and metals. Soil samples from one soil boring, located at the northeast side of the building will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Maintenance Building

A small Maintenance Building is located east of the Pitch Building (Figure 5.2.5-8). The Maintenance Building will be investigated with one soil boring located at the southwest side of the building. The boring will be completed to a depth of up to 10 feet or refusal. Discrete samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Paste Plant

The Paste Plant Building is located south of the Pitch Building and was the primary location for manufacturing anode and cathode ramming paste or briquettes (Figure 5.2.5-8). The Paste Plant Building has been demolished and the foundation remains. SWMUs 9 and 30 are located in the vicinity of the Paste Plant and investigation results from these SWMUs may be used to evaluate the structures in the Carbon Manufacturing Investigation Group. SWMU 9 was a small structure located east of the Paste Plant structure and is investigated separately (refer to Section 5.1.9) with two soil borings.

The Paste Plant will be investigated with two soil borings located along the south side of the building foundation that will be completed to depths of up to 10 feet or refusal. Two other borings north of the Paste Plant, and part of investigation of the Pitch Building, will provide information for evaluation of subsurface soil in the vicinity of the Paste Plant.

Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples from one of the borings will be analyzed for PAHs and metals. Soil samples from the second boring will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Petroleum Coke Silos

Two silos for storage of petroleum coke were located south of the Paste Plant, and along the southern fenced boundary of the plant area (Figure 5.2.5-8). The silos have been demolished, the concrete sampled and analyzed for COPC, and evaluated for reuse onsite (PGG 2014). The crushed concrete from the two silos is presently stockpiled north of the silo foundations. Investigation results for structures located northeast of the coke silos may also be used to evaluate the coke silos.

The Coke Silos will be investigated with two soil borings located adjacent to the silo foundations (Figure 5.2.5-8). The soil borings will be completed to depths of up to 10 feet or refusal. Soil samples from one boring will be analyzed for PAHs and metals. Samples from the second boring will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Metallurgical Coke and Anthracite Coal Silos

Two silos located west of the Paste Plant stored metallurgical coke and anthracite coal for use in manufacturing briquettes (Figure 5.2.5-8). The silos have been demolished and the foundations remain. No demolition debris from the silos remains onsite.

The Metallurgical Coke and Anthracite Coal Silos foundations will be investigated with two soil borings located at the southwest margins of the foundations (Figure 5.2.5-8). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs and metals.

Briquette Storage Slab

A concrete slab is present and located northeast of the Paste Plant, and was used for storage of finished hard briquettes prior to distribution into the plant area (Figure 5.2.5-8). The Briquette Storage Slab will be investigated with 5 soil borings; two located north and three located south of the slab. Discrete soil samples will be collected from depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring.

Soil samples from three borings located at the northwest and northeast sides of the slab will be analyzed for PAHs and metals. Soil samples from two borings located at the southwest and southeast sides of the slab will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

HEAF Building

The HEAF Building has been demolished, and was reportedly located to the east of the Paste Plant Building, however no building or footprint remains (Figure 5.2.5-8). The HEAF Building housed the HEAF air emissions control unit that was the source of the filters stored in the HEAF roll-off bins (SWMU 26). The floor of the HEAF Building was observed by Ecology inspectors to contain oil and containers of pitch-related waste.

The HEAF Building will be investigated with one soil boring located at the eastern side of the Paste Plant Building (Figure 5.2.5-8). The soil boring will be completed to the depth of first encountered shallow groundwater. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for PAHs, TPH-Dx, and metals.

Paste Plant Maintenance Shop

The Paste Plant Maintenance Shop was located south of the Paste Plant and near the southern fenced boundary of the plant area (Figure 5.2.5-8). The building has been demolished and the foundation remains.

The Paste Plant Maintenance Shop will be investigated with three soil borings, located on the northwest, southeast, and southwest sides of the foundation (Figure 5.2.5-8). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Coke and Pitch Unloading Structure and Sump

The Coke and Pitch Unloading Structure is located northwest of the Pitch and Hard Pitch Buildings (Figure 5.2.5-8). The Unloading Structure includes a conveyor system, portions of which are underground, for unloading product from rail cars. An associated groundwater dewatering sump is located at the unloading structure. All portions of the structure remain.

Initial investigation for the Unloading Structure will include review of plans and inspection of the structure to confirm construction and presence of the sump. The inspection will be used to confirm potential presence of product, presence of sediment and/or water in the sump, elevation of the bottom of the sump, and access to the sump for sampling.

The Unloading Structure and Sump will be investigated with three soil borings located at the northwest, southwest, and southeast sides of the structure (Figure 5.2.5-8). The soil borings will be completed to the depth of first encountered shallow groundwater. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. One sample of sediment and one sample of water will be collected from the sump, if present and if the sump is accessible.

Soil samples from the boring located at the southwest side of the structure will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination. Soil samples from the borings located at the southeast and northwest sides of the structure will be analyzed for PAHs and metals. The sump sediment and water samples will be analyzed for the same larger suite of COPC as the soil samples from the southwest side of the structure.

5.2.5.5 Scope for Cryolite and Bath Group

The purpose of the investigation of the Cryolite and Bath Group is to characterize COPC in soil. The Cryolite and Bath Group consists of the following SWMUs, structures and features (Figure 5.2.5-9):

- SWMU 25 Solid Waste Bins.
- Bath Recycle Building.
- Bulk Cryolite Storage Silo.

Bath materials include cryolite, aluminum fluoride, fluor spar, and soda ash. The cryolite and other bath materials used in the reduction cells contained fluoride, which is one of the main site COPC for groundwater. With the exception of the Bath Storage Building, which is the same location as the East SPL Storage Area (SWMU 12), no environmental investigations have been performed and no data has been collected specifically related to the identified cryolite and bath features. The Bath Storage Building (SWMU 12) will be investigated separately under SWMU 12.

The following subsections describe the proposed scope for the features, and SWMUs located in the cryolite and bath investigation group. Table 5.2.5-4 summarizes the sampling program for the Cryolite and Bath Group.

SWMU 25 Solid Waste Bins

Solid waste bins were used for accumulation of miscellaneous non-hazardous solid waste from various areas onsite. The number and their locations are not well documented but may have changed over time. The investigation of SWMU 25 Solid Waste Bin locations is folded into the overall investigation of the Plant Area AOC, except for two areas where bins have been documented in site file maps or inspection reports. Two locations that will be investigated include areas at the northwest side of the Bath Storage Building (Figure 5.2.5-9), and at the east end of Production Buildings A and B near the building entrance ramps (Figure 5.2.5-6).

Table 5.2.5-4
Summary of Sampling for Cryolite and Bath Group

FOCUS CATEGORY CRYOLITE AND BATH GROUP	Sample Method	Media Sampled	Number of Samples	Sample Depth	Sample Type	Analytes	Sample Rationale
SWMU 25 Solid Waste Bins	Test Pits (5)	Surface Soil	5	0.5 feet bgs	Composite	Fluoride, Metals, Total Cyanide, PAHs, TPH-Dx	Characterize COPC in soil at historic general location associated with SWMU 25.
		Subsurface Soil	5	2 feet bgs			
Bath Recycle Building	Test Pits (4)	Surface Soil	2	0.5 feet bgs	Discrete	Fluoride, Metals	Characterize COPC in soil adjacent to building historically used for bath storage. Samples from test pits on northwest and southeast side of building to be analyzed for expanded suite.
		Subsurface Soil	4	2 feet bgs, and 4 feet bgs			
		Surface Soil	2	0.5 feet bgs	Discrete	Fluoride, Metals, Total Cyanide, PAHs, TPH-Dx	
		Subsurface Soil	4	2 feet bgs, and 4 feet bgs			
Bulk Cryolite Silo	Test Pits (1)	Surface Soil	1	0.5 feet bgs	Discrete	Fluoride, Metals	Characterize COPC in soil adjacent to silo historically used for bulk cryolite storage.
		Subsurface Soil	2	2 feet bgs, and 4 feet bgs			

Notes:

See Figures 5.2.5-6 and 5.2.5-9 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern
PAHs Polycyclic Aromatic Hydrocarbons
SWMU Solid Waste Management Unit
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
Test Pits (5) Total of 5 test pits

SWMU 25 solid waste bins will be investigated with test pits that will be excavated to a depth of about 2 feet bgs. Two test pits will be excavated at the Bath Storage Building (Figure 5.2.5-9), and three test pits will be excavated at the east end of Production Buildings A and B (Figure 5.2.5-6). In the five test pits, composite soil samples will be collected from depths of 0.5 and 2 feet bgs. Soil samples will be analyzed for fluoride, metals, total cyanide, PAHs, and TPH-Dx.

Bath Recycle Building

The Bath Recycle Building is located south of the east end of Production Building A (Figure 5.2.5-9) and was used for cleaning and recycling bath residual, as well as unloading of cryolite. The building and foundation are in satisfactory condition, and have been retained for future use.

The Bath Recycle Building will be investigated with four test pits excavated to depths of about 4 feet bgs. Two test pits will be located on the southwest side of the building with one near the south side of the adjacent bulk cryolite silo, one test pit on the southeast side of the building, and one test pit located on the northwest side of the building (Figure 5.2.5-9). Discrete soil samples will be collected from the test pits at depths of 0.5 feet, 2 feet, and 4 feet bgs. The test pit at the south side of the silo will be excavated to refusal.

Soil samples from the two test pits on the southwest side of the building will be analyzed for fluoride and metals. Soil samples from the test pits on the northwest and southeast sides of the building will be analyzed for fluoride, metals, total cyanide, PAHs, and TPH-Dx.

Cryolite Storage Silo

The Cryolite Storage Silo was located at the northwest corner of the Bath Recycle Building (Figure 5.2.5-9). This structure has been demolished and no demolition debris remains onsite.

The Cryolite Storage Silo will be investigated with one test pit located at the north side of the silo (Figure 5.2.5-9). The test pit will be completed to a depth of about 4 feet bgs. A test pit located at the south side of the silo that will investigate the Bath Recycle Building will provide information to evaluate impact to surface soil from the cryolite storage silo. Discrete soil samples from the test pits will be collected at depths of 0.5 feet, 2 feet, and 4 feet bgs. Soil samples will be analyzed for fluoride and metals.

5.2.5.6 Scope for Petroleum Storage Group

The purpose of the investigation of the Petroleum Storage Group is to characterize petroleum-related COPC in soil, and determine if there have been contaminant releases associated with the tanks. The UST and AST are no longer present at the site. The Petroleum Storage Group consists of the following features that are shown on Figure 5.2.5-1:

- Former Gasoline UST (1,000 gallons) west of the BPA Harvalum Substation (Figure 5.2.5-10).
- Former Gasoline UST (5,000 gallons) and two former diesel USTs (5,000 gallons) west of the Compressor Building (Figure 5.2.5-7).
- One diesel AST south of the Compressor Building (Figure 5.2.5-7).
- Three diesel ASTs in the southeast portion of the plant area (Figures 5.2.5-6, 5.2.5-8, and 5.2.5-9).
- One heating oil AST south of the Administration Building (Figure 5.2.5-7).

The scope for investigation of USTs proposed in the following sections is based in "Ecology Guidance for Site Checks and Site Assessments for Underground Storage Tanks" (Ecology 2003). This guidance is primarily based on a premise of sidewall and the base of the excavation sampling during tank removal. At this site, the USTs were removed several years ago. The guidance recommends sampling of the vertical interval where contamination is most likely to occur and that this is likely to be the lowest point of the backfill/native soil contact, or 1 to 2 feet beneath the bottom of the tank or piping system. The analytical program for the Petroleum Storage Group is based on Table 830-1 of MTCA (WAC 173-340-900) that specifies testing requirements based on petroleum hydrocarbon type.

Gasoline, diesel, and heating oil used at the facility were stored in a series of USTs and ASTs in several locations. One gasoline UST located west of the BPS substation, and one gasoline and two diesel USTs located at the west end of the Compressor Building, were removed in 1990 and subsurface soil and stockpile soil confirmation sampling was conducted along with a small soil removal (Westinghouse 1990).

Diesel used at the facility was also stored in ASTs in six locations. Three diesel ASTs were located in the Courtyards (as are described and addressed under the Courtyards sampling program), three diesel ASTs were located in the southeast portion of the plant, and one heating-oil AST was located south of the Plant Administration Building. These seven ASTs have been removed, however, records for decommissioning and environmental investigations have not been found. Table 5.2.5-5 summarizes the sampling program for the Petroleum Storage Group.

UST West of BPA Substation

One gasoline UST located east of the BPA Substation (Figure 5.2.5-10) was decommissioned and removed in 1990 (Westinghouse 1990). The tank excavation was reportedly 17 feet long, 13 feet wide, and 6 feet deep (Westinghouse 1990).

This former UST excavation will be investigated with two soil borings located at the margins of the former UST excavation (Figure 5.2.5-10). The UST excavation figure from the tank removal report (Westinghouse 1990) will be used to locate the borings. The soil borings will be completed to depths of up to 15 feet, or refusal. Discrete soil samples will be collected from depths of 4 feet bgs and the base of the former tank excavation at 6 feet bgs. If evidence of contamination is present at 6 feet depth, then additional soil samples may be collected, as appropriate, based on field screening and field observations. Soil samples from one soil boring will be analyzed for TPH-Gx, BTEX, and lead. Soil samples from the second soil boring will be analyzed for TPH-Gx, VOCs, and metals.

Table 5.2.5-5
Summary of Sampling for Petroleum Storage Group

FOCUS CATEGORY PETROLEUM STORAGE GROUP	Sample Method	Media Sampled	Number of Samples	Sample Depth	Sample Type	Analytes	Sample Rationale
Gasoline UST West of BPA Substation	Soil Borings (2)	Subsurface Soil	2	4 feet bgs, and former UST excavation base (6 feet bgs)	Discrete	TPH-Gx, BTEX, Lead	Characterize COPC in soil for gasoline UST.
		Subsurface Soil	2	4 feet bgs, and former UST excavation base (6 feet bgs)		TPH-Gx, VOCs, Metals	
Compressor Building USTs	Soil Borings (4)	Subsurface Soil	9	6 feet bgs, 8 feet bgs, and former UST excavation base (10 feet bgs)	Discrete	TPH-Gx, TPH-Dx, BTEX, Lead	Characterize COPC in soil for gasoline and diesel USTs.
		Subsurface Soil	3	6 feet bgs, 8 feet bgs, and former UST excavation base (10 feet bgs)		TPH-Gx, TPH-Dx, VOCs, Metals, PAHs	
Compressor Building AST	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Discrete	TPH-Gx, TPH-Dx, BTEX, Lead, PAHs	Characterize COPC in soil. Collect additional samples if soil staining observed.
		Subsurface Soil	2	Surface 2 feet bgs, and 4 feet bgs			
Diesel ASTs in SE Plant (3)	Soil Borings (4)	Surface Soil	4	0.5 feet bgs	Discrete	TPH-Dx, BTEX, PAHs	Characterize COPC in soil. Collect additional samples if soil staining observed.
		Subsurface Soil	8	Surface 2 feet bgs, and 4 feet bgs			
Heating Oil AST at Admin Building	Soil Boring (1)	Surface Soil	1	0.5 feet bgs	Discrete	TPH-Dx, BTEX	Characterize COPC in soil. Collect additional samples if soil staining observed.
		Subsurface Soil	2	4 feet bgs			

Notes:

See Figures 5.2.5-2 through 5.2.5-10 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

AST Aboveground Storage Tank
BTEX Benzene, toluene, ethylbenzene, and total xylenes
COPC Chemicals of Potential Concern
PAHs Polycyclic aromatic hydrocarbons
TPH-Dx Diesel- and oil-range petroleum hydrocarbons
TPH-Gx Gasoline-range petroleum hydrocarbons
UST Underground Storage Tank
VOCs Volatile Organic Compounds
Soil Borings (2) Total of two soil borings

USTs West of Compressor Building

Three USTs, two diesel and one gasoline, were located at the west end of the Compressor Building (Figure 5.2.5-7) and were decommissioned and removed in 1990 (Westinghouse 1990). The single tank excavation was reportedly 33 feet long, 21 feet wide, and 10 feet deep (Westinghouse 1990).

The three Compressor Building USTs will be investigated with four soil borings located near the margins of the former UST grouping (Figure 5.2.5-7). The UST excavation figure from the tank removal report (Westinghouse 1990) will be used to locate the borings. The soil borings will be completed to depths of up to 15 feet or refusal. Discrete soil samples will be collected at depths of 6 feet bgs, 8 feet bgs, and the base of the former tank excavation (10 feet bgs). If evidence of contamination is present at 10 feet bgs, then additional soil samples may be collected, as appropriate, based on field screening and observations.

Soil samples from three of the soil borings will be analyzed for TPH-Gx, TPH-Dx, BTEX, and lead. Soil samples from the fourth soil boring will be analyzed for a more comprehensive suite including TPH-Gx, TPH-Dx, VOCs, PAHs, and metals.

A shallow temporary well (RI-GW6) will be installed in the vicinity of the Compressor Building former UST excavation to determine if a release to groundwater has occurred. This groundwater characterization activity will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2).

AST South of Compressor Building

One diesel AST was located south of the Compressor Building and will be investigated with one soil boring completed to a depth of up to 10 feet or refusal (Figure 5.2.5-7). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and 4 feet bgs. Soil samples will be analyzed for TPH-Gx, TPH-Dx, BTEX, lead, and PAHs.

Diesel ASTs (3) in Southeast Plant

Three diesel ASTs were located in the southeast portion of the plant area. One was located at the east end of Production Buildings A and B (Figure 5.2.5-6), one was located northwest of the Pitch Building (Figure 5.2.5-8), and one was located northwest of the Bath Storage Building

(Figure 5.2.5-9). These ASTs were used for equipment refueling. The ASTs have been removed; no environmental investigations have been conducted for these ASTs.

The locations of the former ASTs will be investigated with a total of four soil borings; one boring will be located at each former AST east of the Production Buildings and northwest of the Bath Storage Building, and two borings will be located at the former AST northwest of the Pitch Building (Figures 5.2.5-6, 5.2.5-7 and 5.2.5-8). The soil borings will be completed to depths of up to 10 feet or refusal.

Discrete soil samples will be collected at depths of 0.5, 2, and 4 feet. Soil samples from the borings for the three former ASTs located east of the Production Buildings and northwest of the Pitch Building will be analyzed for TPH-Dx, BTEX, and PAHs.

Heating Oil AST

One heating oil AST was located south of the Administration Building (Figure 5.2.5-7). No environmental investigation has been conducted for this former AST. An initial inspection will be conducted to determine accessibility for sampling.

If feasible, the former heating oil AST will be investigated with one soil boring that will be completed up to a depth of 10 feet. Discrete soil samples will be collected at depths of 0.5, 2, and 4 feet. Soil samples will be analyzed for TPH-Dx and BTEX.

5.2.5.7 Scope for Maintenance and Ancillary Group

The purpose of the investigation of the maintenance and ancillary group is to characterize COPC in soil in the vicinity of structures identified for further investigation. The maintenance and ancillary investigation group consists of the following features (Figure 5.2.5-7).

- Carpenter Shop.
- Plant Laboratory.
- Compressor Building.
- Dross Storage Building.

These structures are to be investigated as part of the Maintenance and Ancillary Group and are located in the southeast portion of the plant area. These structures have not been previously investigated.

The following subsections describe the proposed scope for the structures associated with the maintenance and ancillary investigation group. Table 5.2.5-6 summarizes the sampling program for the Maintenance and Ancillary Group.

Table 5.2.5-6
Summary of Sampling for Maintenance and Ancillary Group

FOCUS CATEGORY MAINTENANCE AND ANCILLARY GROUP	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
Carpenter Shop	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil. Collect additional samples if soil staining is observed.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Plant Laboratory	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	6	2 feet bgs, and base of boring		
	Grab (2)	Sediment	2	NA	COPC	Characterize COPC in sewer line sediment cleanout and outlet from laboratory.
Compressor Building	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Dross Storage Building	Soil Borings (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	4	2 feet bgs, and base of boring		

Notes:

See Figure 5.2.5-7 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Metals include Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn.

COPC Chemicals of Potential Concern including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx.
NA Not applicable
Soil Borings (2) Total of two soil borings

Carpenter Shop

The Carpenter Shop is located east of the main office building (Figure 5.2.5-7) and continues in use. The Carpenter Shop will be investigated with two soil borings located north and southwest of the building (Figure 5.2.5-7). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals

(Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. VOCs and TPH-Gx will be analyzed if there is field evidence of VOC or gasoline contamination.

Plant Laboratory

The Plant Laboratory occupies the southern portion of the main administration building (Figure 5.2.5-7). Testing conducted in the laboratory was typical for a large industrial facility including for process materials, air, and discharge waters. The Plant Laboratory Building is still present although not currently in use.

The Plant Laboratory Building will be investigated with three soil borings located on the northeast, south and southwest sides of the building. In addition, two sediment samples will be collected from the sewer lines that lead from the Plant Laboratory Building (Figure 5.2.5-7).

The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Two sediment samples will be collected from the nearest sewer cleanout and the sewer outlet from the laboratory. Soil and sediment samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. VOCs and TPH-Gx will be analyzed if there is field evidence of VOC or gasoline contamination.

Compressor Building

The Compressor Building is located east of the main Administration Building (Figure 5.2.5-7) and is in current use. Compressed air was generated at this building for use throughout the plant. Chemicals that may have been used include petroleum hydrocarbons and solvents. Three USTs located at the west side of the Compressor Building were previously decommissioned and removed (Westinghouse 1990). No other environmental investigation has been conducted at the compressor building.

The Compressor Building will be investigated with two soil borings located on the northeast and southwest sides of the building (borings SB-AC-01 and SB-AC-02) (Figure 5.2.5-7). The remaining borings near the Compressor Building shown on Figure 5.2.5-7 are being installed for investigation of Petroleum Storage Group features. Discrete soil samples will be collected from depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. VOCs and TPH-Gx will be analyzed if there is field evidence of VOC or gasoline contamination.

Dross Storage Building

The Dross Storage Building is located east of the compressor building (Figure 5.2.5-7). The building exists but is not currently in use. The building was used to store dross skimmed from the surface of molten aluminum in the furnaces. Dross impurities may include aluminum oxide, metals and fluoride. No environmental investigation has been conducted for the dross building.

The Dross Storage Building will be investigated with two soil borings located at the northern and southern sides of the building (Figure 5.2.5-7). The borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected from depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring.

Samples will be analyzed for COPC including PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. VOCs and TPH-Gx will be analyzed if there is field evidence of VOC or gasoline contamination. Table 5.2.5-6 summarizes the sampling program.

5.2.5.8 Scope for Cast House and Production Buildings Group

The purpose of the investigation of the Cast House and Production Buildings Group is to characterize COPC in soil and characterize potential releases from Maintenance and Shipping Areas, as well as casting pits and other low-lying features associated with the building foundations. The Cast House and Production Buildings Group consists of the following features (Figures 5.2.5-2 through 5.2.5-6):

- West Cast House Building Foundation.
    - Machine Shop.
    - Maintenance Area.
    - Maintenance Area ASTs (3).
    - Maintenance Area Oil-Water Separator & Sump.
    - Maintenance Area Oil Change Pit.
    - Maintenance Area Wash Station.

- Central Cast House Building Foundation.
  - DC Casting Pits.
  - Oil Storage Room (north of casting pits).
- East Cast House Building Foundation (Shipping Area).
- Stud Repair/Friction Weld Sump Foundation.
- Production Buildings A-D Foundations.
  - Crucible Cleaning Room.
  - Subsurface Ducts.
  - Under Floor Trenches.
  - Battery Storage Areas (within Passages of Production Buildings).

All structures associated with the Cast House Building and Production Buildings have been demolished. According to NSC Smelter LLC, the foundations for these features are planned to remain in place. The Cast House foundation housed areas with separate operations, including the Machine Shop and Maintenance Area at the west end of the foundation, casting area with casting pits in the center part of the foundation, and the shipping area at the eastern end of the foundation. The Stud Cleaning and Friction Weld Building was located east of the shipping area of the Cast House, and its foundation also remains. Several features that were located on the Cast House foundation, including the Machine Shop Diesel ASTs (three), Maintenance Area Wash Station, Oil Change Pit, Oil-water Separator, and Cast House Oil Storage Room and Casting Pits, cannot be directly investigated because of the thickness and reinforcement of the cast house foundation. Therefore, the focus of the investigation for features associated with the Cast House foundation will be to sample soil adjacent to the existing foundation.

The four Production Buildings have been demolished and their foundations remain. The Production Building foundations also include the raised foundations for the smelting pots. Several features associated with the Production Building foundations, including Battery Storage Areas and the Crucible Cleaning Room, were located on the foundations inside of the Production Buildings and cannot be investigated directly because those portions of the building no longer exist. Therefore, the focus of the investigation for these features will be to sample soil adjacent to the existing foundations.

The Stud Cleaning and Friction Weld Building, located at the east end of the Cast House, has been demolished and the foundation remains. The Friction Weld Sump was cleaned during demolition and all waste properly disposed. At present, the Friction Weld Sump is exposed to weather and is filled with rainwater. Because the sump was cleaned during demolition, it is not planned to be sampled during the investigation.

The following subsections describe the proposed scope for the Cast House and Production Buildings Group. Table 5.2.5-7 summarizes the sampling program for the Cast House and Production Buildings Group.

<u>West Cast House Foundation</u>

The west portion of the cast house foundation includes the Machine Shop and the Maintenance Area (Figure 5.2.5-2). Features associated with this portion of the cast house foundation include three ASTS (motor oil, hydraulic fluid, waste oil), oil-water separator and sump, oil change pit, and an equipment wash area. According to the site drawing A1/1752 (Goldendale Aluminum Company 1996), the wash station is connected to the industrial lines via a grease/oil trap at the south edge of the foundation. A sump is located south of the foundation in line with the wash station, grease/oil trap, and a manhole along the industrial line in the plant entrance road.

The Machine Shop will be investigated with two soil borings; one located at the west end and one located on the south side of the foundation (Figure 5.2.5-2). The soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depth of 0.5 feet bgs, 2 feet bgs, and the base of the boring.

The Maintenance Area will be investigated with six soil borings; three borings located along the north side of the foundation, two located along the south side of the foundation, and one located adjacent to the sump outlet from the Truck Wash Area. The borings will be completed to depths up to 10 feet or refusal. Discrete soil samples will be collected from depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. One sediment sample will be collected from the oil-water separator sump.

Soil and sediment samples for the Machine Shop and Maintenance Area will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

One well will be installed in the West Cast House Area (RI-MW11-BAU). The well will be used to determine if a release has occurred from the Equipment Wash Station, or Oil Change Pit, as well as to characterize groundwater flow. The groundwater investigation work will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2).

Table 5.2.5-7
Summary of Cast House and Production Building Group

FOCUS CATEGORY CAST HOUSE, PRODUCTION BUILDINGS GROUP	Sample Method	Media Sampled	Number of Samples	Sample Depth	Analytes	Sample Rationale
Machine Shop	Soil Boring (2)	Surface Soil	2	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	4	2 feet bgs, and base of boring		
Maintenance Area	Soil Borings (6)	Surface Soil	6	0.5 feet bgs	COPC	Characterize COPC in soil.
		Subsurface Soil	12	2 feet bgs, and base of boring		
Maintenance Area Oil-Water Separator Sump	Grab (1)	Process Solids	1	NA	Metals, TPH-Dx, TPH-Gx, VOCs	Characterize COPC in sediment in the Maintenance Area Oil-Water Separator Sump
Cast House & DC Casting Pits	Soil Borings (4)	Surface Soil	4	0.5 feet bgs	COPC	Characterize COPC in soil north of Cast House.
		Subsurface Soil	8	2 feet bgs, and base of boring		
Shipping Area	Soil Borings (3)	Surface Soil	3	0.5 feet bgs	COPC	Characterize COPC in soil north and south of shipping area.
		Subsurface Soil	6	2 feet bgs, and base of boring		
Stud Repair/Friction Weld	Soil Borings (5)	Surface Soil	5	0.5 feet bgs	COPC	Characterize COPC in soil north and south of Friction Weld foundation.
		Subsurface Soil	10	2 feet bgs, and base of boring		
Production Buildings A-D Foundations	Soil Borings (8)	Surface Soil	8	0.5 feet bgs	COPC	If feasible, characterize COPC in soil beneath Production Building Foundations.
		Subsurface Soil	16	2 feet bgs, and base of boring		
Subsurface Ducts/ Under Floor Trenches	Grab (4)	Process Solids	4	NA	COPC	Characterize COPC in sediment in foundation subsurface ducts.

Notes:

See Figures 5.2.5-2 through 5.2.5-6 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

COPC	Chemicals of Potential Concern include: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.
NA	Not applicable
TPH-Dx	Diesel- and oil-range petroleum hydrocarbons
TPH-Gx	Gasoline-range petroleum hydrocarbons
Soil Boring (2)	Total of two soil borings

Central Cast House Foundation

The central portion of the Cast House Foundation is the main casting area for the plant (Figure 5.2.5-3). Features associated with the casting area include the casting pits and oil storage room. The casting pits are constructed to a depth of about 40 feet below the foundation surface, and about 8 feet above ground surface adjacent to the building foundation. The Oil Storage Room was a walled room at the north side of the foundation, north of the Casting Pits.

The central Cast House Foundation will be investigated with three soil borings; one located on the north side of the foundation, and two located on the south side of the foundation (Figure 5.2.5-3). The boring at the north side of the foundation will be completed to a depth of about 20 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. If soils extend below 10 feet bgs, additional deeper vertical sample intervals may be collected. The two soil borings at the south side of the foundation will be completed to depths of about 40 feet bgs or refusal. Discrete soil samples will be collected from depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. If soils are present below 10 feet bgs, additional vertical intervals can be collected. The soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

One well (RI-MW12-BAU) will be installed on the south side of the Casting Pits to evaluate if a release has occurred from this unit and to characterize potential hydrologic effects of the Casting Pits. This work will be performed as part of the Groundwater in the Uppermost Aquifer AOC investigation (refer to Section 5.2.2).

East Cast House Foundation (Shipping Area)

The shipping area at the east end of the Cast House foundation will be investigated with three soil borings; one located on the north side and two on the south side of the foundation (Figure 5.2.5-4). The borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. The soil samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

Stud Repair/Friction Weld Building

The stud repair/friction weld building foundation will be investigated with four soil borings; two located on the north side and two on the south side of the foundation (Figure 5.2.5-5). Discrete soil samples will be collected at depths of 0.5 feet bgs, 2 feet bgs, and the base of the boring. Soils will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx. TPH-Gx and VOCs will be analyzed if there is field evidence of gasoline or VOC contamination.

A shallow temporary well (RI-GW2) will be installed to determine if a release has occurred to shallow groundwater near the Friction Weld Press Pit. This activity will be performed as part of the Groundwater in the Uppermost Aquifer AOC (refer to Section 5.2.2).

Production Buildings

Production Buildings A through D have been demolished and the concrete has been sampled and evaluated for reuse onsite (Figures 5.2.5-2 through 5.2.5-6). The crushed concrete is stockpiled in three areas onsite, including along a portion of the Production Building D foundation. The Production Building foundations also contain raised pads for each of the smelting pots along the north and south sides of each building foundation. Other features associated with the Production Buildings include the crucible cleaning room at the east end of Production Building C, subsurface ducts, under floor trenches, and several battery storage areas located in passageways and in the Production Buildings. The Crucible Cleaning Room is investigated and discussed in the previous Courtyard soil section (Section 5.2.5.3).

The Production Buildings foundations will be investigated with eight soil borings located along the centerline of the foundations (Figures 5.2.5-2 through 5.2.5-6). The eight soil borings are distributed along and between the four Production Buildings foundations.

Initial attempts will be made to core through the reinforced concrete floors to gain access to underlying soil. If access is successfully achieved, the soil borings will be completed to depths of up to 10 feet or refusal. Discrete soil samples will be collected at depths of 2 and 4 feet. In addition, an attempt will be made to access process solids accumulated in the subsurface ducts through the portions of the ducts that daylight alongside the building foundations. Up to four process solids samples will be collected. The soil and process solids samples (potentially) will be analyzed for

COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, and TPH-Dx.

5.2.5.9 Scope for Industrial Lines Group

The purposes of the investigation of the Industrial Lines Group are to characterize COPC in soil, determine status of cleanup for the industrial lines, characterize the hydrologic interaction of the lines with shallow groundwater, and characterize the ongoing water discharge to NPDES Pond A. The Industrial Lines Group includes industrial and monitoring lines, scrubber effluent lines, and a portion of the southeastern portion of the groundwater collection system lines. The Industrial Lines Group (Figure 5.2.5-11) consists of the following features:

- Industrial Drain Lines.
  - Industrial and Monitoring Lines and Sumps.
  - Industrial Sump.
- Scrubber Effluent Lines.
- Southeast Portion of Groundwater Collection (Under Drain) System.
  - Groundwater Collection Lines in the southeast portion of the plant.
  - Water discharge to Pond A.
  - Sewage Treatment Plant Sump.

The scopes of investigation for the three main elements of the Industrial Lines Group are summarized in Table 5.2.5-8. Tasks for investigating the three elements are discussed in the following subsections. Table 5.2.5-9 summarizes the sampling program for the Industrial Lines Group.

Industrial Drain Lines

The industrial and monitoring lines consist of wastewater lines that historically routed effluent such as contact cooling water and scrubber blowdown to either the water treatment plant or the industrial sump prior to 1978. The layout of the Industrial Drain Lines was preliminarily investigated during 2011 (PGG 2013b) and water in the Industrial Sump was sampled.

The following sections describe the tasks that will be conducted to evaluate the Industrial Drain Lines (Table 5.2.5-8).

Table 5.2.5-8
Summary of Field Tasks for Industrial Lines Group, Plant Area AOC

PLANT AREA AOC FOCUS INDUSTRIAL LINES GROUP	Investigation Objectives	Investigation Task	Task Description
Industrial Drain Lines	Determine Status of Cleanup for CBs and Conveyance Lines	System Identification	Locate all CBs, inspect for process solids and debris accumulation, depth, and presence of water. Clear any CBs buried or impacted by demolition activities to provide access for surveys and sampling.
			Video survey lines for solids accumulation, type of material present, presence of water, line integrity, and connections to other systems (e.g., groundwater collection and scrubber effluent lines).
			Survey CBs, inverts and inlet/outlet for horizontal and vertical elevation control.
			Update system maps and cross sections.
		Characterize COPC in Process Solids in Industrial Lines, Industrial Sump, and other system-related sumps.	Collect process solids sample from Rectifier Station sump north of Machine Shop.
			Collect process solids sample from Pipe E11 at entrance road south of Machine Shop.
			Collect process solids sample from Oil Change Pit/Oil-Water Separator sump adjacent to south of Maintenance Area.
			Collect process solids sample from Industrial Sump.
			Collect process solids samples from Sewage Treatment Plant sump (one per chamber).
			Collect process solids samples from additional CBs to be selected based on results of system identification.
		Characterize COPC in Soil adjacent to Industrial Lines and Sump.	Collect soil samples at line invert depth near lines on downgradient side. Sample locations will be determined based on results of system identification
			Collect soil samples at line invert depth near breaches in lines, if breaches are found during system identification.
			Collect soil samples near the Industrial Sump.
		Confirm System Cleanup	Evaluate presence of contaminated solids in lines, and whether cleanup is warranted in Industrial Lines and/or adjacent soil.
			Calculate volume of contaminated solids in Industrial Sump for remediation.
Scrubber Effluent Lines (Electrostatic Precipitation Lines)	Determine Status of Cleanup for CBs and Conveyance Lines	System Identification	Locate all CBs, inspect for solids and debris accumulation, depth, and presence of water. Clear any CBs buried or impacted by demolition activities to provide access for surveys and sampling.
			Video survey lines for solids accumulation, type of material present, presence of water, line integrity, and connections to other systems (e.g., groundwater collection and industrial drain lines).
			Survey CBs, inverts and inlet/outlet for horizontal and vertical elevation control.
			Update system maps and cross sections.
		Characterize COPC in Sediment	Collect solids samples from selected CBs. Sample locations will be based on results of system identification. At a minimum, sample will be collected at CBs that were not previously sampled or where re-sedimentation has occurred.
		Characterize COPC in Soil adjacent to Scrubber Effluent Lines	Collect soil samples at line invert depth near Scrubber Effluent Lines, on downgradient side, and at minimum 1 per courtyard. Sample locations are shown on Figures 5.2.5-2 through 5.2.5-6, and details are summarized in Table 5.2.5-9.
			Collect soil samples at line invert depth near breaches in lines, if breaches are found during system identification.
		Confirm System Cleanup	Evaluate presence of contaminated solids, and whether additional cleanup is warranted.
Southeast Portion of Groundwater Collection (Underdrain) System	Characterize Piping System	Investigate Piping System Connections	Evaluate connections to other systems (e.g., groundwater collection and industrial drain lines) as part of SWMU 32 investigation.
			Update system maps and cross sections.
		Investigate Stormwater Bypass Line	Evaluate presence and condition of stormwater bypass line indicated in historical records.

Notes:

See Figures 5.2.5-2 through 5.2.5-9 for sample locations.

CB Catch Basins

Table 5.2.5-9
Summary of Sampling for Industrial Lines Group, Plant Area AOC

FOCUS CATEGORY INDUSTRIAL LINES GROUP	Sample Method	Media Sampled	Number of Samples	Sample Depth	Sample Type	Analytes	Sample Rationale
Industrial Drain Lines Sumps and CBs							
Industrial Line Sump at Pump Station North of Machine Shop	Grab	Process Solids	1	NA	Discrete	COPC	Characterize COPC in Industrial Line sumps and CBs.
Industrial Line Ell in Entrance Road South of Maintenance Area	Grab	Process Solids	1	NA	Discrete	COPC	
Oil-Water Separator Sump South of Maintenance Area	Grab	Process Solids	1	NA	Discrete	COPC	
Industrial Sump	Grab	Process Solids	1	NA	Composite	COPC	
Sewage Treatment Plant Sump	Grab	Process Solids	3	NA	Composite	COPC	
Industrial Line CBs	Grab	Process Solids	TBD	NA	Discrete	COPC	
Soil Adjacent to Industrial Drain Lines							
Industrial Line Alignment	Soil Boring (TBD)	Surface Soil	1	0-6 inches	Discrete	COPC	Characterize COPC in soil adjacent to Industrial Drain Lines.
		Subsurface Soil	2	1 above invert 1 below invert			
Industrial Line Breaches	Soil Borings (TBD)	Surface Soil	1	0-6 inches	Discrete	COPC	Characterize COPC in soil adjacent to breaches in Industrial Drain Lines.
		Subsurface Soil	2	1 above breach 1 below breach			
Scrubber Effluent Lines							
Scrubber Effluent Line CBs	Grab	Process Solids	TBD	NA	Discrete	COPC	Characterize COPC in Scrubber Effluent Line CBs primarily from CBs with re-sedimentation, and not previously sampled.
Scrubber Effluent Line Alignment	*See Table 5.2.5-2 for details of scrubber effluent soil boring and soil samples.*						
Scrubber Effluent Line Breaches	Soil Borings (TBD)	Surface Soil	1	0-6 inches	Discrete	COPC	Characterize COPC in soil adjacent to breaches in Scrubber Effluent Lines.
		Subsurface Soil	2	1 above breach 1 below breach			

Notes:

See Figures 5.2.5-2 through 5.2.5-9 for sample locations.

Laboratory analytical methods and sample container, preservative, and holding time requirements are provided in Section 6.0 (Tables 6-5 and 6-4, respectively).

Field quality control sample (e.g., field duplicates and field blanks) requirements are summarized in Section 6.6.1.

Investigation derived waste (IDW) management and sample requirements are summarized in Section 5.3.18.

Breach	Opening in pipe resulting from physical or chemical damage
CB	Catch Basin
COPC	Chemicals of Potential Concern including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, TPH-Dx, TPH-Gx, and VOCs.
Invert	Lowest point inside Industrial and Scrubber Effluent pipes
NA	Not applicable
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
TBD	To be determined based on results of Industrial Lines surveys
TPH-Dx	Diesel- and oil-range petroleum hydrocarbons
TPH-Gx	Gasoline-range petroleum hydrocarbons
VOCs	Volatile Organic Compounds
Soil Borings (TBD)	Number of soil borings and total number of samples to be determined based on results of Industrial Lines surveys.

System Construction Identification. System investigation for the industrial drain lines will be conducted jointly with investigation of the scrubber effluent lines since both systems share similar features and the system identification steps and equipment will be similar. Industrial drain line system plans will be reviewed for construction details. Items to be noted during review include pipe dimensions, materials, elevations, slopes, and access manholes associated with the industrial drain lines.

Confirm Layout of System. Once system identification is complete, manholes will be located in the field. Some manholes may be buried, as a result of demolition activities, and may have to be located using methods such as probing or a metal detector. Upon location, manholes will be sounded for total depth and depth of water and/or sediment, if present. Catch basin positions and inverts, and inlet and outlet line inverts will be surveyed for horizontal and vertical control. Data from surveys will be used to determine slopes of lines.

Industrial drain lines will be inspected by video camera. Images and data from video inspection will be used to determine pipe diameter, pipe material, locations of joints, line condition, connections between systems, and depth of flow at the time of inspection. Video inspection can also be used to identify manholes that could have been buried. Alternative methods of inspection may be considered for smaller lines if video inspection proves to not be feasible.

Once the above activities have been completed, system maps and cross-sections will be updated to include findings.

Process Solids Sampling. Samples of process solids (or sediment) will be collected at sumps that are associated with the industrial drain lines (Figures 5.2.5-2, 5.2.5-8, and 5.2.5-9). The associated sumps and number of samples to be collected include:

- Rectifier station sump – one sample.
- Pipe E11 at entrance road – one sample.
- Oil-Water Separator south of Maintenance Area – one sample.
- Industrial sump – one sample.
- Sewage treatment plant sump – three samples (baffled sump with three sections).

Seven grab samples of solids will be collected from the various sumps listed above that are associated with the industrial drain lines. Solids samples collected from the Industrial Sump and the Sewage Treatment Sump will be composite samples, and other samples will be discrete. The solids samples will be analyzed for COPC including: PAHs, total cyanide, fluoride, sulfate, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), PCBs, TPH-Dx, TPH-Gx, and VOCs.

Additional sediment samples may be collected from a subset of industrial line catch basins (Table 5.2.5-9). Catch basins to be sampled would be identified based on the findings of the system identification task that will identify presence of solids/sediment, connection to other catch basins or features, unusual conditions observed, and accessibility.

Soil Sampling. Soil borings are proposed to be completed adjacent to the industrial drain lines. Samples of soil will be collected at line invert depth near lines on the downgradient side, and at line invert depth near breaches in lines identified during video inspection. The location and number of borings will be based on findings of the system identification as indicated on sample summary Table 5.2.5-9. Additionally, results of investigation of scrubber effluent lines located beneath Passageway No. 3 can also be used to evaluate the industrial drain lines.

A well (RI-MW10-BAU) will be installed near the Industrial Sump to determine if a release to groundwater has occurred and to characterize groundwater conditions. This characterization activity will be performed as part of the Groundwater in the Uppermost Aquifer AOC (refer to Section 5.2.2).

Scrubber Effluent Lines

The scrubber effluent lines consist of wastewater lines that historically routed effluent such as scrubber blowdown to NPDES Pond A (Figure 5.2.5-5) (Figure 5.2.5-8). The scrubber effluent lines reportedly were constructed of wood because of the corrosive nature of the effluent and actively operated only before 1978. A portion of the scrubber effluent lines [also informally called electrostatic precipitator (EP) lines] catch basins and wood piping were sampled during 2011 (PGG 2013b).

System Construction Identification. System investigation for the scrubber effluent lines will be conducted jointly with investigation of the industrial drain lines since both systems share similar features and the system identification steps and equipment will be similar. Scrubber effluent line system plans will be reviewed for construction details. Items to be noted during review include pipe dimensions, materials, elevations, slopes, and access manholes.

Scrubber effluent lines will be inspected by video camera. Images and data from video inspection will be used to determine pipe diameter, pipe material, location of joints, line condition, and connections between systems. Video inspection can also be used to identify manholes that may have been buried. Alternative methods of inspection may be considered for smaller lines if video inspection proves to not be feasible.

Once the above activities have been completed, system maps and cross sections will be updated to include system construction identification findings.

Confirm Layout of System. Manholes will be located in the field, as some manholes may be buried, and may have to be located using methods such as probing or a metal detector. Upon location, manholes will be sounded for total depth and depth of water and/or sediment, if present. Manhole positions and inverts, and inlet and outlet line inverts will be surveyed for horizontal and vertical control. Data from surveys will be used to determine slopes of lines.

Process Solids Sampling. Samples of process solids (or sediment) will be collected from a subset of manholes. Manholes to be sampled will be identified based on findings of the system identification that would identify the presence of accumulations, connection to other manholes or other features, breaches, or unusual conditions observed.

Soil Sampling. Soil borings will be completed adjacent to the scrubber effluent lines, and soil will be collected at line invert depth on the downgradient side. Soil samples will also be collected at line invert depth near breaches in lines identified during video inspection. Soil sampling associated with the scrubber effluent lines located in the Production Building Courtyards are discussed in Section 5.2.5.3, Courtyard Soil. The location and number of additional soil borings investigating the scrubber effluent lines will be based on findings of the system identification as indicated on sample summary Table 5.2.5-9.

Southeast Portion of Groundwater Collection (Underdrain) System

The southeast portion of the groundwater collection system consists of those groundwater collection lines that run southeast from the eastern end of Production Building A to the sewage treatment plant, and then southwest to NPDES Pond A. The following sections describe the tasks that will be conducted to evaluate the southeastern section of the groundwater collection system.

System Construction Identification. System investigation for of the groundwater collection system will be conducted as part of the SWMU 32 (Stormwater Pond and Appurtenant Facilities) investigation due to the possible interaction with SWMU 32. Groundwater collection system plans will be reviewed for construction details. Items to be noted during review include pipe dimensions, materials, elevations, slopes, and access manholes.

Groundwater collection lines will be inspected by video camera. Images and data from video inspection will be used to determine pipe diameter, pipe material, locations of joints, line condition, connections between systems, and depth of flow at time of inspection.

The condition of the historical bypass line from Pond A to the outfall at the Columbia River (and associated manholes) will be investigated.

Once the above activities have been completed, system maps and cross-sections will be updated to include findings.

Sewage Treatment Plant Sump. The sanitary sewer lines converge at the Sewage Treatment Plant in the southeast portion of the plant area. Because of potential discharges into the sanitary sewer line from other areas of the plant, such as the plant laboratory, the sewage treatment sump is included in the Industrial Drain Lines Investigation Group. The Sewage Treatment Plant Sump is configured with baffles creating three separate sections.

The Sewage Treatment Sump will be investigated with three solids samples collected in the three sump sections. A description of the sampling and analysis for the sewage treatment sump is discussed in the Industrial Drain Lines section above.

5.3 FIELD METHODS AND PROCEDURES

This section summarizes the field investigation activities and procedures for the remedial investigation of the Columbia Gorge Aluminum Smelter Site, Goldendale, Washington. Investigation sampling rationale, as well as sampling station locations and sample analytical programs are summarized and discussed for SWMUs in Section 5.1 and for AOCs in Section 5.2. Laboratory analytical protocols and associated data quality objectives are summarized in Section 6.0.

5.3.1 Project Activities Summary

A brief summary of the primary activities and major work elements to be conducted in support of the RI work effort is provided as follows:

- **Pre-mobilization Planning and Permitting**. These activities includes preparation of a project health and safety plan, cultural resources monitoring protocol, and a Joint Aquatic Resources Permit Application (JARPA), as well as coordination of site access, utility clearance, and obtaining start cards for drilling operations.

- **Coring and Packer Testing**. Drilling and logging of up to three continuous cores to characterize lithology, fracture patterns, and occurrence of groundwater in basalt sequences. Packer Testing (water pressure injection tests) of the coring locations to determine the hydraulic characteristics of targeted permeable zones within the basalt, including the BAU and BAL zones (refer to Section 5.2.2 and Table 5.2.2-1).

- **Groundwater Monitoring Inspection and Installation**. Existing well inspection to verify the physical condition of the existing well network and ancillary equipment to determine appropriateness for use in support of the RI groundwater characterization effort.

  Drilling and construction of up to 22 new monitoring wells and up to six temporary wells in accordance with Washington Administrative Code (WAC) Chapter 173-160 Minimum Standards for Construction and Maintenance of Wells.

- **Groundwater Sampling**. Comprehensive baseline groundwater monitoring and sampling will include existing well network(s), as well as all newly installed and temporary monitoring wells in support of the RI work effort (refer to Section 5.2.2 and Table 5.2.2-1).

- **Aquifer Testing**. Aquifer testing will include: 1) slug testing of all newly installed groundwater monitoring wells, 2) two 24-hour constant-rate pumping tests, 3) two production well pumping tests, 4) a water-level data logger study, and 5) a stormwater pond drawdown test. These tests will provide information regarding aquifer-specific characteristics and flow information, as well information regarding the interconnection between primary aquifer zones.

- **Trenching and Test Pit Excavation**. Shallow trenching and exploratory test pit excavations will be performed at select SWMU locations were buried aluminum reduction-related waste materials may be present. These excavations will be used to help characterize the subsurface soil conditions and qualitatively determine the type and extent of encountered buried materials. Test pits may also be used to obtain representative soil samples in cases where soil borings cannot be advanced due to existing lithologic conditions (e.g., larger rock and cobble matrix).

- **Unconsolidated Soil Sampling**. Unconsolidated surface and subsurface soil samples will be routinely collected to establish the nature and extent of potential soil contamination associated with individual SWMUs and AOCs. Sampling techniques may include routine use of hand-augers, hollow-stem auger and direct-push drilling techniques, as well trenching and test pit sampling.

- **Columbia River Sediment Sampling**. Over 40 discrete sediment sample station locations, including select background stations have been identified to provide current sediment quality information for the Columbia River Sediment AOC work effort. Sampling and analysis activities will follow standardized procedures developed for the Puget Sound Estuary Program (PSEP), State of Washington SMS, and guidance from Ecology Draft Sediment Cleanup User’s Manual II.

- **Stormwater Pond and Stormwater System Inspection and Sampling**. Investigation of the Stormwater Pond will include water depth and soft sediment depth profiling, as well as sediment and water quality sample collection. Inspection of stormwater appurtenant conveyances and basins, as well as sampling of select stormwater discharges, will also be performed.

- **Wetlands Sampling**. Wetlands characterization will focus on soil quality assessment, as surface water quality was the focus of recent investigations of these features. The designated wetland area(s) associated with the NESI Area (SWMU 31) will be investigated independently and will include trenching and test pit excavation requiring JARPA permitting.

- **Surveying**. Land surveying activities will include position locating of individual sample station locations, location of trenching and test pit excavations, and horizontal and vertical measurements of newly installed monitoring well locations. Columbia River sediment sample station location using Trimble™ differential global positioning system (DGPS). Coordinates based on Washington State Plane (NAD 83) and the National Geodetic Vertical Datum.

In addition to the above primary work elements, this section also covers sample handling, sample custody, field QC program, field measurements, equipment decontamination, investigation derived waste management, record keeping and field data management, as well as variances, corrective action and non-conformance reporting.

5.3.2 Pre-Mobilization Planning and Permitting

This section summarizes anticipated project pre-mobilization planning and permitting requirements.

5.3.2.1 Health and Safety

A Health and Safety Plan (HASP) is provided as Appendix A to this plan to address the health and safety practices and controls that will be implemented by all Performance Contractor employees, and any other site workers participating in the field activities associated with this work effort. The HASP will be modified by the Performance Contractor once the field work is awarded to conform with the Performance Contractor's corporate health and safety program requirements and to identify field personnel and the site-specific information.

The HASP will include detailed procedures for protecting workers and the general public from potential hazards during site investigation. The Performing Contractor will ensure that all field personnel will comply with HASP requirements. The plan will be prepared consistent with the requirements of the Federal Occupational Safety and Health Administration (OSHA) Regulations Parts 1910 and 1926 and includes the following components:

- Site description.
- Key personnel.
- Safety and Health Hazard Assessment for each work task.
- Education and training for proposed field staff.
- Personnel protective equipment.
- Medical surveillance.
- Standard operating procedures, engineering controls and work practices.
- Site control measures including work zones, communications and security.
- Logs, reports, and record keeping.

The HASP will also include a description of necessary monitoring equipment identified based on the results of hazard assessment, and define action levels for upgrading the level of protection as appropriate.

5.3.2.2 Cultural Resources Monitoring Protocol

A Cultural Resources Monitoring Protocol (CRMP) has been developed for use in completing the RI field activities. This protocol will be used to help locate, identify, document, and report potential cultural resource artifacts at the site, if encountered during the course of the planned field investigation activities. This protocol is a requirement of the Agreed Order, and is also an anticipated requirement by the USACE and Ecology as part of their JARPA permit approval process (see Section 5.3.2.4), as well as by the Yakama Nation due to the potential for cultural resource artifacts in the general site vicinity. The CRMP prepared in support of this RI work effort is provided in Appendix B, and will be implemented consistent with Washington State Department of Archaeology and Historic Preservation guidance (DAHP 2010).

5.3.2.3 Site Access and Utility Clearance

Portions of the area of investigation are located on property that is not owned by NSC (e.g., USACE). Prior to initial mobilization to the site and at the start of field operations at any specific location, the Performing Contractor will confirm with the Project Coordinator(s) that site access agreement(s) have been obtained.

The project site is accessed through the main entrance off State Route 14 using John Day Dam Road (refer to Figure 2-2). NSC maintains limited site operations with personnel onsite during week-day hours. The Performing Contactor and their consultants will be responsible for daily check-in with NSC operations personnel at the main gate facility prior to beginning planned site activities. Access to certain portions of the site are gated and locked and will require coordination with NSC personnel to gain access and work authorization.

<u>Project Staging Areas</u>

The Performing Contractor will be responsible for identification and approval of all project staging areas, including citing and use of project trailer(s), equipment laydown, soil and water containment areas, and personnel facilities such as portable restrooms prior to initial site mobilization. The potential use of NSC facilities, including access and use of existing office space and building structures and access to potable water and electricity is also the responsibility of the Performing Contractor.

Utilities Location

The 48-hour underground utility notification number will be contacted prior to any subsurface investigation activities (e.g., drilling and/or excavation) consistent with state law. In addition, a Lockheed Martin Operation Procedure Dig Permit will be completed, submitted to the Lockheed Martin Project Coordinator, and approved by Lockheed Martin prior to the start of excavation activities.

A private utility contractor will also be contracted to clear the proposed drilling and excavation locations. Prior to commencing drilling operations, the Performing Contractor will hand dig the top 2 to 3 feet at each boring location to verify that no shallow underground utilities are present.

Overhead Bonneville Power Administration (BPA) power line passes through the south-central and eastern portion of the project area that must be considered during field operations. Work authorization must be obtained if work is planned in the vicinity of the BPA power line corridor.

5.3.2.4 Permits

The Performing Contractor will be responsible for all permitting requirements associated with the RI work effort, including those associated with drilling and excavation work activities.

Start cards are required by Ecology for the construction of wells and borings that intercept groundwater.

The proposed fieldwork includes test pit sampling in select wetland areas at the NESI Area (SWMU 31) (refer to Section 5.1.30) that will require submission and approval of a JARPA by USACE and Ecology. The USACE Nationwide 6 Permit process allows survey activities including exploratory trenching for sampling purposes to occur on a wetlands site that is considered waters of the United States under Section 404 of the Clean Water Act. This general permit is a type of pre-issued permit that already authorizes the proposed work type; however, verification of authorization from the USACE and Ecology is required.

The JARPA permit process reportedly takes about 30 days from submittal of a complete application package for determination of whether the project may proceed under the nationwide permit or whether an individual permit is required. The JARPA application will be submitted concurrently for review to the USACE and Ecology. Klickitat County is not party to the JARPA process, but will be notified to ensure that the project complies with the Klickitat County Critical Areas Ordinance.

The JARPA form is provided as Appendix C to this plan. As part of the JARPA application, the USACE requires preparation of a CRMP, as previously discussed in Section 5.3.2.2. The completed JARPA will be submitted and approved in advance of the trenching and test pit excavation work in the NESI area that is currently scheduled for June 2016.

5.3.3 Coring and Packer Testing

Continuous rock coring will be performed at up to three locations (RI-MW1-BAL, RI-MW2-BAL, and RI-MW3-BAL) across the project site to characterize lithology, the occurrence of groundwater, and fracture patterns in the basalt bedrock (refer to Section 5.2.2 and Figure 5.2.2-1). Two of these core holes (RI-MW1-BAL and RI-MW2-BAL) will be extended from the ground surface to the depth of the approximate elevation of the adjacent Columbia River about 215 to 240 feet bgs. The third core hole (RI-MW3-BAL) located in the western portion of the site, will be installed from ground surface to the upper contact of the BAL aquifer zone about 150 feet bgs. The overlying UA aquifer is anticipated to extend deeper in this western portion of the site and a temporary casing will be installed through the unconsolidated alluvium of the UA zone and set into the basalt bedrock prior to beginning coring at this location.

These core holes will be the initial locations drilled in order to provide guidance on screen intervals at subsequent new well locations. The continuous cores will extend into the BAL aquifer zone at each location. The corings will be performed using a wire-line coring rig and recommended size NQ™ core barrel that produces approximately 2-inch diameter core holes. Monitoring wells will be completed near the coring locations with air-rotary drilling as part of a later and separate phase of work.

For planning purposes, about 50 feet per day of core of this type can be drilled depending on drilling conditions and the degree of packer testing that is needed.

Single-phase packer or straddle packer tests will be intermittently run near the base of the borehole as it is drilled downward based on the observed fracture pattern in the cores and the anticipated depths of the target zones. Single-phase packers are recommended where practical compared to the straddle-packers due to their greater reliability, ease of use, and reduced likelihood of problems extracting the packer assembly from the core hole. The length of the corer and coring runs will be 5 feet. Maximum injection pressure will not exceed 0.5 psi/foot of overburden.

Water and cuttings will be generated by the coring operation. It is anticipated that greater than 10,000 gallons of water will be generated during drilling of a single core hole. The water will not be reused during the coring operations. The water will be physically separated from the cuttings. The cuttings will be containerized (e.g., 55-gallon drums) and the water will be contained onsite in bulk storage tank(s) pending chemical test results (refer to Section 5.3.18, Investigation Derived Waste Management).

The core holes will be abandoned by filling the hole with a Portland-cement grout slurry, and in accordance with specifications in WAC Chapter 173-160 Minimum Standards for Construction and Maintenance of Wells.

5.3.3.1 Core Logging and Handling

The onsite geologist will log each section of core retrieved from the coring device. Each core run will be approximately 5 feet in length. The core will be brought to the surface using wireline retrieval methods, removed from the core barrel and placed onto a logging rack constructed from 6-inch diameter PVC pipe that has been cut in half lengthwise, with the top of the core oriented to the left. The core will be marked with two felt tip or paint pens (one black, the other red or by a solid line and a dashed line) along the entire length of the core (noted as centerline in the core log). The black line (or solid line) will be on the top, the red line (or dashed line) will be on the bottom. Once marked, there will be no confusion which direction is the top and bottom of the core. The core will be photographed with a digital camera and each photograph will include a color chart and scale. The log will note whether the core is wet or dry.

Once photographed, the geologist will calculate and record core recovery and rock quality designation. Total core recovery will be calculated by taking the sum of all pieces (including non-intact core) and dividing by the total core run length. Solid core recovery will then be calculated by summing the length of all the pieces (not including non-intact core) and dividing by the total core run, rock quality designation (RQD) will be determined according to ASTM Standard 6032-08. RQD is the sum of all core pieces longer than 4 inches in length, divided by the total core run length and recorded as a percent. RQD will be identified as follows: 0 to 25% very poor, 26 to 50% poor, 51 to 75% fair, 76 to 90% good, and 91 to 100% excellent.

The core will then be logged, paying particular attention to lithology (rock type, field strength, color, texture, structure); presence of bedding planes or other distinguishing characteristics such as degree of decomposition; presence of vesicles, fracture, and vesicle fill; disintegration; fracture density; and fracture characteristics. Fracture characteristics will include type of fracture (joint, shear, bedding plane joint, micro joint, fracture zone, shear zone, or mechanical break). The core will be logged based on the linear length of the borehole and will be recorded in feet and inches. Fractures will be described in detail and will include the dip angle (relative to the axis of the core), aperture, degree of healing (if present), the presence of any infilling material (clean, surface oxidation or staining, non-cohesive sediment, cohesive sediment, mineralization, clay, gouge, etc.), degree of unevenness (rough, smooth, slickensides, stepped, undulating, or planar), and moisture conditions.

When core logging activities are completed the core will be placed in wood core boxes, with the top of the core to the upper left and the bottom of the core placed in the lower right. Each core box will be labeled with the site name, borehole number, what run or runs (sequentially numbered from 1 to however many), the length of the core contained in the box (e.g., 50 to 60 feet), the date the core was collected, the total recovery of each run (as a percent), the solid recovery (as a percent), and the RQD. Spacers will be placed in the core box at the end of each core run to fill the core box so that core movement is minimized during shipping. Fill blocks will be used whenever core is missing. Fill blocks will have notes as to the section of core missing. On the outside of each box, the project name, boring ID number, box number, and depth will be recorded for easy cataloging and core storage. The cores will be retained in their wood core boxes and archived onsite at a pre-selected NSC building location to provide a reference source for hydrostratigraphic work should the need arise in the future.

5.3.3.2 Packer Testing

The location of the permeability tests also commonly referred to as "packer tests" will be determined based on the continuous core log from each borehole and the observed occurrence of water in the target zones. The objective is to test hydraulic characteristics of the water-bearing zones in the fractured bedrock. The packer tests will also be used to verify the location of low permeability zones. Inflatable packers will be used to seal off the borehole across fractured near the base of the borehole as the boring is advanced. The typical setup includes packers, a pipe that can be connected to a water line, an airline as well as associated air tank, and valves and gauges associated with the pneumatic packers. The bottom of the pipe will be sealed and the pipe section test interval will be perforated. In cases where the interval of interest is near the base of the core, a single packer will be mounted above the perforated interval of the pipe. For straddle packer testing, two inflatable packers set 5 to 10 feet apart, will be mounted on both sides of the perforated pipe interval. Prior to conducting any test, the borehole should be purged or flushed to remove cuttings which may affect the test and water-levels should be allowed to re-equilibrate.

The packer assembly will be used to perform fracture permeability testing by injecting water under pressure. Before mobilization to the field, the Performing Contractor will prepare final procedures and specifications for the packer assembly and associated fracture permeability testing within borings.

Potable water will be injected into the packed-off sections of the borehole to measure the amount of water injected over a measured amount of time. Flow and pressure will be monitored during each test to quantify the amount of water injected into the bedrock.

Typical packer set ups include the straddle packer assembly with packers designed to seal an NQ core hole, a ¾-inch or 1-inch diameter pipe leading from the packer assembly to the ground surface, a swivel, water pressure gauge, flow valve, water-flow meter, bypass valve, surge chamber and pump. The assembly will include provisions to monitor pressure both in the tested zone and adjacent zones to verify no leakage around the packer. An airline connects the packer assembly to the compressed nitrogen source. For intervals of interest at the base of the boring, a single packer may be used.

There are various methods of conducting the test and evaluating the data. The following description is provided as an example and general guideline. The test will be conducted by injecting water at specific pressures. Pressure will be increased in steps and the resulting pressure will be recorded when the flow reaches a quasi-steady state condition (i.e., Lujeon tests). The pressure will be maintained at levels below those that could potentially hydraulically fracture the rock mass (a general rule-of-thumb to prevent over pressurization of the formation is not to exceed 0.5-psi per foot of depth or 100-psi total whichever is lower). The packer assembly will be placed across the zone of interest). While the distance between packers can vary, packers should generally not be less than 5 feet apart and no more than 20 feet apart. Modifications to the distance between the packers will be evaluated in the field and distance will be determined based on the geologic conditions present at each borehole. The data collected during each test will consist of the flow rate and the corresponding pressure when "steady state" conditions have been achieved. The data are recorded over a number of increasing and decreasing pressures. Data are plotted on a flow rate versus pressure graph for each pressure step. Each test will usually consist of three to five ascending pressure steps, and two to four recovery pressure steps (the recovery pressure steps should be the same as the ascending pressure steps).

The data from the injection tests can be used to determine the effective transmissivity (T) by means of the Thiem equation:

$$T = \frac{Q * \ln(R/rb)}{2\pi Pi}$$

Where:

T = transmissivity (m^2/day)
Q = injection rate (m^3/day)
R = radius of influence (m)
rb = radius of borehole
Pi = net injection pressure

The impacts from possible friction losses will be evaluated based on the flow rate and the nominal supply line diameter and length, using standard empirical correlations relating friction loss to flow rate and pipe diameter. Injection pressure will be calculated as the net sum of gauge pressure plus any elevation corrections minus any friction losses.

Effective radius or radius of influence (R) is generally assumed to be 5 to 10 meters. The net injection pressure (Pi) is calculated as the combined pressure head (m) that is exerted on the test zone. It is calculated as follows:

$$Pi = Pg + hg + hs + hf$$

Where:

Pi = net injection pressure (m)
Pg = gauge pressure (m)
hg = height of gauge above ground level (m)
hs = vertical depth to pre-test water-level (m)
hf = friction losses (m)

The sum of the hg and hs is usually referred to as the column height. Both components of the column height should be measured before the test is carried out. The value for the hg should be the same for each test if the testing apparatus is not changed. Hs will vary depending on the hydrogeologic zone to be tested.

5.3.4 Monitoring Well Inspection and Installation

Groundwater investigation activities in support of the RI work effort are being conducted as part of the Groundwater in the Upper Most Aquifer AOC (refer to Section 5.2.2). Groundwater investigation will include use of both existing and newly installed groundwater monitoring wells across the site, as well as use of temporary wells at select locations within the plant area footprint. The rationale for newly installed groundwater monitoring wells is provided in Table 5.2.2-1. The following sections provide information regarding existing well inspection and verification, as well as new monitoring well installation procedures.

5.3.4.1 Existing Well Inspection and Verification

Verification of the physical condition of the existing wells and ancillary equipment (e.g., pumps) will performed prior to collection of groundwater samples from these locations in support of the RI work effort. This will include evaluation of available construction details to determine which wells are appropriate from a construction standpoint for inclusion in the RI sampling program. Verification will also include assessment of well elevation and location survey information.

A well verification technical memorandum will be prepared to 1) identify those wells that are appropriate for use in support of the RI groundwater characterization effort, and 2) identify those wells that either need rehabilitation or should be considered for formal decommissioning. The well verification effort will be completed prior to initiation of groundwater investigation activities.

5.3.4.2 Monitoring Well Installation

Up to 22 new monitoring wells are proposed for installation at the site including: 2 UA zone wells, 14 BAU zone wells, and 6 BAL zone wells as described in Section 5.2.2. In addition, up to 10 temporary wells will be installed in the UA-zone if shallow groundwater is encountered at select SWMU and AOC locations (refer to Table 5.2.2-1). All wells will be constructed in accordance with WAC Chapter 173-160 Minimum Standards for Construction and Maintenance of Wells. The installation of the wells will be overseen by a Washington State-licensed geologist who will be available to provide consultation as needed. Lithologic logs and well construction diagrams will be prepared for each well.

The wells in unconsolidated materials may by be drilled using Hollow-Stem Auger (HSA) drilling techniques, while well installed within basalt formations will be drilled using air-rotary drilling methods. Potable water will be used as needed to cool and lubricate the drilling bit associated with air-rotary drilling.

The specific completion intervals for the wells will be identified based on coring activities (see Section 5.3.3 above), and the screen intervals for nearby or previously existing monitoring wells in the area of the proposed wells. Screen lengths are planned to be 10-feet.

5.3.4.3 Lithologic Logging

For soil, a lithologic description of each soil interval will be logged consistent with the Unified Soil Classification System (USCS) as described in ASTM D-2488-00 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM 2000). General descriptive information will include color (descriptive and Munsel code), predominant particle size, percent of gravel, sands, and/or fines, description of grading or sorting, moisture, and evidence of staining or odor.

In bedrock, lithologic logging during well installation at locations (other than the continuously cored borings) will be performed based primarily on cuttings, drill rig response, and the occurrence of water encountered in the borings. The mineralogy and rock texture will be logged in the cuttings. The cores and basalt cutting will be logged, classified, and described using standard geological field classification and procedures including those described in Compton (1985) and Travis (1955). Rock textures and basalt flow characteristics will be described as practical and appropriate.

5.3.4.4 Use of Temporary Drilling Casing

Temporary casing will be used during well drilling and construction for wells where contaminated groundwater could migrate through the borehole into potentially uncontaminated or less contaminated deeper water-bearing zones.

Temporary surface casing will be set and grouted into low permeability layers before drilling into the deeper zone. Thirty percent solids bentonite grout slurry will be used to grout between the temporary conductor casing and the drill casing. The temporary bentonite seal will be 6 to 10 feet thick. The temporary casing will be grouted in place using 30 percent active solids by weight bentonite slurry and allowed to set for about one to a few hours depending on drilling conditions. To reduce or eliminate the potential for cross-contamination of aquifer zones during well drilling, temporary casings will be installed to case off each encountered aquifer zone before drilling into deeper aquifer zones. The integrity and adequacy of the grout seal will be verified before drilling into the deeper zone, and periodic monitoring of the seal will be performed during drilling operations. Seal verification will include periodic measurement of the depth to the top of the seal in the annular space between the casings.

5.3.4.5 Monitoring Well Casing and Screens

The wells to be completed in unconsolidated soils and shallow bedrock (UA and BAU zones) will be constructed of 2-inch diameter Schedule 40 PVC casing and 10-foot length, machine- slotted (10-slot size) screens. Wells to be completed in deeper bedrock materials (deeper BAU and BAL zone) will be constructed of 2-inch diameter Schedule 80 PVC casing and 10- to 20-foot length (determined based on coring and well installation observations), machine-slotted (20-slot size) screens. Two new wells (RI-MW1-BAL and RI-MW2-BAU) will be of 4-inch diameter as to accommodate a larger pump in support the aquifer testing described in Section 5.2.2 and in Section 5.3.6 below.

End caps will be installed at the bottom of the screen assemblies. All joints will be flush-threaded. The slot size will be confirmed in the field based on lithology. As necessary, centralizers will be used to center the well screen and casing in the borehole. One centralizer will be used for every 20 to 50 feet of well depth. Use of centralizers in the filter pack interval will be minimized to the extent practical due to potential concerns of bridging of the filter pack and centralizer during construction.

5.3.4.6 Filter Pack

The borehole annulus will be filled with a silica filter sand pack to 3 feet above the screened interval consistent with WAC Chapter 173-160 requirements. Shallow UA and BAU wells will utilize a 10-20 silica sand pack and deeper BAU and BAL wells will utilize an 8-12 sand pack. A fine sand collar consisting of 6 inches of fine 20-40 silica sand will be placed on top of the filter pack for all wells where the seal is grouted.

Filter pack material will be placed using a Tremie pipe to ensure proper placement.

5.3.4.7 Bentonite Seal and Annular Seal

A 3-foot-thick layer of compressed bentonite pellets will be installed on top of the sand pack and hydrated. The depth to the top of the bentonite seal will be verified with a weighted tape before the well is complete. The bentonite seal will set for about 20 minutes to allow for sufficient hydration before grouting begins.

The Washington well construction standards provide for sealing the annular space between the top of the bentonite seal to the bottom of the surface seal using multiple methods. The annular seal will consist of physically and chemically stable hydrated grout slurry composed of bentonite, neat cement, neat cement grout, or sodium bentonite chips placed in an un-hydrated state and subsequently hydrated down hole. Bentonite used to prepare slurries for sealing or decommissioning shall have an active solids (bentonite) content of at least 20 percent. The use of un-hydrated sodium bentonite chips is limited to boreholes less than 50 feet in total depth and standing water in the bore hole of less than 25 feet at the time of placement. Prior to field mobilization, the final annular seal requirements will be determined based on well and water depth, and anticipated levels of contamination.

5.3.4.8 Surface Completions

Permanent monitoring well will be completed with either a traffic rated, flush-mounted well monument or a stickup (above ground) steel security casing and an approximate 3-foot by 3-foot concrete surface pad/seal depending on location. Wells in the former plant footprint with potential traffic concerns will be completed with traffic rated, flush-mounted surface completions. For above-ground completions, three steel bollards will be installed around the well to protect the security casing. The bollards will be installed outside of the concrete surface pad.

Temporary monitoring wells will be installed with traffic-rated, flush-mounted well security casing to facilitate ease of future decommissioning, as appropriate.

5.3.4.9 Well Development

Each monitoring well will be developed no sooner than 24 hours after it is completed. Development will consist of pumping and possibly bailing. Development equipment will be decontaminated before it is used to minimize the potential for cross-contamination between wells.

Pumping will be completed with a down-hole impeller type pump in the monitoring wells. Wells will be developed until water turbidity is minimized and about three to 10 borehole volumes of groundwater have been removed from each well and water field parameters have approximately stabilized. Water field parameters including: pH, conductivity, temperature, oxidation reduction potential, dissolved oxygen, and turbidity will be measured and recorded during well development. An objective of well development is to reduce turbidity to the extent practicable to less than 5 nephelometric turbidity units (NTUs). The criteria for stabilization of field parameters during development are about 10 percent based on three rounds of successive measurement.

Also, an equivalent volume of all water added during drilling will be removed during development. All development water will be contained in labeled 55-gallon drums, transported, and then stored at a secure, centrally located, NSC-owned location pending chemical analysis (refer to Section 5.3.18, Investigation Derived Waste Management).

There are some existing wells that have not been sampled over the past several years. The operational status of the wells and any ancillary equipment (e.g., pumps) will be evaluated as part of the well verification survey discussed in Section 5.3.4.1 above.

5.3.5 Groundwater Sampling

This section summarizes the proposed groundwater sampling procedures for the site.

5.3.5.1 Water-Level Measurements

Water-level will be measured with an electronic water-level indicator. The depth to water and total well depth will be measured from a marked reference point at the head of each monitoring well. If a dedicated pump is already installed in a well, measurement of total depth will only be performed during the baseline sampling round.

Water-level measurements will be made prior to starting well purging. The elevation of the water surface will be calculated relative to the surveyed reference point. Water-level measurements will be reported to the nearest 0.01 foot. The water level indicator will be decontaminated between well location using procedures described in Section 5.3.17 below.

5.3.5.2 Well Purging and Sampling

Each well will be purged after water-levels are measured and immediately before samples are collected.

Existing wells that are already equipped with operational pre-installed dedicated pumps will be sampled with those pumps. Other wells with standing water-levels of less than 20 feet bgs will be sampled with peristaltic pumps equipped with disposable polyethylene tubing. Deep wells characterized by standing water-level elevations deeper than 20-feet bgs will be sampled with a non-dedicated electric submersible pump (Grundfos™ or similar suitable environmental pump) or a bladder pump. The pump will be decontaminated between wells. Pump tubing will be either decontaminated or replaced after sampling of each well. If the pump tubing is to be reused following decontamination, then wells suspected of being more contaminated in a given area will be sampled last. The pump tubing will be replaced with new tubing following sampling of a given well based on past sample results or if field observations indicate potential moderate to high levels of contamination during purging (e.g., sheen, odor, discoloration, or elevated field instrumentation readings). For all these methods, the pump inlet will be placed in the center of the well screen interval.

Groundwater samples will be collected using low-flow sampling techniques (EPA 1996, 2002a). The purpose is to draw fresh formation water into the well screen with minimal disturbance and drawdown. A low pumping rate of less than about 0.5 liters per minute will be used to minimize drawdown and water-level measurements will be made to document drawdown in the well. Measurements of field parameters will be made about every 5 minutes. The pump inlet screen will be placed in the center of the well screen interval.

An in-line flow-through cell will be used to measure field parameters. Field parameters to be measured and recorded include: pH, conductivity, temperature, dissolved oxygen, oxidation-reduction potential, and turbidity. Guidelines for stabilization include successive measurements within the following ranges:

- pH +/- 0.1 units.
- Temperature +/- 5 percent.
- Specific electrical conductance +/- 3 percent.
- Oxidation-reduction potential +/- 10 millivolts.
- Turbidity +/- 10 percent (when turbidity is greater than 10 nephelometric turbidity units [NTUs]).
- Dissolved Oxygen +/- 0.3 mg/L.

If drawdown is excessive (greater than 0.5 feet) or stabilization of field parameters is not attained after several readings, a minimum of one casing volume will be purged from the well prior to sampling. Any well that purges dry will be allowed to recharge and sampled as soon as practical.

Samples will be collected using the specified glassware and preservatives for the chemical analyses specified in the QAPP (refer to Section 6.0). Groundwater samples will be collected from the dedicated polyethylene tubing outlet from the pump following stabilization of water quality parameters. Groundwater samples will be collected while wearing clean nitrile gloves and sampled using the following procedures:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below).
- Collect groundwater samples in order of volatilization (i.e., volatile organic compounds first). Samples for VOC analysis (if any) will be filled directly from the polyethylene tubing into pre-labeled, pre-preserved VOA sample containers, with care taken to minimize turbulence. The VOA containers will be filled completely to eliminate any headspace, and the seal/lid will be secured.

  Dissolved metals (if any) will be filtered in the field using a 0.45 micron disposable, in-line filter. Care will be taken not to overfill pre-preserved sample containers as to help maintain proper pH control.
- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0^{o} to 6^{o} C for the duration of sampling and transportation to the laboratory.
- Record all sample collection information (e.g., location, date and time sampled, the well identification and number, and preservative(s), if any, in the field logbook and/or on appropriate field forms (refer to Section 5.3.19).
- Follow sample custody and handling procedures as described in Section 5.3.14.
- Decontaminate any re-useable down-hole equipment between sample locations according to the procedures described in Section 5.3.17.
- All purge water will be placed in labeled 55-gallons drum at the property pending receipt of chemical test results (refer to Section 5.3.18, Investigation Derived Waste Management).

5.3.6 Aquifer Testing

Aquifer testing will consist of both slug tests and constant rate pumping tests as described in the following sections. It is assumed that groundwater extracted during aquifer testing will be approved for discharge to the facility stormwater pond under the existing NPDES permit based on results obtained during the initial, comprehensive baseline groundwater monitoring event (refer to Section 5.2.2). It is the Performing Contractors responsibility to confirm that pump-test water meets NPDES permit criteria and is permitted for discharge prior to performing these tests (refer to Section 5.3.18).

5.3.6.1 Slug Tests

Slug testing is one of the most common methods for field determination of hydraulic conductivity. Slug tests are short-term tests that are designed to provide approximate hydraulic conductivity values for the portion of a hydrostratigraphic unit immediately surrounding the screened interval of a well. All existing and newly installed wells will be slug tested, and the testing will be performed at least one week following well development.

A conventional slug test artificially raises or lowers the water-level in a well from its normal static level through injecting or removing a known volume. The recovery of the water-level to its original state is measured. Tests employing a sudden drop in water-level by removing a volume are referred to as a rising head or slug-out tests.

Rising Head Test Procedure

For wells in which the well screen interval is not completely saturated, only rising head tests are applicable. There are potential wells at the site to be completed in the unconsolidated aquifer where the well screens will not be completely saturated (particularly given expected seasonal fluctuations). For this reason, the following general procedures for rising head/slug-out tests will be used:

- Information about each well will be obtained including total depth, screen interval, diameter, and the height of the water column above the screen. This information should be evaluated prior to test and will be used to determine the appropriate transducer ranges for the test, and the size of the slug.
- The well cap will be removed and a water-level measurement will be collected. This measurement should be taken a few times to ensure that it has stabilized.
- The appropriate transducer will be selected and lowered to below the location where the bottom of the slug will be placed. Make sure the transducer is suitable for the test based on the screen interval depth and the height of the water column above the transducer.
- The transducer will be secured to the top of well casing by taping the transducer cable to well head with duct tape so that that transducer doesn’t move during testing.
- The transducer will be connected to the data logger to establish the transducer settings and prepare for starting of the test. Take a reading from the data logger to check if the water depth appears reasonable. The pressure transducer will be set at an appropriate measurement frequency such as 0.1 seconds for the first 10 seconds followed by measurements every second for the remainder of the test.

- Lower the slug with rope to below the water-level surface and allow it to equilibrate.
- Re-check the data logger and establish the reference level to a value greater than the maximum expected displacement.
- Untie the slug rope and get ready to retrieve the slug. Start the data logger in log mode and completely withdraw the slug in one quick, smooth, continuous motion within a few seconds.
- Check the data logger to see that the water-level has equilibrated and stop the test. The test should be repeated to make sure the data are consistent.

Water-levels will be measured with an electronic water-level indicator, before the slug is inserted into the water table, after the slug is inserted into the water table, and after the slug is removed. All downhole equipment (slug and cable, transducer and cable, water-level indicator) will be decontaminated after use.

Collected data will be analyzed using an appropriate method for the data analysis under the aquifer conditions.

Pneumatic Slug Tests

Wells completed in aquifer zones generally characterized by high hydraulic conductivity should utilize pneumatic slug tests to obtain accurate results. Pneumatic slug tests use pressurized air or nitrogen as the slugging agent (InSitu 2011). During a pneumatic slug test, the well is sealed and the water column is pressurized. The water-level in the well drops as the pressure rises. Once equilibrium is attained, the pressure is instantaneously released and the water-level returns to the static water-level.

Performance of pneumatic slug tests requires a specialized well head assembly that includes: a quick release ball valve with pressure gage, an air-tight probe port for the transducer, a rubber base that can accommodate 2-inch or 4-inch wells, and an air compressor and regulator. The pneumatic slug test is conducted in the following main steps:

- Determine depth of the static water-level.
- Determine depth from the static water-level to the top of the well screen. The amount of applied pressure must not depress the static water-level below the top of the well screen.
- Install well head assembly.

- Program the transducer/data logger with logarithmic data frequency with more frequent measurements at the beginning of the test. Program the data logger to start prior to column pressurization in order to capture the original static water-level and determine the elapsed time to column pressurization.

- Begin pressurizing the well. A pressure equivalent of 2 to 8 feet is recommended, but do exceed the maximum depth to the top of the well screen.

- Once equilibrium is reached, the test may begin. Reset data logger to record at the maximum frequency, then release the ball valve and monitor the rise in water-level until it returns to the static water-level.

5.3.6.2 Water-Level Characterization Study

Two cluster well locations will be outfitted with water-level data loggers to better define seasonal trends and aquifer interconnection. The period of investigation is proposed for several months to include a wet and dry season. The water-level data logger study will be performed following the baseline comprehensive sampling round and conclude at around the fourth quarterly groundwater sampling round.

The well clusters proposed for the water-level data logger study include: 1) the RI-MW1-BAL/BAMW-3/MW-8 well cluster, and 2) the RI-MW2-BAU/RI-MW2-BAL well cluster. At the MW-2 well cluster, a data logger/transducer would also be placed at the stormwater detention pond if feasible. Klickitat County PUD will be consulted to determine the pumping schedule and anticipated amount of withdrawal for the production wells at the facility for the study period.

All downhole equipment will be thoroughly decontaminated prior to use following procedures described in Section 5.3.17. Each transducer will be pre-programed to collect water level measurements at a 15-minute interval frequency for the duration of the study. Each transducer will be vented to provide barometrically-corrected water level readings. Each transducer must be capable of collecting water-level data at the specified frequency and test duration using a single deployment. The transducers and data loggers will be periodically inspected during the course of the study.

5.3.6.3 Step-Draw Down and Constant Rate Pumping Test

The objectives of the test is to evaluate the degree of interconnection between aquifer zones and associated aquifer properties (e.g., transmissivity). The following activities will be conducted as part of the aquifer tests: 1) pre-test water-level monitoring, 2) step-drawdown pumping test, 3) constant-discharge test, and 4) recovery test.

The proposed pumping tests and associated test well locations are described in Section 5.2.2. Based on the results of the coring, packer testing, and initial well drilling, the monitoring locations for aquifer testing and test layout will be adjusted and finalized.

Initial Setup and Water-Level Measurements

Before the start of a given test, initial water-level measurement will be measured at 30-minute intervals on all selected wells. The data will be collected using an electronic data logger and pressure transducer and/or hand measurements. The exact time, date, and water-level will be recorded. Data-logger transducers will be installed near the bottom of the pumping well and in the two observation wells. In the pumping well, the transducer will be installed before the pump is set. Water-level reading will be recorded to ensure that equilibrium has been reached after pump installation.

Step-Drawdown Test

A step-drawdown test will be performed in the proposed pumping well to evaluate the optimal discharge rate for the pumping test. The step-drawdown test will be conducted at least one day prior to the scheduled constant-discharge aquifer test. During the step-drawdown test, the well will be pumped at three successively higher steady discharge rates for about one hour. The drawdown during each step will be recorded on a logarithmic schedule by a transducer and data logger. The drawdown will be manually checked during each step using a water-level meter. The anticipated pumping rates for the step-drawdown tests are 5 gallons per minute (gpm), 15 gpm, and 25 gpm. These rates will be finalized based on packer test results, slug test results, and observed pumping well response during well development.

With each succeeding step increase, the discharge rate will be doubled until the maximum sustainable yield of the well (without dewatering) is reached. The observation wells will be monitored during the step-drawdown test at 15-minute intervals with a water-level probe. Drawdown information from these wells will aid in determining the maximum pumping rates for the constant discharge test.

A discharge rate will be chosen to provide the greatest sustainable drawdown in the pumping well without encroaching on the down-hole pump during the test, or overstressing the well. The well intake depth of the pump will be placed as low as possible to meet this objective.

The discharge rate may be evaluated from the results of the step-drawdown test by the following method:

- Water-levels will be plotted against the time log from the start of the step-drawdown test on semi-logarithmic paper.
- The top of the screen and pump intake levels will be marked on the graph.
- Each drawdown step will be extrapolated for 72 hours.

Constant Rate Test

The constant rate test will begin after water-levels in the pumping and observation wells have recovered to their static levels following the step-drawdown test. For the constant rate test, the pumping well will pumped for a maximum of 24 hours or until the drawdown stabilizes. Water-level stabilization will be considered complete when the log-time versus drawdown data in the observation well begins to plot as a straight line on semi-log graph paper. At the end of the constant rate test, the pump will be stopped and the water-levels will be allowed to recover. The current planned pumping rate is 20 gallons per minute. This rate will be finalized based on the results of the step-drawdown tests as well as other RI data. Note that the pumping rate has potential impacts on the equipment and temporary water storage requirements necessary for the tests (particularly if the needed pumping rate is higher), so additional planning based on the early RI data results will be needed.

Two tests are planned. The RI-MW1-BAL test will include pumping of RI-MW1-BAL with transducer monitoring of well BAMW-3, RI-MW8-BAU, and at least one background well. The RI-MW2-BAU test will include pumping of RI-MW2-BAU with transducer monitoring of RI-MW2-BAL, RI-MW16-BAU and RI-MW9-BAU.

Water-levels in the pumping well and two observation wells will be measured on a logarithmic time schedule that begins at the start of pumping and the start of recovery. This schedule ensures that measurements are made at a close time-spacing for the early portion of the tests. A typical measurement frequency for an aquifer zone of moderate hydraulic conductivity is as follows:

Pumping Well	
Time Since Pumping Started (or stopped)	**Time Intervals Between Measurements**
0 to 2 seconds	0.2 seconds
2 to 20 seconds	1 second
20 to 120 seconds	5 seconds
2 to 10 minutes	20 seconds
10 to 100 minutes	2 minutes
100 to 1000 minutes	2 minutes
1,000 minutes to test termination	2 minutes
Observation Wells	
0 to 60 minutes	1 minutes
60 to 120 minutes	5 minutes
120 to 240 minutes	15 minutes
240 minutes to test termination	15 minutes

The measurement frequency will be further evaluated based on field observations during the initial phase of drilling.

The discharge rate will be measured with a recently calibrated in-line flow meter with a volume totalizer. The discharge rate will be maintained at plus or minus 10 percent of the optimal flow rate during the entire test. Discharge rates will be recorded at about 5- to 10-minute intervals during the first hour of pumping. After the first hour, the discharge will be recorded with each round of water-level measurements. The discharge rate will be checked every 2 to 4 hours using a bucket and stop watch at the same time water-levels in the monitoring wells are manually checked.

Water-level measurement data from selected wells will be plotted during the test as time versus drawdown. Early test data are extremely important, and all equipment must be operational when pumping begins. The test will be terminated at an early stage if the pump or water-level measurement instruments are not working properly. The instruments will be repaired and checked, and the test restarted after the pumping well recovers completely.

The governing factors involved in the decision to start a new test are: 1) the duration of the initial test, 2) whether the drawdown curve is sufficient to calculate aquifer parameters, and 3) whether the drawdown has reached steady state. If the water-level in the pumping well approaches the pumping level (about 1 foot) above the down-hole pump intake elevation and the constant pumping rate is not possible to maintain, pumping will be terminated, and the recovery portion of the test will be monitored.

Recovery Test

After pumping has terminated, water-level recovery data will be collected from the observation wells until water-levels have recovered to within 90 percent of initial static levels. The recovery test will take place for a maximum of 24 hours.

Equipment Needed

The following is a typical equipment list that is provided for field team reference (Note: this list may not be fully inclusive and should only be used as a guide):

- Electronic water-level meters.
- Multichannel data loggers.
- Transducers with Teflon-coated line for each transducer.
- Watches that read to the nearest second.
- Appropriate field forms.
- Flashlights.
- Adequate lighting for night work.
- Submersible 5-, 10-, and 15-gal/min Grundfos (or equivalent pumps) with a minimum of 100 feet of discharge line.
- Transfer pump and tank (200 to 250 gallon capacity).
- 240-volt, 30-amp generator, extension cords, and gas can.
- Low-flow sensor and flow/totalizer meter.
- Fuel cans.
- Rain gauge.
- 6,500 gallon capacity Baker tank.
- Laptop computer.

- Aquifer-testing software and Printer.
- Graduated, 3 to 5 gallon bucket.
- Miscellaneous tools and fittings.

5.3.6.4 Production Well Pumping Test

Two supplemental tests will be performed to evaluate aquifer interconnection through pumping of the production wells and measurement of the response in nearby wells completed in the BAL and BAU units. Because of the lack of physical control of the pumping rates, and wide completion interval of the production wells, no attempt will be made to determine aquifer zone properties from the production well pumping tests. The primary goal will be to evaluate the degree of relative response in particular aquifer zones to production well pumping.

Two tests are planned that include; 1) Pumping of Production Well 2 with monitoring of new wells RI-MW1-BAL, RI-MW8-BAU, existing well BAMW-3, and RI-MW2-BAL and 2) Pumping of Production Well 1 and/or Production Well 3 with monitoring of new well RI MW13-BAU (to be located adjacent to Production Well 1) and BAMW-1, (where there was previously a hydraulic response reported during the URS [2011] production well tests), and RI-MW2-BAL. During these tests, the production wells will be cycled on and run for a period of 2-3 days (constant rate) with water level data logger measurement in selected monitoring wells identified above.

The applicable procedures described above for constant rate and recovery tests will be utilized in support of each production well pumping test. Drawdown and recovery will be measured and evaluated in the monitoring wells only.

5.3.6.5 Stormwater Pond Drawdown Test

The objective of the stormwater pond drawdown test is to evaluate the degree of interconnection between surface water and the underlying bedrock.

This test will utilize the water-level data loggers to be installed within the stormwater pond and within the newly proposed monitoring well cluster RI-MW2-BAU/RI-MW2-BAL described as part of the water-level data logger study above (refer to Section 5.3.6.4). The mass balance of water inflow and outflow will be assessed based on volume of water contributed by stormwater and groundwater collection systems, and records of periodic pumping of water from pond to the industrial sump.

The stormwater pond drawdown test is recommended to be performed during the “dry” season to minimize potential for stormwater influx during the test providing for measurement of drawdown response in the adjacent monitoring wells screened in the BAU and BAL aquifer zones.

The data logger/transducer placed within the stormwater pond to collect continuous (15-minute intervals) water-elevation data will be secured within a stilling well. The stilling well will be installed at a sufficient depth so that the data logger will remain submerged beneath the water surface at all times during the test. The top of the stilling well will be surveyed similar to the newly installed monitoring wells so that pond water elevation can be directly correlated to groundwater elevation measurement data.

The drawdown test will be initiated by instantaneously pumping water out of the pond to significantly lower the water level (i.e., head) for measured response in the adjacent monitoring wells. Pumping of pond water will be performed using the existing facility pump and discharge system(s) used in support of the current NPDES permit. Pumping rates and duration of pumping required to adequately lower the pond water level will be calculated and compared to current facility pump system capacity and NPDES limit requirements and specifications. Ideally, the drawdown test would be performed during a single pumping event, but may require periodic pumping depending on existing system and permit capacity.

The water elevation data collected in support of this test will be evaluated as part of the water-level data logger study described in Section 5.3.6.4 above.

5.3.7 Trenching and Test Pit Excavation

Shallow trenches and test pit excavations are proposed to characterize subsurface soil conditions and qualitatively determine the type of wastes that may be present in particular areas, as well as to determine the lateral extent of wastes as encountered. The physical characteristics of encountered waste materials will be described and these observations will be used to categorize the wastes.

The Performing Contractor will take measures to avoid unnecessary disturbance to wetland areas (specifically the NESI investigation area, part of SWMU 31). The gravel access roads and non-wetland areas will be used to the maximum extent practicable for access and positioning of excavation equipment. For trenches and test pits currently situated near the margin of wetlands, the trenches and test pits will be shifted out of the wetland area as much as practicable as long as the full thickness of waste and soil contamination can be adequately characterized. Soils from excavations near the edges of wetlands will be temporarily stockpiled in the adjoining buffer area, rather than in the wetland footprint to the extent practicable.

All trenching and test pit excavations in the NESI area will include cultural resources monitoring by a qualified archeologist in accordance with the CRMP included as Appendix B to this plan.

Soil sample collection and handling procedures are discussed in Section 5.3.13. Trench and test pit surveying requirements are described in Section 5.3.12. Trenching and test pit construction, as well as waste identification and categorization protocols are described in the following sections.

5.3.7.1 Trench and Test Pit Construction

Exploratory trenches will be excavated using a backhoe-loader. The width of the excavation will equal width of the backhoe bucket (about 3 feet) and will extend to a depth of up to 4 feet deep. The lateral extent for individual trenches will depend on area-specific conditions, but may extend for more than 100 feet should waste materials be encountered.

At least one test pit will be excavated at each trench location, unless contaminated soils or wastes aren't found or the total thickness of waste is penetrated by the trench. For trenches completed in waste that are over one hundred feet in length, two test pits will be excavated to better establish the waste thickness along the trench transect. Test pit excavations will be installed to determine the vertical extent of wastes, to provide characterization of smaller suspected areas of waste accumulation, and to provide characterization of the vertical extent of contamination in soil below the waste. Each test pit will extend to a depth of three feet below encountered waste unless bedrock is encountered. The maximum depth of characterization will be about 15 bgs based on the reach of the excavator.

Waddles, hay bales, and/or short section of silt fencing will be placed on the down slope side of trenches as appropriate to prevent the migration of contamination if the excavation is left open overnight or if rain is forecast. All excavated soils will be stockpiled temporarily on plastic sheeting. Temporarily stockpiled soils/wastes will be covered if left overnight.

The potential generation of dust will be closely monitored during project excavation activities. If necessary, a water truck will be used as needed for dust suppression at the site. Watering activities associated with the soil excavation activities will be performed based on visible dust or exceedances of the particulate monitoring action levels specified in the health and safety plan.

At the completion of trenching and/or test pit installation, all excavations will be backfilled with the excavated materials and compacted and graded using the excavator.

5.3.7.2 Waste Recognition, Categorization, and Logging Protocols

Two SWMUs, including SWMU 17 (East End Landfill) and SWMU 31 (Smelter Sign/NESI Area) have been identified with the potential for encountering SPL, a listed hazardous waste, as well as other aluminum process wastes that include anode or other carbon wastes, cryolite and alumina waste, and potential scrubber sludges. For this reason, a waste recognition, categorization, and sampling approach has been developed for these two SWMUs.

Waste Recognition

A technical memorandum regarding definition and recognition of SPL wastes is included as Appendix D to this plan, and will be used to help confirm the presence and/or absence of SPL (K088) wastes, as well as to provide basis for roughly estimating the quantity of SPL waste. All field staff performing sampling at these SWMUs will have participated in spent potliner recognition training before the start of field activities. An expert on aluminum waste recognition will be present onsite to conduct the initial training and to help confirm initial waste identifications and sample selections.

Waste Categorization and Logging Protocols

The lithology of each trench will be continuously logged consistent with the Unified Soil Classification System (USCS) as described in ASTM Method 2488 Visual-Manual Procedure. The presence and depth of potentially impacted soils from field observations and field screening will be recorded. Field observations regarding the physical characteristics of the waste will be recorded including the following as appropriate: color, odor, texture, density, evidence of crystallization/salt-like encrustations, labeling on metal and other debris, grain-size, hardness, evidence of sheen, and field screening results for the health and safety program (e.g., PID readings for volatile vapors, particulate air readings for dust, and iBRID™ meter readings for aluminum reduction-related constituents such as hydrogen cyanide gas). The presence or absence of water in all excavations will also be recorded including the depth of any water encountered.

The Performing Contractor will document and obtain digital photographs of the types and quantities of solid waste encountered within each trench or test pit. For each test pit and/or trench, a log showing the materials and categories of wastes encountered will be prepared. The Performing Contractor will use the following categories of waste on the field forms:

- **Suspected SPL (K088) wastes** will be identified through the use of the recognition memorandum and field-training. The materials may be identified from other carbon wastes by its blue-gray color, recrystallization, presence of salt-like encrustations, and co-occurrence with brick. Spent potliner can superficially resemble weathered basalt, but may be distinguished be its lower hardness and dull sound when struck by a hammer.

- **Anode carbon wastes.** These wastes are commonly cobble or boulder-sized blocks of carbon that may show evidence of drilling. Anode wastes will be profiled if they are encountered in association with suspected SPL wastes.

- **Coke and pitch carbon wastes**. Briquettes and other source materials used in construction of the pots and anodes can contain elevated PAH concentrations and will be profiled if they are encountered in significant quantities.

- **Bricks.** The presence and color of brick will be noted as well as its association with carbon materials. Both fire (red) and insulating (yellow or white) brick were reportedly used in facility operations. According to facility personnel, red brick is more likely associated with potliner wastes. White brick was reportedly associated with cast house operations.

- **Cryolite and alumina wastes**. These fine-grained white or gray materials represent bath materials and ore-derived materials placed in the pots. These wastes commonly contain fluoride in addition to alumina. Fluoride can represent a COPC for groundwater.

- **Metal debris.** Miscellaneous metal debris (e.g., piping, crusted drums, metal sheeting) that may have been disposed with other wastes.

- **Electrical equipment such as transformers or capacitors.** Discovery of potential transformers or capacitors will be reported as soon as practical to Lockheed Martin and CDM. Based on review of previous environmental reports, it does not appear likely that transformers or capacitors will be encountered. Handling and characterization of such wastes is beyond the current scope of this plan.

- **Potential asbestos-containing materials** including such items as roofing materials, insulation, and siding will be noted in the trench and test pit excavation logs.

- **Scrubber sludges.** Based on process knowledge, these materials are not expected at the Smelter Sign Area, but may be recognized in the field by their fine-grained nature and steel-gray to dark-brown/black color. If significant quantities of these wastes are found, a sample will be collected and analyzed for PAHs.

- **Undifferentiated or mixed carbon wastes**. It is anticipated that the origin of some carbon wastes will unable to be identified with confidence in the field or that other carbon materials (e.g., anode wastes) will be mixed with spent potliners. Chemical sampling will be conducted of wastes in this category. If wastes in this category cannot be reliably segregated and screened from SPL materials, they will be treated as spent potliner wastes for remediation purposes. Sampling of mixed carbon wastes is one of the main waste types targeted by the proposed sampling program.

- **Fill.** The presence of soil (silt, clay, sand, and gravel) and bedrock (basalt cobble and boulder) fill materials will be noted where encountered and distinguished from waste materials used as fill. Soil fill material is suspected beneath the lawn and on the south-facing slope above the railway spur. Basalt cobble fill is suspected in the bench area.

For each excavation and subarea of the site, the rough volume of the identified waste categories will be estimated in the field to support the rough order-of-magnitude estimation of the waste categories (e.g., RCRA-listed wastes, Washington State Dangerous and Extremely Dangerous Wastes, and non-hazardous wastes). These quantities will be needed for future evaluations of remedial alternatives and associated costs.

5.3.8 Unconsolidated Soil Sampling

Unconsolidated surface and subsurface soil sample collection procedures are described in the following sections. For unconsolidated soil, a lithologic description of each soil interval will be logged consistent with the Unified Soil Classification System (USCS) as described in ASTM D-2488-00 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM 2000). General descriptive information will include color, predominant particle size, percent of gravel, sands, and/or fines, description of grading or sorting, moisture, and evidence of staining or odor.

Soil samples will be selected for analysis based on field screening observations which indicate suspected signs of contamination (e.g., staining, odor, stressed vegetation).

5.3.8.1 Surface and Shallow Subsurface Soil Sample Collection Procedures

Surface and shallow subsurface soil samples will be collected using the following procedures:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below). Remove any existing vegetation layer and surface debris (e.g., stones, twigs, leaves) from the specific sample location. Record surface conditions in log book.

- A clean stainless steel 2-inch diameter hand-auger will be used to collect discrete shallow (0 to 5 feet bgs) subsoil samples. Surface soil samples can be collected with any clean stainless steel sample device (e.g., spoon, trawl), including a hand-auger.

- Collect soil samples in order of volatilization (i.e., volatile organic compounds first). Samples for VOC analysis will be collected by placing soil directly from sample device into appropriate, pre-labeled sample container(s) with zero head space and securely fasten lids.

  For non-VOC samples, place the soils in a clean stainless steel bowl and homogenize completely using a clean stainless still spoon. Collect the homogenized sample directly from the bowl into appropriate, pre-labeled sample container(s) and securely fasten lids.

- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0^o to 6^o C for the duration of sampling and transportation to the laboratory.

- Record all sample collection information (e.g., location, sample identification, sample type, sample characteristics, etc.) in the field logbook (refer to Section 5.3.19).

- Follow sample custody and handling procedures as described in Section 5.3.14.

- Decontaminate all soil sampling equipment between sample locations according to the procedures described in Section 5.3.17.

5.3.8.2 Subsurface Soil Sample Collection Procedures

Subsurface soil samples may be collected using drilling or excavation (e.g., test pit) techniques as described below.

Hollow-Stem Auger and Direct-Push Soil Borings

Borings for unconsolidated subsoil sampling will be advanced using a truck-mounted hollow-stem auger drill rig equipped with 4.25-inch i.d. hollow-stem augers. Some of the borings completed in unconsolidated soils may also drilled using a direct-push drilling rig depending on subsurface conditions and the degree of planned continuous logging. Sample collection procedures are generally similar between the two drilling methods with the exception that the direct-push drilling method uses a different sample collection tooling and that standard penetration tests as described below will not be performed. Relatively undisturbed subsoil samples will be collected at 5-ft sample intervals using the Standard Penetration Test procedure split-spoon method unless otherwise specified in the sampling scheme for specific SWMUs and AOCs (refer to Sections 5.1 and 5.2). Sample material will be selected for laboratory analysis based on field screening observation as previously described. The rationale used for sample selection will be recorded in the field logbook and/or on field boring log, including field screening results. Subsoil samples will be collected at each boring location using the following procedure:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below).
- Drive a clean, standard, 18-inch long, split-spoon sampler equipped with 1.5-inch diameter brass or stainless-steel sample liners, into the soil a distance of 18 inches at the chosen depth interval, using a 140 lb hammer, free falling 30 inches. Record the number of blow counts on the field boring log.
- The drillers will relinquish the unopened sampler to the sampling crew when a split-spoon sample is collected. The drillers' gloved hands should never come in contact with the sample liners. Place the sampler on a clean, flat surface such as a stainless-steel pan or oil-free aluminum foil covered surface, and separate the two halves of the split-spoon.
- For detecting the presence of VOCs, neatly cleave the soil between adjacent liners with a clean stainless-steel trowel or knife and insert the tip of a photoionization detector (PID) between adjacent liners in the split-spoon sampler immediately upon retrieval and separation of the sampler. Record the PID response on the boring log. Record the total sample recovery on boring log.
- Place soil directly from the split-spoon sample device into appropriate, pre-labeled sample containers using a clean stainless steel spoon and securely fasten lids (samples for VOC analysis should be filled with zero head space). Immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0^{o} to 6^{o} C for the duration of sampling and transportation to the laboratory.

- Record soil sample characteristics on the field boring log. Record all sample collection information (e.g., location, sample identification, sample type, depth collected, etc.) in the field logbook or in the field boring log as described in Section 5.3.19.

- Follow sample custody and handling procedures as described in Section 5.3.14.

- Decontaminate all soil sampling equipment between sample locations according to the procedures described in Section 5.3.17.

Trenches and Test Pits

Test pits will be excavated using a backhoe excavator and licensed operator. Relatively undisturbed subsoil samples can be collected either directly from the backhoe bucket or from within excavations that are less than 4 feet deep. Sample material will be selected for laboratory analysis based on field screening observation as previously described. Waste recognition and categorization will follow the procedures outlined in Section 5.3.7 and in Appendix D.

The rationale used for sample selection will be recorded in the field logbook and/or on field boring log, including field screening results. Subsoil samples will be collected at each test pit location using the following procedure:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below).

- Collect soil samples in order of volatilization (i.e., volatile organic compounds first). Samples for VOC analysis will be collected by placing soil directly from the backhoe bucket or excavation walls using a clean stainless steel spoon or trawl into appropriate, pre-labeled sample container(s) with zero head space and securely fasten lids.

  For non-VOC samples, place the soils in a clean stainless steel bowl and homogenize completely using a clean stainless still spoon. Collect the homogenized sample directly from the bowl into appropriate, pre-labeled sample container(s) and securely fasten lids.

- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0^{o} to 6^{o} C for the duration of sampling and transportation to the laboratory.

- Record all sample collection information (e.g., location, sample identification, sample type, sample characteristics, etc.) in the field logbook (refer to Section 5.3.19).

- Follow sample custody and handling procedures as described in Section 5.3.14.

- Decontaminate all soil sampling equipment between sample locations according to the procedures described in Section 5.3.17.

5.3.9 Columbia River Sediment Sampling

The investigation rationale, including proposed sediment sample station locations and laboratory analytical program for the Columbia River Sediment AOC is summarized in Section 5.2.1. The sampling effort includes collection and analysis of surface sediment samples represented by the BAZ (0 to 6 inches). For this reason, a van Veen grab sampler is proposed for collecting surface sediments to the extent feasible. Collecting surface sediment using a van Veen grab sampler or equivalent causes minimal disturbance to the surficial layer while providing sufficient capacity for collecting larger volumes of sediment. Downstream stations within a spatial group will be collected first to eliminate potential effects from suspended sediment caused by sampling.

Surface sediment collection and processing will follow standardized procedures for the Puget Sound area that have been developed by Puget Sound Estuary Program (PSEP 1997a,b), as well as guidance for implementing the cleanup provisions of the SMS, Chapter 173-204 WAC and SCUM II guidance (Ecology 2015c).

Surface sediments will be collected from a sampling vessel at each location shown in Figures 5.2.1-1 and 5.2.1-2 using a 0.1-m^2 van Veen grab sampler or equivalent, if feasible. Some locations may be too shallow or otherwise inaccessible from the sampling vessel, in which case surface sediments will be sampled from a small, low-draft vessel using a smaller Ponar™ grab sampling device, or equivalent. The surface sampling method is consistent with PSEP (1997a,b) protocols and EPA Methods for Collection, Storage, and Manipulation of Sediment for Chemical and Toxicological Analyses: Technical Manual – Chapter 3 (EPA 2001). Both of these guidance manuals recommend collection of surficial sediment samples by van Veen grab sampler or similar.

Equipment required for Columbia River sediment sample collection includes the following:

- van Veen Bottom Grab sampler (0.1 m, stainless steel with frame).
- Hydraulic winch with power source.
- Hydrowire (or approved alternative), swivels, and shackles for sampler.
- Metal floats (to adjust sampler penetration, if necessary).
- Teflon® or Tygon® tubing and suction bulb (decanting water from sampler).

- Stainless-steel bowls or buckets, spoons, or scoops.
- Tools for assembly and disassembly of equipment.
- Sampler tray (large, flat plastic or metal tray used to stabilize sampler during sampling and to contain sediment emptied from sampler).
- Decontamination equipment.

Sediment sample station locations will be surveyed and sample depths recorded as specified in Section 5.3.12. Columbia River surface sediment samples will be collected using the following preparation and procedure:

Preparation

- Move sampling equipment and supplies to work vessel and assemble van Veen bottom-grab apparatus. The hydrowire should be attached to the sampler using a ball-bearing swivel or similar hardware to minimize twisting forces during deployment and retrieval. For safety, the hydrowire, swivel, and shackles should have a load capacity at least three times the weight of the sampler. After assembly, secure the van Veen sampler by placing it in the sampler tray and releasing the tension on the hydrowire.

  Note: The van Veen sampler should always be secured when the work vessel is in motion.

- Move work vessel to sampling location and anchor or hold on station using GPS data and navigation system.
- Record necessary data in field logbook including date, time, and sampling station coordinates.

Procedure

- Lock the sampler open with the safety pin and position over sampling location.
- Remove the safety pin, keeping hands and fingers outside the sampler. Deploy the sampler using the hydraulic winch and an overhead davit or boom. The sampler should be lowered at a controlled rate of speed approximately equal to 1 ft/sec.

  Note: Under no circumstances should the sampler be allowed to "free fall" to the bottom, as this may result in premature triggering, an excessive bow wake, or improper orientation of the sampler.

- After the sampler has triggered (check for stack wire), enclosing a sediment sample, retrieve the sampler at a controlled rate of speed approximately equal to 1 ft/sec.

- Lift the sampler carefully on board the work vessel and secure in large, flat pan or stand. Be careful not to swing or tip the sampler during retrieval.

- Open the sampler and evaluate the sample acceptability using the PSEP protocol. The following acceptability criteria should be satisfied:

  1. The sampler is not over-filled so that sample is pressing against the top of the sampler.

  2. Overlying water is present (indicates minimal leakage).

  3. The overlying water is not excessively turbid (indicates minimal sample disturbance).

  4. The sediment surface is relatively flat (indicates minimal disturbance or winnowing).

  5. The desired penetration depth was achieved (6- to 8-inches deep surficial sample depth). Penetration depth may be limited based on substrate type/conditions at individual station locations.

- Remove the water overlying the sediment sample. The preferable method for removing the water is by slowly siphoning it off near one corner of the sampler.

- Record the physical description of the sample in the field logbook. This description should include:

  1. Gross characteristics of the surficial sediment such as texture, color, biological structures present (shells, tubes, macrophytes), debris present (wood chips, wood fiber, human artifacts), oily sheen present on the sample, and odor.

  2. Gross characteristics of the vertical sediment profile, such as changes in any of the surficial characteristics listed above.

  3. Penetration depth for the sample.

  4. Comments related to sample quality such as leakage when the sampler retrieved, the presence of winnowing, or visible disturbance of the sediment.

- Photograph the sediment.

- Remove any unrepresentative material from the sediment using a stainless-steel spoon or scoop and record this action in the field logbook. The types of materials considered unrepresentative should include large pieces (greater than 2 inches in diameter) of wood/bark, large shell fragments, man-made artifacts, and rocks.

- Don a clean pair of unpowdered (zinc-free) disposable gloves and collect the top 6 inches of sediment using a clean stainless steel spoon or scoop. Avoid contact with the sides of the sampler and do not touch the sediment sample with ungloved hands.

- Place the sediment collected in a stainless-steel bowl or bucket and cover immediately with aluminum foil to prevent air borne contamination.

- Empty the van Veen sampler and repeat the sampling procedures until sufficient sediment is obtained for all required analyses. Be sure to record the total number of grabs taken at the sampling site.

  Note: Excess sediment (and rejected sample) from the sampler should be carefully placed back into the water as far away from the sampling location as possible.

- When sufficient sample has been obtained, gently homogenize the sediment grabs by carefully stirring with the sampling spoon/scoop. The finished composite should be uniform in color and texture.

  Note: Discrete sample for analysis of volatile constituents (if any) will be collected from the first acceptable grab prior to removing sediment from the sampler. These samples should have zero headspace.

- Transfer the sediment to appropriate sample containers using a stainless steel spoon, scoop, or spatula, and seal.

- Label and manage the sample containers in accordance with Section 5.3.13 and Section 5.3.14 for shipping and handling of samples.

- Decontaminate the van Veen sampler, Teflon® tubing, and sampling tools; secure the sampler; and move the work vessel to the next sampling location.

  Note: The van Veen sampler should always be decontaminated prior to leaving a sampling station to begin work at a new station (refer to Section 5.3.17). This prevents transport of sediments between the stations.

5.3.10 Stormwater Pond and Stormwater System Sampling

The rationale for stormwater sampling, including proposed locations for stormwater sample collection and associated analytical program is provided in Section 5.1.31. Procedures for sampling the Stormwater Pond, stormwater catch basins, and stormwater discharge point(s) are discussed in the following sections.

5.3.10.1 Stormwater Pond Sampling

Stormwater Pond sampling will include collection of both pond sediments and standing water using the following procedures.

Stormwater Pond Sediment Sampling

A small aluminum boat or pontoon-style raft will be used to access the Stormwater Pond for measurement and sediment sample collection. All in-water work must comply with the HASP (Attachment A to this plan), including required personal protective equipment (PPE) and training for in-water work. The elevation of the pond, and coordinates for pond soundings and sediment sample station locations will be measured and recorded using the land surveying techniques described in Section 5.3.12.

Standing Water and Soft Sediment Measurements. Prior to sediment sample collection, the pond will be sounded using a calibrated staff or an 8-pound mushroom-style anchor and calibrated anchor line depending on pond depth and conditions at time of inspection. Pond depth measurements will be collected and recorded along two transects, include the longitudinal and transverse pond axis. A hand-mounted, battery-operated depth sounding device may also be used to provide quick bottom reference and profile cross-check information.

In addition, a qualitative survey of soft sediment thickness will be performed along the same axes used to measure water depth. An extendable, calibrated 1-inch diameter pole (15 feet maximum length) will be slowly lowered to the top of the sediment surface (mud-line) where accessible. The intersection of the water-line will be noted on the pole and arm pressure will be applied to advance the pole into existing soft sediments. Sediment thickness (i.e., distance pole driven below mud-line) will be measured and recorded to 0.1 foot. This information will be used in part to help pre-determine appropriate sediment sample location stations.

Pond Sediment Sample Collection. Pond sediment samples will be collected using a clean stainless steel Ponar™ grab sampler, or equivalent clam-shell type grab sample device. The procedure for pond sediment grab sampling is as follows:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below).
- Once the boat is properly positioned over station, the sampling device will be opened and trip-pin inserted. The sampler will be held out away from the boat by the attached retrieval line and released to free-fall to the pond bottom.
- Upon reaching the pond bottom the retrieval line will go slack and the grab sampler should be immediately retrieved by hand and placed securely in the boat.

- Any overlying water (if present) within the grab sampler will be carefully siphoned off prior to sediment sample collection.

- Collect sediment samples in order of volatilization (i.e., volatile organic compounds first). Samples for VOC analysis (if any) will be collected by placing sediment directly from the grab sampler using a clean stainless steel spoon into appropriate, pre-labeled sample container(s) with zero head space and securely fasten lids.

- Typically, a minimum of three individual sub-samples will be required from each station location to provide an adequate sediment volume for laboratory analysis other than VOCs. Debris encountered in the sub-samples (e.g., gravel-size or greater particles, wood fragments, and vegetation) will be carefully removed prior to composition of the sample material. Once the debris (if any) has been removed, sediment will be collected from the grab sampler using a clean stainless steel spoon, and placed into a clean stainless steel bowl for compositing. Excess sediment (and rejected sample) from the sampler should be carefully placed back into the water as far away from the sampling location as practical.

- The material collected within the stainless steel bowl will be thoroughly mixed with the stainless steel sample spoon and placed directly into pre-labeled sample container(s) and securely fasten lids.

- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0^{o} to 6^{o} C for the duration of sampling and transportation to the laboratory.

- Record all sample collection information (e.g., location including latitude and longitude, sample identification, sample type, sample characteristics, etc.) in the field logbook (refer to Section 5.3.19).

- Follow sample custody and handling procedures as described in Section 5.3.14.

- Decontaminate all sediment sampling equipment between sample locations according to the procedures described in Section 5.3.17.

If representative sediment grab samples cannot be collected using the above procedure, a hand-driven coring device will be used in attempt to collect representative pond sediment samples. The coring device will consist of a 1.5-inch or smaller diameter drive tube with acetate liner that will be hand-driven into pond sediments. Once collected, sediment from the core sampler would be processed and handled using the same procedures described above.

Stormwater Pond Water Sampling

Surface water sample(s) will be collected directly from the Stormwater Pond using the following procedure. Care will be taken not to suspend sediment in the water prior to or during sampling. A

Wheaton™ surface water sampling device (or equivalent) will be used to collect representative water samples from below the pond water surface using the procedure below.

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below). Inspect surface water conditions (e.g., sheen or discoloration) and record information in the field logbook or on a field data sheet.

- Collect a water sample for field water quality measurements, including temperature, pH, specific conductivity. Record all field measurement data in field logbook or on a field data sheet.

- Collect surface water samples: 1) slowly lower the Wheaton™ sampler with attached sample bottle below the water surface, 2) remove sample bottle cap and fill, 3) recap the sample bottle below the water surface, and 4) retrieve sample. Fill surface water sample containers in the order of volatilization sensitivity (i.e., VOCs samples first, then other organic compound samples, and inorganic samples last). In particular, VOC sample containers should be carefully filled to minimize turbulence and aeration, and must be absolutely free of bubbles, with no headspace. Exercise care to not overfill sample containers containing preservatives (HCl for VOCs, HNO_3 for metals). Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 0^o to 6^o C for the duration of the sampling and transportation period.

- Record all sample collection information (e.g., location, sample identification, sample description, depth collected, etc.) in the field logbook or on a data sheet as described in Section 5.3.19.

- Follow sample custody and handling procedures as described in Section 5.3.14.

- Decontaminate all surface water sampling equipment between sample locations according to procedures described in Section 5.3.17.

5.3.10.2 Stormwater Catch Basin Sampling

Stormwater catch basin sampling, including both sediment and water sample collection is discussed in Section 5.1.31. Catch basin sediment samples will be obtained using a long handle dipper to reach the bottom of the basin. The dipper bowl will be dragged on the bottom of the basin to capture the settled and representative sediment material. The sample will be obtained directly from the dipper bowl upon removal of the basin. The process will be repeated as necessary to fill all sample bottles following the sample collection procedures for surface and shallow subsurface soils outlined in Section 5.3.8.

Stormwater catch basin water samples will be collected and handled in the same manner as water samples collected from the Stormwater Pond as previously described in Section 5.3.10.1.

Samples will be collected using new and disposable equipment. Upon completion of the sampling event, the sampling equipment will be disposed following IDW handling procedures described in Section 5.3.18.

5.3.10.3 Stormwater Sampling from Discharge Piping

Stormwater discharge from existing piping will be sampled directly into appropriately labeled and pre-preserved (as appropriate) sample containers using the following procedures:

- Label the appropriate sample containers with all necessary information (refer to Section 5.3.13 below).
- Collect stormwater samples in order of volatilization (i.e., volatile organic compounds first). Samples for VOC analysis (if any) will be filled directly into pre-labeled, pre-preserved VOA sample containers, with care taken to minimize turbulence. The VOA containers will be filled completely to eliminate any headspace, and the seal/lid will be secured.

  Dissolved metals (if any) will be filtered in the field using a 0.45 micron disposable, in-line filter. Care will be taken not to overfill pre-preserved sample containers as to help maintain proper pH control.
- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of 0º to 6º C for the duration of sampling and transportation to the laboratory.
- Record all sample collection information (e.g., location, date and time sampled, and preservative(s), if any, in the field logbook and/or on appropriate field forms (refer to Section 5.3.19).
- Follow sample custody and handling procedures as described in Section 5.3.14.

5.3.11 Wetlands Sampling

Thirteen wetlands are identified for surface soil/sediment sample collection as discussed in Section 5.2.3. Wetland surface soils will be collected using a clean, stainless steel, hand-auger device following the sample collection procedures for surface and shallow subsurface soils outlined in Section 5.3.8. If use of a hand auger is impractical due to the presence of water, a manually operated clan-shell style sediment sampler (e.g., Ponar™ grab sampler) will be used following the same procedures outlined in Section 5.3.10 for pond sediment sample collection.

5.3.12 Surveying

Surveying activities will include land surveying of newly installed monitoring wells and RI sample station locations, including the location and depth of sediment samples collected in support of the Columbia River Sediment AOC.

5.3.12.1 Land Surveying

Land surveying activities will include use of a hand-held global positioning systems (GPS) for routine recording of sample station locations, and use of a State-licensed land surveyor for establishing vertical and horizontal coordinates of all newly installed monitoring well.

Surface Soil and Soil Boring Sample Station Location. The horizontal coordinates for investigation surface soil samples and soil borings will be located using a high-accuracy (e.g., Trimble® GeoXH™ GeoExplorer®) hand-held GPS device. Sample and boring location coordinates and measurement datum will be recorded in the field log book at time of collection.

Monitoring Well Location. The newly installed wells and a subset of existing wells (refer to Section 5.2.2) will be surveyed by a State of Washington Licensed Surveyor. Well location, top of casing, and ground surface elevations will be surveyed to Washington State Plane Coordinates (NAD 83) (in both International Survey Feet and United States Survey Feet) and the National Geodetic Vertical Datum, respectively. The wells will be surveyed with vertical and horizontal accuracies of 0.01 foot and 0.1 foot, respectively.

Trenches and Test Pits. The vertical and horizontal coordinates of test pits, trenches, samples, and waste locations will be documented by use of a handheld Trimble GPS unit enabled to receive the Wide Area Augmentation System (WAAS) or U.S. Coast Guard differential corrections. The WAAS enhancements produce positioning accuracy to within three meters. Washington State Plane coordinates North (NAD83) will be used for the horizontal datum. All depth measurements will be taken with a calibrated tape in the field. The depth elevation of all trenches, test pits, soil sample locations, and waste materials will be reported by subtracting the field measured depths from the recorded land surface elevations.

5.3.12.2 Columbia River Sediment Sample Station Survey

Target sample locations will be located using a Trimble Ag132 differential global positioning system (DGPS) or equivalent. The DGPS includes a GPS receiver unit onboard the sampling vessel and a Coast Guard differential beacon receiver. The GPS unit will receive radio broadcasts of GPS signals from satellites. The Coast Guard beacon receiver will provide differential corrections to the GPS, providing positioning accuracy to within approximately one meter. Northing and easting coordinates will be processed in real time and stored at the time of sampling using the HYPACK software package. Washington State Plane Coordinates, North (NAD 83) will be used for the horizontal datum. The water depth at each sampling location will be measured using an onboard depth finder or 8-pound mushroom anchor.

A handheld Trimble GPS unit enabled to receive the Wide Area Augmentation System (WAAS) or U.S. Coast Guard differential corrections will be used during sampling in areas that cannot be sampled from the primary sampling vessel. The WAAS enhancements produce positioning accuracy to within three meters. Washington State Plane coordinates North (NAD83) will be used for the horizontal datum.

5.3.13 Sample Handling

Samples will be placed into the appropriate containers prepared for the specified analysis as described in the QAPP (refer to Section 6.4, Table 6-5). After filling to the top without allowing overflow, the containers will be tightly capped with the provided lids. The containers will then be labeled, wrapped with bubble wrap shipping material, and stored on ice in a thermally insulated shipping container until delivered to the analytical laboratory. Each sample within a shipping container will be listed on a Chain-of-Custody (CoC) record for that container (see Section 5.3.14). The samples will be packaged and transported in a manner that maintains proper sample custody, temperatures, and integrity. Sample containers, sample identification systems, and sample packaging and shipping are discussed below.

5.3.13.1 Sample Containers and Preservation

Sample containers are purchased pre-cleaned and treated according to EPA specifications for the methods. Sample volumes, container types, and preservation requirements for project-specified analytical methods are listed in Section 6.4 and Table 6.5 of the QAPP. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for project-specified analytical methods are also included in Table 6-5 of the QAPP.

Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

5.3.13.2 Sample Identification

A sample identification number that uniquely identifies each sample will be assigned at the time of sample collection. Sample identification numbers will be designated by either two-part or three-part codes depending on their location and sample types. The first part of the code includes site designation of the SWMU or AOC. SWMU-specific samples will be given the unique SWMU identification number (e.g., SWMU01 = NPDES Ponds). For AOCs, an abbreviation will be used as follows:

- Wetlands AOC = WLAOC.
- Rectifier Yard AOC = RYAOC.
- Groundwater in the Upper Most Aquifer AOC = GWAOC (Note: groundwater samples will be identified using existing and newly installed well nomenclature – see below).
- Columbia River Sediment AOC = CRSAOC.
- Plant Area AOC = PAAOC.

The second part of the code includes the media-specific sample type and sample sequence as follows:

- Surface Soil Sample = SS (SS01 or SS-01).
- Soil Boring Sample = SB (SB01 or SB-01).
- Test Pit Soil Sample = TP (TP01 or TP-01).
- Sediment Sample = SED (SED01 or SED-01).
- Stormwater Sample = ST (ST01 or ST-01).
- Surface Water Sample = SW (SW01 or SW-01).

- Groundwater Sample = Groundwater samples will be identified using the existing well identification number (e.g., MW-8A). For newly installed wells, identification will include a unique designation (e.g., RI-MW01).

An example of a two-part sample identification for a Columbia River sediment sample is presented below:

CRSAOC-SED01

where:

CRSAOC:	Denotes the site designation
SED01:	Uniquely identifies the sample station location

The third part of the code would include additional sample specific information as necessary to distinguish multiple samples collected from a single sample station location. For instance, more than one soil sample might be collected from a single soil boring or test pit location. An example of a three-part sample identification for a soil boring is presented below:

SWMU31-SB01-5.0

where:

SWMU31:	Denotes the site designation
SB01:	Uniquely identifies the sample station location
5.0	Denotes the sample depth in feet below ground surface

Note that for groundwater samples the unique well designation number will be used as follows:

- **Existing monitoring wells**: Multiple well nomenclature is used for existing site monitoring wells, including use of the following designations (MW-1; MW-1A; MW-W1; MW-E1; IB-1; and BAMW-1).

- **Existing piezometers**: PZ01.

- **Existing water supply wells**: Well #1, Well #2, and Well #3.

- **Newly installed monitoring wells**: To distinguish the new monitoring wells installed and sampled in support of the remedial investigation work effort the following three-part designation will be used (RI-MW01-UA, RI-MW01-BAU, RI-MW01-BAL). These wells include a three-part code that designates the aquifer zone in which they are installed, including the unconsolidated aquifer zone (UA), upper basalt aquifer (BAU) and lower basalt aquifer (BAL).

For water and soil/sediment samples, varying container types and sizes with generally one to three containers for each analysis are required. A single sample identification number will apply to all containers of the same sample.

When field duplicate samples are collected, the duplicate samples will be designated using unique sample numbers provided by the Project Manager or Data Management Coordinator. Sample numbers used for blind duplicate samples will be unique, and will be distinguishable from primary sample numbers.

If the sample is a field matrix spike/matrix spike duplicate (MS/MSD) sample, the sample identification is the same and extra volume collected as required. Indicate “MS/MSD” in the comments section of the CoC.

For field blanks, letters are used to denote the type of blank, followed by a sequential number and date, which, at the conclusion of work, indicates the total number of the blank type collected for each day of sampling.

5.3.13.3 Sample Labels

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection. Where necessary, the label will be protected from water and solvents with clean label-protection tape. At a minimum, each label will contain the following information: unique sample location identifier, name of collector, date and time of collection, place of collection, and preservative, if any.

A sample identification label will be affixed to each sample container. In addition, each sample number, date, and time the sample was obtained will be recorded in the field notebook or appropriate data sheet. Other information to be entered on the label shall include the date and time of sample collection, initials of the sampler, sample identification, the analysis to be performed on the sample, and preservatives used, if any.

5.3.13.4 Sample Packaging and Shipping

All samples will be packaged carefully in proper containers at proper temperatures to avoid breakage or contamination, and will either be relinquished to a laboratory courier or shipped to the laboratory. Samples will be packed properly for shipment according to U.S. Department of Transportation (DOT) regulations. Sample bottle lids will not be mixed; all sample lids will stay with the original containers.

The following procedures will be applied for packaging:

- All sample bottles will be wrapped in bubble pack material to minimize the potential for contamination and breakage during shipment.
- When a 6°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during storage and transportation. If ice is used, the ice shall be double-bagged. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. If provided by the laboratory, a temperature blank shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. Alternatively, the laboratory may use an infrared thermometer to measure the temperature of the cooler on receipt.
- Empty space in the cooler will be filled with inert packing material (i.e. bubble-wrap). Under no circumstances will locally obtained material (sawdust, sand, etc.) be used for packing. Newspaper material will not be used.
- The CoC record will be placed in a plastic bag and taped to the inside of the cooler lid.
- All shipping containers will be sealed for shipment to the laboratory. Packing tape will be wrapped around the package at least twice.
- Laboratory-provided custody seals will be attached to each cooler being shipped to the laboratory and affixed in such a manner that the seals will be broken if the cooler is opened. The custody seals will be signed and dated.

5.3.14 Sample Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

Sample custody is maintained by a CoC record form, and the Performing Contractor shall maintain CoC records for all field and field QC samples. The custody record must be completed at the sampling site by the individual designated by the Project Manager or Data Management Coordinator as responsible for sample shipment. A sample is considered to be under custody if:

- It is in the possession of the responsible person.
- It is in the view of the responsible person.
- It is locked or sealed by the responsible person, to prevent tampering.
- It is in a designated secure area.

The following minimum information concerning the sample shall be documented on the CoC form:

- Unique sample identification.
- Date and time of sample collection.
- Sample matrix type.
- Type of container.
- Designation of MS/MSD (if applicable).
- Preservative type (if used).
- Analyses required.
- Signature of collector(s).
- Number of containers.
- The name of the laboratory that the samples are sent to.
- Serial numbers of custody seals and transportation cases (if used).
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories.
- Bill of lading or transporter tracking number (if applicable).

A CoC record is required for each shipping container. The original form will be sent with the container to the testing laboratory. A copy should be promptly returned to the Performing Contractor by laboratory personnel upon receipt of the samples and completion of the form. Copies are retained by the Performing Contractor for the field and office files, and a copy is retained by the testing laboratory.

Field personnel collecting the samples are responsible for the care and custody of the samples until they are properly transferred. All samples will be accompanied by CoC forms. When transferring samples, the individual relinquishing and receiving the samples will sign, date, and note the time on the form, along with the reasons for transference. The person receiving samples will also sign, date, and provide the time of receipt. If a courier is used, the samples are relinquished to the individual delivering the samples, and that person will relinquish the samples to the laboratory when samples are delivered. Unless samples are specified to be held, all samples should be received by the laboratory within 48 hours of the sample collection period or within the specified holding times for the analyses requested.

The individual shipping the containers will record the specific shipping data (e.g., airway bill number) on the original and duplicate records. If sent by mail, the package will be sent by registered mail with a return receipt requested. If sent by common courier, a bill-of-lading will be used. Freight bills, postal service receipts, and bills-of-lading will be retained as part of the permanent project file.

5.3.15 Field QC Program

Multiple field sampling parameters will be collected during the site investigation. Field QC controls will include measurement of these parameters on duplicate samples and, where possible, comparison against historical readings from the same location. Sample representativeness is a function of the sampling design and procedures and the subsequent sample handling procedures designed to maintain the integrity of collected samples. Representativeness will be ensured by using the appropriate sampling and sample handling techniques as presented in Section 5.3 of this Phase 2 Work Plan.

Field QC samples will be collected and analyzed in order to assess the consistency and performance of the sampling plan, and for assessment of overall laboratory and field sampling precision. The data quality objectives established in support of this investigation work effort are outlined in Section 6.0. Field QC, for environmental samples collected for laboratory analysis, will include field duplicate samples, equipment blanks (EBs), and MS/MSD samples. Field QC samples will not be collected for investigation-derived waste profiling samples.

Field QC samples will be collected and analyzed as specified in Section 5.1 for SWMUs and Section 5.2 for AOC, labeled as specified in Section 5.3.13, and evaluated as discussed in the QAPP (Section 6). A description of the type of field QC samples anticipated in support of this work effort is provided below:

- **Equipment Blank (EB)**. The purpose of the EB is to assess the effectiveness of equipment decontamination procedures. EBs may be collected from groundwater sampling equipment used in more than one well (e.g., pumps, bailers, and other equipment used in the field). EBs will not be collected from dedicated sampling pumps. In each case, the blank shall be collected by pouring analyte-free, reagent grade deionized water into or through the equipment, and then transferring the water into sample containers. The EBs are analyzed for the same analytes as all associated environmental samples. The frequency of all EB collections shall be every day that reusable, down-hole sampling equipment is used. The intent is that over time, rinsate blanks will be collected from each type of non-dedicated sampling equipment.

- **Field Duplicate**. A field duplicate sample is defined as a second sample of the same matrix collected independently, at the same location as the original sample during a single act of sampling. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. Groundwater duplicate samples should be collected as “blind” duplicates, where the sample containers are assigned a unique identification number specified by the Project Manager or Data Management Coordinator such that they cannot be identified as duplicate samples by laboratory personnel performing the analysis.

  The field duplicate data are used to assess the precision of the overall sample collection and analysis process. Field duplicate samples will be collected at a frequency of one for every ten field samples (10 percent). The sample and the duplicate will be analyzed for the same parameters.

- **Matrix Spike/Matrix Spike Duplicate**. MS/MSDs are defined as one water sample collected at a single sampling location during a single act of sampling, with triplicate sampling volumes. The MS/MSD samples provide the laboratory with additional sample material for the purpose of performing QC analyses. MS/MSD water samples will be collected at a frequency of one for every twenty field samples (5 percent). The sample and the MS/MSD will be analyzed for the same parameters.

5.3.16 Field Measurements

Field measurements to be collected in support of this remedial investigation includes ambient air monitoring for personnel health and safety, water-level measurements within existing and newly constructed monitoring wells, continuous water-level fluctuation measurement at select monitoring locations during aquifer testing, and water quality parameter measurements during groundwater sample collection. In addition, land surveying will be performed by a state-licensed surveyor at newly constructed well locations as described in Section 5.3.12 above.

Table 5.3.16-1 provides a summary of anticipated field measurement parameters, including instrumentation and instrument calibration requirements. The following sections provide a brief discussion regarding personnel health and safety and environmental field measurements.

5.3.16.1 Health and Safety Monitoring

As required by the site-specific HASP (Appendix A), periodic ambient air quality monitoring will be required when working within areas of known or suspected VOCs and/or areas of known or suspected KO88 wastes. During air quality monitoring, Workers' breathing zone (WBZ) will be monitored for detectable concentrations of chemicals of potential concern (COPC) using a hand-held PID for organic vapors and a MX6 iBRID™ instrument (or similar instrument) that can monitor aluminum reduction-related compounds including hydrogen cyanide, hydrogen sulfide, phosphine, methane, and ammonia. Dust monitoring using a Miniram™ or equivalent will be conducted when visible dust is present and/or during trenching excavation activities primarily due to the potential presence of PAHs in soil.

5.3.16.2 Environmental Monitoring

During groundwater sampling, water quality field parameters including temperature, specific conductivity, pH, DO, turbidity, and ORP will be routinely measured using a multi-parameter water quality meter (e.g., YSI 566™ or equivalent). Water-levels and total well depths will also be routinely measured at individual well locations using an electronic water-level indicator outfitted with a calibrated tape to collect measurements to hundredths of a foot increment. Continuous water-level fluctuation measurements during aquifer testing (refer to Section 5.3.6) will be measured and recorded using calibrated pressure transducers and data logger system (e.g., InSitu Aqua Troll™ or equivalent). Unit measurements and instrument calibration information are summarized in Table 5.3.16-1. General calibration and maintenance considerations for use of field instrumentation are described below.

Table 5.3.16-1
Field Measurement and Instrument Calibration

Field Parameter	Field Instrument	Calibration
Water Quality Parameters		
pH (pH units)	Multi-parameter water quality meter (e.g., YSI 556™ or equivalent) with flow through sample cell	Calibrate instrument to manufacturer specifications on a minimum daily basis prior to beginning of sample collection (recalibrate as necessary).
Specific Conductance (µS/cm or equivalent)		
Temperature (° Fahrenheit or ° Celsius)		
Dissolved Oxygen (mg/L)		
Turbidity (NTU)		
Oxidation/Reduction Potential (ORP Units)		
Air Quality Parameters		
Hydrogen sulfide (µg/m3)	Multi-parameter air quality meter (e.g., MX6 iBRID™ or equivalent)	Calibrate instrument to manufacturer specifications on a minimum daily basis prior to beginning of sample collection (recalibrate as necessary).
Hydrogen cyanide (µg/m3)		
Phosphine (µg/m3)		
Ammonia (µg/m3)		
Methane (Lower Explosive Limit)		
Volatile Organic Vapors (ppm)	Photoionization Detector (PID)	Calibrate instrument to manufacturer specifications on a minimum daily basis prior to beginning of sample collection (recalibrate as necessary).
Airborne Dust (mg/m3)	Miniram™ (or equivalent) dust monitor	Instrument supplied calibrated by manufacturer.
Groundwater Level and Total Well Depth		
Water-Level and Total Well Depth (feet in hundredths)	Electronic Water-Level Indicator (with tape calibrated to within 0.01 ft) and length of 200 ft or greater	Instrument supplied with manufactured calibrated tape.
Continuous water fluctuation measurement and recording (feet in hundredths)	Barometric compensated pressure transducer and data logger (e.g., In-Situ Level Troll™ or equivalent)	Pressure transducers are factory calibrated. Data logger programmed to collect selected water-level information at predetermined frequency and duration.

cm = centimeter
ft = feet
µg/m^3 = micrograms per meter cubed
µS = micro Siemens
mg/L = milligrams per Liter
NTU = Nephelometric turbidity unit

Equipment Calibration

General requirements for equipment calibration and quality control are: 1) following the manufacturer's calibration procedures and frequency for the field tests calibration, 2) using certified standards for calibration materials, 3) the quality control materials and frequency for the field tests, 4) the quality control limits and acceptance criteria for the quality control materials, 5) the acceptance criteria for calibration procedures, 6) the corrective actions for out-of-control events for both calibration and quality control samples, 7) the actions required by field personnel in the event that control parameters exceed the acceptance criteria, and 8) documentation of exceedance of criteria and subsequent corrective actions.

In order to meet project data quality objectives (DQOs), proper calibration procedures for field and laboratory instrumentation will be followed. All instruments and equipment used during data and sample collection activities will be maintained, calibrated, and operated according to the manufacturers' instructions to ensure that the equipment is functioning within established tolerances and as required by the project. Conventional field instruments should be calibrated daily, using standards that bracket the range of probable values, and checked prior to each use. Equipment will be calibrated and maintained in good condition prior to and during use.

Proper maintenance, calibration, and operation of each field instrument will be the responsibility of the field personnel and the instrument technicians assigned to the project. Field equipment will be calibrated prior to use in the field as appropriate. A record of field calibration or calibration checks of analytical instruments will be maintained in a calibration logbook by field personnel. All instruments are to be stored, transported, and handled with care to preserve equipment accuracy. Damaged instruments will be taken out of service immediately and not used again until a qualified technician repairs and recalibrates the instruments.

Copies of the instrument manuals and other equipment calibration records will be maintained by the Performing Contractor. These records will be subject to QC audit. Any notes on unusual results, changing of standards, battery charging, and operation and maintenance of the field equipment will be included in the calibration logbook.

Equipment Maintenance

Maintenance responsibilities for field equipment are coordinated through designated field personnel who are responsible for ensuring that available equipment and instrumentation are ready for use.

Field measurement equipment will be maintained according to the manufacturer's recommended procedures provided in the operations manual for each instrument. All field measurement equipment shall be decontaminated according to the specifications in Section 5.3.17 prior to any measurement activities and shall be protected from contamination until ready for use. Field measurement equipment will be kept clean to ensure accurate performance and reduce cross contamination. Field measurement equipment will be cleaned, stored, and maintained according to the manufacturer's recommendations.

5.3.17 Equipment Decontamination

Equipment decontamination procedures for drilling equipment and general field sampling and monitoring equipment are provided in the following sections.

5.3.17.1 Drilling and Excavation (Test Pit) Equipment

An equipment decontamination area located onsite will be used for drilling and excavation equipment decontamination. A temporary decontamination pad may be constructed at the site with prior client approval.

All equipment that may directly or indirectly contact samples or directly enter a borehole or well casing shall be decontaminated prior to and after each use in a designated decontamination area. This includes excavator bucket, as well as casing, drill rods and bits, sampling devices, and instruments, such as slugs and sounding equipment. The drill rig(s) used for this work effort must be equipped with a self-contained decontamination station to provide for day-to-day decontamination requirements. Drilling equipment will be decontaminated before and after use, and between each distinct sampling location (e.g., borehole, well). The following procedure shall be used to decontaminate large pieces of equipment and those portions of the drill rig that may stand directly over a boring or well location, or that come into contact with casing, pipe, or rods:

- Rinse with high-pressure water cleaner.
- Wash external surfaces of the drilling equipment with high-pressure/ water and laboratory grade detergent (i.e., Alconox™ or Liquinox™), and scrub if necessary to remove dirt, grime, grease, and oil.
- Wash internal surfaces of casings and drill rods as described above.
- Rinse with high pressure water cleaner.
- Rinse with potable water until all rinsate water appears clear.
- Drain decontamination materials (solids and fluids) to a collection container and dispose in accordance with applicable regulations, following proper chemical characterization and evaluation of disposal options (refer to Section 4.3.18 below).

5.3.17.2 Sampling and Monitoring Equipment

The following procedure shall be used to decontaminate sampling and monitoring equipment which may directly contact groundwater (e.g., lifting lines, water-level indicators, and re-usable bailers, transducers, down-hole water quality probes) will be decontaminated prior to collection of the sample following the sequential steps below.

- Scrub the equipment with a solution of potable water and Alconox™, Liquinox™, or equivalent laboratory-grade detergent to remove visible soil or other visible potential contaminants.
- Rinse the equipment with copious quantities of potable water until rinsate appears clean.
- Double rinse with distilled or deionized water.
- Dispose of rinse solutions in a designated 55-gallon drum or bulk fluid storage container properly marked for its contents (refer to Section 4.3.12 below).

Purge equipment, including pumps and discharge lines, will be decontaminated by flushing/pumping a Liquinox™ or equivalent solution, potable water, then deionized water through the components. Lifting lines will be washed with a Liquinox™ or equivalent solution and rinsed with potable and deionized water.

Distilled or deionized water shall be purchased, stored, and dispensed only in approved containers. It is the Performing Contractor's responsibility to assure these materials remain free of contaminants. If any question of purity exists, new materials shall be used.

Discarded materials, including paper towels and decontamination fluids, will be stored in 55-gallon drums for disposal in accordance with applicable regulations, following chemical characterization and evaluation of disposal options (refer to Section 4.3.18 below).

5.3.18 Investigation-Derived Waste Management

Investigation-derived waste (IDW) may include test pit soils, drilling soil cuttings/rock, liquid drilling fluids, groundwater from development of newly constructed wells, groundwater from purging and sampling, groundwater from aquifer pump testing, decontamination fluids, and disposable personal protective equipment (PPE). The following sections discuss IDW waste management planning, handling, storage, and disposal.

5.3.18.1 Waste Management Planning

The Lockheed Martin Energy, Environment, Safety, & Health (EESH) organization has established Operation Procedures (No: EROP-03) for remediation and waste management. The Performing Contractor will be responsible for preparing a Lockheed Martin EESH Waste Management Plan for this project.

The EESH Waste Management Plan consist of five elements, including A) Hazardous Waste Determination, B) Responsibilities and Training Requirements, C) Pre-Shipping Requirements, D) Shipping Requirements, and E) Post Shipping Requirements – Records. In accordance with Section 4.1 of EROP-03, if the waste is determined to be non-hazardous (Element A), then only Elements D and E are required to be completed.

As required by the EROP-03, this plan documents how contaminated fluids, soils, and other project derived wastes may be generated during RI activities, and what waste management procedures the Performing Contractor will follow to characterize and dispose of these materials.

5.3.18.2 Waste Handling and Storage

An IDW containment and storage area will be established in secured location(s) onsite. All IDW shall be segregated at the site according to matrix (solid or liquid) and derivation (e.g., soil cuttings, decontamination fluids, purged groundwater, etc.). Each container shall be properly labeled with site identification, sampling point, generation date, matrix, constituents of concern, and other pertinent information for handling.

All IDW will be kept in containers until analytical results are obtained to determine if IDW is hazardous or nonhazardous. The number of containers shall be estimated on an as-needed basis. Acceptable containers shall be sealed, DOT-approved plastic or steel 55-gallon drums, water tanks/vessels with lids, and/or roll-off bins with lids. The containers shall be transported in a manner that prevents spillage or particulate loss to the atmosphere. A brief discussion regarding IDW types is provided below:

- **Soil and Rock Cuttings**. Soil cuttings are generated during the course of coring and drilling boreholes and wells. Cuttings will be containerized and will be labeled to identify the associated boring and/or well location they were generated from. Soil cuttings with obvious indications of contamination (e.g., visible staining) will be containerized separately in an attempt to limit the volume of material that may require special handling and disposal. All containers will be periodically moved to the centralized waste storage area and disposed of after waste characterization has been completed.

- **Trench/Test Pit Soils**. All excavated soils will be stockpiled temporarily on plastic sheeting. Temporarily stockpiled soils/wastes will be covered if left overnight.

  At the completion of trenching and/or test pit installation, all excavations will be backfilled with the excavated materials and compacted and graded using the excavator.

- **Decontamination Fluids**. Equipment decontamination fluids will be placed in labeled 55-gallon drums, or for larger volumes, transported to bulk fluid storage tanks at the designated IDW storage area. These fluids will be bulk sampled for waste characterization and disposal evaluation.

- **Well Development and Purged Groundwater Fluids**. Fluids generated from well development and during purging and sampling of monitoring wells will be containerized and transported to bulk fluid storage tanks at the designated IDW storage area. These fluids will be bulk sampled for waste characterization and disposal evaluation.

- **Coring operations** will generate significant water. Fluids generated during coring will require large-volume, onsite containment pending waste characterization and disposal evaluation.

- **Two 24-hour, constant rate aquifer pump tests** will generate significant water that requires containment pending waste characterization and disposal evaluation.

- **Disposable PPE.** IDW may include disposable PPE such as chemical protective gloves, rags used to wipe equipment, and plastic sheeting. All disposable protective clothing and supplies will be placed in labeled 55-gallon drums and stored at the IDW storage area at the Site until fieldwork is completed. Soil and groundwater analytical data will be used to determine if IDW materials are hazardous or non-hazardous waste. At the end of the field program, these materials will be disposed of accordingly, depending on assessment of the analytical data.

5.3.18.3 Waste Transport and Disposal

Waste characterization will consist of collecting and analyzing soil cuttings and waste water per waste profiling requirements set by an appropriate disposal facility. IDW soil will be disposed of onsite if MTCA A residential criteria are met. Water generated during coring, aquifer testing, equipment decontamination, well development, and well purging will be disposed of at the plant industrial sump or stormwater pond if it meets NPDES permit criteria and there is sufficient capacity. Note that discharge to the stormwater pond should not be performed during the period of the water-level elevation characterization study, stormwater pond drawdown test, or RI-MW2-BAU aquifer tests because of the potential effects of the pond discharge on the test results. If permitted, the IDW water will be discharged to the industrial sump during these tests. The Performing Contractor will be responsible for verifying that project wastewater meets the NPDES permit requirements prior to discharge.

The Performing Contractor will be required to use a Project Coordinator Lead-approved waste disposal facility for any offsite disposal of project IDW. It is the Performing Contractor's responsibility to confirm that the selected waste disposal facilities are currently approved for use by the Project Coordinator Lead(s).

Any evaluations of alternative onsite treatment and all field activities that are not part of the existing site remedy will require Ecology review and approval prior to initiation.

5.3.19 Record-Keeping and Field Data Management

The following section describes field recordkeeping and data management, including use of field logbooks, data sheets and field forms, and photographs.

5.3.19.1 Field Logbooks

The Performing Contractor shall maintain field records sufficient to recreate all sampling and measurement activities and to meet all electronic data deliverable (EDD) loading requirements. The requirements listed in this section apply to all measuring and sampling activities. Requirements specific to individual activities are listed in the section that addresses each activity. These records shall be archived in an easily accessible form and made available to the client upon request.

All information pertinent to a field survey and/or sampling will be recorded in project field logbooks and/or on appropriate data sheets. The field logbook may also be a bound book with fixed pages that cannot be removed, or may consist of daily field activity forms. Entries will be made in waterproof ink. Entries will be described at an appropriate level of detail so that the situation can be reconstructed without relying on memory. Information to be recorded in field logbooks for all field activities may include, but is not limited to:

- Project name and number.
- Location.
- Date and time.

- Weather conditions.
- Personnel protection levels.
- Identity of people performing field activities.
- Personnel or visitors on the site.
- General work activity.
- Field activity subject.
- Unusual events or other items pertinent to the history of the investigation.
- Subcontractor progress or problems.
- Communications with the client or others.
- Sampling locations.
- Field measurements.
- Calibration of field equipment and record of calibration standards (e.g., pH standards) expiration dates.
- For field measurement records: (1) the numerical value and units of each measurement and (2) the identity of and calibration results for each field instrument.
- Other field-specific activities not recorded on data sheets.

Each data sheet or the end of each entry in the logbook will be signed or initialed and dated by the person making the entries. All original data recorded in field logbooks, on sample tags, or in custody records, as well as other data sheet entries, will be written with waterproof ink. If an error (e.g., incorrect data or sample depth) is made on the document, corrections will be made simply by crossing a single line through the error (in such a manner that the original entry can still be read) and entering the corrected information. All corrections will be initialed and dated.

5.3.19.2 Data Sheets and Field Forms

Data sheets and/or field forms will be used to document specific field procedures and daily activities. Project-specific data sheets and field forms developed by the Performing Contractor for use on this project will require review and pre-approval by the Project Coordinator Lead(s) prior to conducting associated field activities. Field logbooks or daily field activity forms will be used to document such activities as site reconnaissance. Boring log and monitoring well construction log forms will be used to log soil conditions and drill cuttings during the drilling and construction of wells. Monitoring well development and purging information will be recorded on well development field data sheets and groundwater sampling field data sheets. Water-level measurements will be recorded on a water-level measurement or groundwater sample field data sheet. A CoC record will be used to document transfer of custody procedures. Completed data sheets will be maintained in project files by the Performing Contractor.

5.3.19.3 Photographs

Photographs will be taken of the sampling area, as appropriate, to show the surrounding area, drilling and sampling equipment, and sample activities. The picture number (and roll number, if film is used) will be logged in the appropriate logbook section or on a photograph record form to identify which sampling area is depicted in the photograph. Each sequence of photographs will be identified by taking a photograph of an information sign on the first frame. The information presented below will be written on each sign to identify the pictures contained in the sequence:

- Project.
- Location.
- Photograph number.
- Date.
- Photographer's name.
- Work activity.

5.3.20 Variances

The Performing Contractor, along with its subcontractors, will perform their services in accordance with the requirements specified in this FSP. An approved variance is required for any exception to or deviation from the requirements in this FSP. An approved variance is also required if additional analytical methods or field sampling techniques are required to support a project, but are not part of this FSP. The sampling and/or analytical method must be included in a FSP addendum with all the accompanying quality control requirements (i.e., reporting limits, calibration requirements, quality control measures, corrective action, data validation, and reporting requirements).

Requests for variances and corresponding written approvals from the Project Coordinator(s) will be part of the project record. Once approved, a FSP addendum will be submitted to the Project Coordinator(s). Only the variances approved by the Project Coordinator(s) shall be included in the final version of the FSP addendum. During the field effort, the Project Coordinator(s) shall obtain, at a minimum, e-mail or field approval from Ecology for project variance(s) and the Performing Contractor shall not proceed without Project Coordinator direction and approval.

5.3.21 Corrective Action and Non-Conformance Reporting

During field operations, all activities must be carried out according to the approved FSP. The following sections discuss requirements for corrective actions and non-conformance reporting, as appropriate.

5.3.21.1 Corrective Action

The Project Manager and sampling team members will be responsible to ensure that all FSP procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. If a problem arises, prompt corrective action must be taken. Engineering and scientific calculations will be checked and corrected as required by technical personnel, and as a rule will not require QC reporting.

Any time an error, deficiency or deviation from specified criteria occurs in the field, it is defined as an out-of-control or non-conformance event. A non-conformance may exist if there is a deviation from or a non-compliance with contract specifications or approved procedures. Non-conformance also includes major errors in documented analysis, data, or results, and deficiencies in documentation of any other aspect of the project that may affect the quality of the results. Some examples of non-conformance events that may occur in the field include:

- Field equipment calibration criteria are not met.
- Equipment falls into a monitoring well.
- A sampling location is overlooked and not sampled by the field team.
- Pressure transducer failure during a pump test resulting in lost data.

Field personnel or the subcontractor must take the necessary actions to resolve these events and bring the system back into control. These actions are defined as corrective actions. If deviations from the approved plan occur, the Performing Contractor must repeat the activity according to requirements in the form of a corrective action, and document that the corrective action was effective. Alternatively, if no corrective action is taken, the lack of corrective action must also be documented, and approval must be obtained.

In each of these cases, a decision must be made, communicated to the appropriate individual(s), and documented. The degree of non-conformance, in part, influences the degree to which the communications must proceed up the chain of command, and the nature of the documentation. The degree of non-conformance can be assessed by determining whether the non-conforming event will significantly affect the DQOs associated with the program. In cases where a significant effect to the work scope or project DQOs may occur, and a corrective action is either not planned or is not effective, approval is required along with communications and documentation.

5.3.21.2 Non-Conformance Reporting

Personnel who identify a non-conformance shall immediately report both verbally and in a written report the condition to the Project Manager and/or Project QC Manager who will review the report. Based on an evaluation of the non-conformance, work on the specific task will stop and corrective actions will be taken. If the non-conformance involves a major deviation from the approved Work Plan which may adversely affect the cost and/or schedule of the work, the client will be notified immediately of the non-conformance. If the non-conformance has adversely affected previously gathered data, the Performing Contractor Project Manager will also notify the client in writing.

For non-conforming events that may affect project DQOs (i.e., missed critical sampling location), the non-conforming event must be corrected according to project requirements. The Project Manager will review each event and exercise professional judgment in recommending a course of action. For instance, the most direct corrective action for a missed critical sampling point is to re-sample, in order to satisfy the Work Plan. The proposed course of action (i.e., re-sampling) will be communicated to the Project Coordinator Lead(s) for approval. Documentation of the corrective action must be written and placed in the job file, and may include telephone contact logs, e-mail correspondence, etc. If corrective actions proved ineffective or if no corrective action was taken, the project manager must communicate to the Project Coordinator Lead(s) that the non-conforming event was not corrected and must gain written acknowledgement and acceptance of the non-corrected, out-of conformance event.

Section 6
Quality Assurance Project Plan

This QAPP has been prepared to comply with the Guidance for Quality Assurance Plans (EPA 2002b), herein referred to as EPA QA/G-5. The QAPP will also follow Ecology's Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology 2004) and Sediment Sampling Analysis Plan Appendix (Ecology 2008).

6.1 INTRODUCTION

The primary function of this QAPP is to describe quality assurance/quality control (QA/QC) procedures to be used for collection and analysis of environmental samples at the former Columbia Gorge Aluminum Smelter site located in Goldendale, Washington. This QAPP describes laboratory specific information and any QA/QC procedures for analytical testing and data management not already stated in EPA QA/G-5. QA/QC procedures presented in EPA QA/G-5 will be briefly summarized and appropriately referenced.

This QAPP describes the QA/QC procedures that will be used for analytical work performed by a Washington State certified laboratory in support of the RI work effort.

6.2 QUALITY ASSURANCE OBJECTIVES

The primary objective of the plan is to produce data that are accurate, reliable, reproducible and representative of site conditions. Data Quality Objectives (DQOs) represent qualitative and quantitative statements developed by data users to specify requirements for data quality from field and laboratory data collection activities to support specific decision and regulatory actions. Field related DQOs for SWMUs and AOCs are included in Section 5.0. DQOs also establish numeric limits of accuracy precisions, quantitation, and completeness for the data to allow the data user to determine whether data collected are of sufficient quality and quantity for use in their intended application. The purpose of DQOs is to guide decisions and processes for the collection, analysis, and evaluation of data in an attempt to satisfy overall project objectives.

6.2.1 Data Quality Objectives

The usability of the data collected during an investigation depends on its quality. A number of factors relate to the quality of data, and sample collection methods are as important to consider as methods used for sample analysis. Following standard operating procedures for both sample collection and analysis reduces sampling and analytical error. Complete chain-of-custody (CoC) documentation and adherence to required sample preservation techniques, holding times and proper shipment methods ensure sample integrity. Obtaining valid and comparable data also requires adequate QA/QC procedures and documentation, as well as established detection and control limits.

Quantitation limits are based on the extent to which the field equipment, laboratory equipment, or analytical process can provide accurate measurements of consistent quality for specific constituents in field samples. The quantitation limit for a given analysis will vary depending on instrument sensitivity and matrix effects.

Analytical data will be obtained using published, standard methods in a Washington State certified laboratory as described in Section 6.5. Analytical DQOs are achieved through evaluation of analytical methods used, project specific reporting limits, and laboratory QC, which are detailed in the following sections of this QAPP.

The components associated with measurement of data quality are described in EPA QA/G-5. Performance and acceptance criteria are often expressed in terms of data quality indicators (DQIs), such as accuracy, precision, representativeness, comparability, and completeness. A set of default QC limits, including analytical method detection and reporting limits, as well as the associated precision, accuracy, and completeness criteria for the RI work effort are summarized in Table 6-1 for aqueous analyses and Table 6-2 for soil/sediments (a summary of the RI analytical program is discussed in Section 6.5.2). Based on the selection of a qualified fixed-based analytical laboratory, these limits and criteria may vary slightly; however, any revisions will be based upon the DQO process and inputs from the Project Coordinator(s), the Project Manager, and project team. The justification for changes in QC Level will be detailed in a QAPP addendum, otherwise the default QC criteria will apply accordingly.

A description of DQIs used in support the RI work effort, including accuracy, precision, representativeness, comparability, and completeness is provided in the following sections.

Table 6-1
Analytical Data Quality Objectives for Groundwater/Surface Water Samples

Chemical	Analytical Method[a]	Matrix	Units	Laboratory Reporting Limit	Accuracy (Percent Recovery)		Precision (Relative Percent Difference)	Completeness (Percent)	MTCA Method B Screening Levels[b]
					Matrix Spike/ Matrix Spike Duplicate	Laboratory Control	Field and Lab Duplicates		
Total Cyanide	EPA 335.4	Water	mg/L	0.05	90-110	90-110	20	90	0.2
Free Cyanide	ASTM D4282-02 or EPA 9213	Water	mg/L	0.1	80-120	80-120	20	90	0.0096
WAD[c] Cyanide	SM 4500N –CN-I	Water	mg/L	0.05	70-140	70-140	20	90	0.0096
Fluoride	EPA 300.0	Water	mg/L	0.5	90-110	90-110	20	90	0.64
Sulfate	EPA 300.0	Water	mg/L	0.5	90-110	90-110	20	90	250
Metals[e]	EPA 200.7	Water	µg/L	1.0-10.0	70-130	75-125	20	90	0.05-4,800
	EPA 200.8			0.05-2.0	70-130	85-115	20	90	
Volatile Organic Compounds[e]	EPA 8260C	Water	µg/L	0.5-20	40-150	20-160	30	90	0.5-16,000
Polycyclic Aromatic Hydrocarbons[e]	EPA 8270D SIM	Water	µg/L	0.02-5.0	40-130	40-125	30	90	0.012-4,800
Polychlorinated Biphenyls[e]	EPA 8082A	Water	µg/L	0.005-0.01	25-145	50-100	30	90	0.04-0.5
Gasoline Range Organics	NWTPH-Gx	Water	µg/L	10	NA[d]	80-120	20	90	80
Diesel / Oil Range Organics	NWTPH-Dx	Water	µg/L	50/500	45-140	45-140	30	90	500
Major Ions and Conventional Parameters									
Total Alkalinity	SM 2320C or EPA 310.1	Water	mg/L	2.0	NA	90-110	20	90	NA
Total Dissolved Solids	SM 2540C or EPA 160.1	Water	mg/L	10.0	NA	80-120	20	90	NA
Hardness	SM 2340C or EPA 130.2	Water	mg/L	2.0	90-120	90-120	20	90	NA
Chloride	SM 4500-Cl E	Water	mg/L	0.5	85-115	75-125	20	90	NA
Iron	EPA 200.7	Water	mg/L	5.0	50-150	70-130	20	90	NA
Calcium	EPA 200.7	Water	mg/L	5.0	80-120	80-120	20	90	NA
Magnesium	EPA 200.7	Water	mg/L	1.10	80-120	80-120	20	90	NA
Sodium	EPA 200.7	Water	mg/L	2.0	80-120	80-120	20	90	NA
Potassium	EPA 200.7	Water	mg/L	3.5	80-120	80-120	20	90	NA

a The methods listed are for typical Standard Methods (SM), U.S. Environmental Protection Agency (EPA) Methods, SW846 Methods (SW), or American Standard for Testing and Materials (ASTM).
b Screening levels are based on Model Toxics Control Act (MTCA) Method B groundwater cleanup levels (ranges provided for analytical methods with multiple compounds).
c WAD = Weak Acid Dissociable.
d NA = Not Applicable.
e Laboratory reporting limits accuracy and precision objectives represent range for analytical methods with multiple compounds. Compound-specific objectives will be established at time of laboratory selection.
mg/L Milligram/liter
µg/L Micrograms/liter

Table 6-2
Analytical Data Quality Objectives for Soil / Sediment Samples

Chemical	Analytical Method[a]	Matrix	Units	Laboratory Reporting Limit	Accuracy (Percent Recovery)		Precision (Relative Percent Difference)	Completeness (Percent)	Screening Levels[b]
					Matrix Spike/ Matrix Spike Duplicate	Laboratory Control	Field and Lab Duplicates		
Total Cyanide	EPA 9012B	Soil/Sediment	mg/kg	0.05	60-140	20-160	20	90	0.1-48
WAD[c] Cyanide	SM 4500N –CN-I Modified	Soil	mg/kg	0.01	60-140	60-150	20	90	0.1-48
Fluoride	SM 4500-F / EPA 300.0	Soil/Sediment	mg/kg	2.0	80-120	80-120	20	90	3,200
Sulfate	SM 4500-F / EPA 300.0	Soil/Sediment	mg/kg	2.0	80-120	90-110	20	90	NE[d]
Metals[e]	SW 6010C	Soil/Sediment	mg/kg	1.0-5.0	75-125	80-120	20	90	0.66-130
	SW 6020A			0.05-2.0	75-125	80-120	20	90	
Volatile Organic Compounds[e]	EPA 8260C	Soil	µg/kg	5.0-20	10-160	50-160	40	90	30-9,000
Polycyclic Aromatic Hydrocarbons[e]	EPA 8270D SIM	Soil/Sediment	µg/kg	5.0	25-140	40-130	40	90	137-137,000
Polychlorinated Biphenyls[e]	EPA 8082A	Soil/Sediment	mg/kg	0.1-20	25-140	40-130	40	90	0.1-120
PCB Congeners[e] (Full List)	EPA 1668C	Sediment	Pg/g	20-120	60-135	15-145	50	90	NE
Dioxin/Furans[e]	EPA 1613B	Soil	Pg/g	1.0-10.0	63-170	13-328	50	90	12.8
Gasoline Range Organics	NWTPH-Gx	Soil	mg/kg	10	NA	80-120	20	90	30-100
Diesel / Oil Range Organics	NWTPH-Dx	Soil/Sediment	mg/kg	25/100	20-140	40-140	30	90	340-2,000
Other Parameters									
Total Organic Carbon	SW 9060	Sediment	mg/kg	5.0	NA	85-115	20	90	NA[f]
Grain Size	ASTM D-422	Sediment	Phi	NA	NA	NA	NA	NA	NA
Calcium	6010C	Soil	mg/kg	4	75-125	83-117	20	90	NA
Sodium	SW6010C	Soil	mg/kg	40	75-125	67-133	20	90	NA
Magnesium	6010C	Soil	mg/kg	2	75-125	76-124	20	90	NA
Lithium	6010C	Soil	mg/kg	4	75-125	75-125	20	90	NA
Phosphorus	6010C	Soil	mg/kg	8	75-125	75-125	20	90	NA
Silica (as Silicon)	6010C	Soil	mg/kg	0.1	60-140	82-119	20	90	NA
Manganese	6010C	Soil	mg/kg	0.2	75-125	82-117	20	90	NA
Total Carbon	9060M	Soil	mg/kg	0.1	72-122	72-122	20	90	NA

a The methods listed are for typical Standard Methods (SM), U.S. Environmental Protection Agency (EPA) Methods, SW846 Methods (SW), or American Standard for Testing and Materials (ASTM).
b Screening levels are based on Model Toxics Control Act (MTCA) Method B Soil Cleanup Levels as well as the Washington State SMS screening levels, WAC 173-204 (ranges provided for analytical methods with multiple compounds).
c WAD Weak Acid Dissociable
d NE Not Established
e Laboratory reporting limits accuracy and precision objectives represent range for analytical methods with multiple compounds. Compound-specific objectives will be established at time of laboratory selection.
f NA Not Applicable
mg/kg Milligram/kilogram
µg/kg Micrograms/kilogram
Pg/g Pico gram/gram

6.2.2 Accuracy

Accuracy reflects the degree to which the measured value represents the actual or “true” accepted value for a given parameter among individual measurements of the same property under prescribed similar conditions. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a Laboratory Control Sample (LcS) and Matrix Spike (MS) against a control limit. Surrogate compound recoveries are also used to assess accuracy and method performance.

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery (%R) of analytes spiked into an LcS to a control limit. Table 6-3 provides statistical calculations and formulas used to assess accuracy and precision control. For semivolatile organic compounds, surrogate recoveries are also used.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy values should be compared to the approved control limits (see Tables 6-1 and 6-2) for specified analytes to assess accuracy and method performance.

6.2.3 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. Laboratories use the LcS to determine the precision of the analytical method. If the recoveries of analytes in the LcS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches.

Table 6-3
Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	$\overline{X}$	$\dfrac{\left(\sum_{i=1}^{n} x_i\right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\dfrac{\Sigma(x_i-\overline{x})^2}{(n-1)}\right)^{½}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S/\overline{X})$ x 100	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	Percent D	$\dfrac{x_1 - x_2}{x_1}$ x 100	Measure of the difference of two observations	Used to assess accuracy
Relative Percent Difference	RPD	$\left(\dfrac{(X1 - X2)}{(X1 + X2)/2}\right)$ x 100	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery (LCS)	Percent R	$\left(\dfrac{X_{meas}}{X_{true}}\right)$ x 100	Recovery of spiked compound in clean matrix	Used to assess accuracy in LCS samples
Percent Recovery (MS)	Percent R	$\dfrac{\left(\text{value of spiked sample} - \text{value of unspiked sample}\right)}{\text{Value of added spike}}$ x 100	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision in MS samples
Correlation Coefficient	R	(COD) ½		Evaluation of "goodness of fit" of a regression line
Coefficient of Determination	COD		Indication of error associated with regression curves	Evaluation of "goodness of fit" of a polynomial equation

Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and MSD samples shall be analyzed to assess field and analytical precision. The precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. For replicate analyses, the relative standard deviation (RSD) is determined. The formulas for calculating RPD and RSD are given in Table 6-3.

Field duplicate/replicate, laboratory duplicate, and MSD samples will be used to assess field and analytical precision, and the precision measurement will be determined using the RPD between the duplicate sample results.

6.2.4 Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter mostly concerned with the proper design of the sampling program.

Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample/well/boring locations and numbers and the statistical sampling design are documented in each project-specific Work Plan. Representativeness may be evaluated using either statistical or qualitative methods as appropriate to the project. Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives.

6.2.5 Data Comparability

Comparability is the confidence with which one data set can be compared to another. Sample data should be compared with other measurements for similar samples and sample conditions. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, as covered in the FSP (Section 5.0) and QAPP (Section 6.0), respectively, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.

Complete field documentation using standardized data collection forms shall support the assessment of comparability. Examples of standard calculations used to evaluate data sets are presented in Table 6-3. Comparability should take into consideration varying field conditions (seasonal changes), data produced under different DQOs, different equipment and/or procedures used by the Performing

Contractor or its subcontractors, and potential involvement of multiple laboratories during the life of a project.

6.2.6 Completeness

The completeness of the data will be evaluated based upon the percentage of data judged to be valid relative to the total tests requested. The completeness goal is to generate a sufficient amount of valid data to meet project needs. For completeness requirements, valid data are defined as usable data that meet the objectives of the specific project [i.e., all results not qualified with a rejected ("R") flag]. The requirement for completeness for analytical samples collected in support of the RI work effort is 90 percent.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that is expected to be obtained under correct, normal conditions. The following formula is used to determine Percent Completeness (%C):

$$\%C = \frac{v}{T} x100$$

where:

v = the number of planned measurements judged valid

T = the total number of measurements

Completeness is calculated for the aggregation of usable data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of usable results determines the completeness of the data set. The laboratory is not required to calculate completeness. The Performing Contractor shall review the validated data for usability for the project and calculate completeness based on the usable data. It is the responsibility of the Performing Contractor to review the appropriateness of the flags based on the DQOs and guidelines presented in the QAPP. Quality assurance objectives for completeness will be defined by the DQOs for the project and in revised if necessary in project-specific QAPP addenda.

6.3 SAMPLING PROCESS DESIGN AND PROCEDURES

Section 5.0 describes the field sampling plan including investigation objectives, scope of work and rationale for the SWMUs and AOCs. Specific field methods and procedures are discussed in Section 5.3.

6.3.1 Sample Container, Volumes, Preservation, and Holding Time Requirements

Table 6-4 provides a general summary of sample volumes, container types, preservation methods and analytical holding times for the specified analytical methods. These will be confirmed by the subcontracted laboratory before the start of field activities.

Sample containers are purchased pre-cleaned and treated according to EPA specifications for the appropriate laboratory methods. Sample containers that are reused are decontaminated between uses by EPA-recommended procedures (EPA 1992). Containers are stored in clean areas to prevent exposure to contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

Preservation of samples is required so that samples retain their integrity. The most common preservation techniques include pH adjustment and temperature control. Pre-cleaned containers for groundwater samples, containing the appropriate preservatives as specified in Table 6-4, will be provided by the laboratory. Field personnel collecting environmental samples will use EPA-recommended containers and adhere to EPA-recommended preservation techniques for the parameters of concern. The minimum sample volumes required for each type of analysis are also specified and must be met (refer to Table 6-4).

If the Performing Contractor deviates from sample type, the new method shall be approved in advance via a request for a variance. The Performing Contractor will request a variance from the Project Coordinator(s). Once this variance has been approved in writing, the departure from the conventional sampling and analysis requirements will be included in a project-specific QAPP addendum.

6.3.2 Recordkeeping

Details of record keeping procedures and requirements are provided in Section 5.3.14.

Table 6-4
Sample Container, Preservative, and Holding Times
(Page 1 of 2)

Chemical	Sample Matrix	Analytical Method[a]	Container	Recommended Volume	Preservative[b]	Holding Time
Total Cyanide	Water	SM 4500-CN / EPA 335.4	Plastic (HDPE)	1,000 mL	NaOH to pH >12: Store cool at <6º C > 0º C	14 days
	Soil/Sediment	EPA 9012B	Glass	4 oz.	Store cool at <6º C > 0º C	14 days
Free Cyanide	Water	ASTM D4282-02	Plastic (HDPE)	1,000 mL	NaOH to pH >12: Store cool at <6º C > 0º C	24 hrs.
WAD Cyanide	Water	SM 4500-CN-I	Plastic (HDPE)	1,000 mL	NaOH to pH >12: Store cool at <6º C > 0º C	14 days
	Soil/Sediment	SM 4500-CN-E Modified	Glass	4 oz.	Store cool at <6º C > 0º C	14 days
Amenable Cyanide	Water	EPA 9010B	Plastic (HDPE)	1,000 mL	NaOH to pH >12: Store cool at <6º C > 0º C	14 days
	Soil/Sediment	EPA 9012B	Glass	4 oz.	Store cool at <6º C > 0º C	14 days
Fluoride	Water	EPA 300.0 / SM 4500-F	Plastic (HDPE)	250 mL	Store cool at <6º C > 0º C	28 days
	Soil/Sediment	EPA 300.0 / SM 4500-F	Glass	8 oz.	Store cool at <6º C > 0º C	28 days
Sulfate	Water	EPA 300.0 / SM 4500-S	Plastic (HDPE)	250 mL	Store cool at <6º C > 0º C	28 days
	Soil/Sediment	EPA 300.0 / SM 4500-S	Glass	8 oz.	Store cool at <6º C > 0º C	28 days
Metals (Total / Field-Filtered Dissolved)	Water	EPA 200.7/200.8	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
	Soil/Sediment	SW 6000/7000 series	Glass	8-oz.	Store cool at <6º C > 0º C	180 days
Volatile Organic Compounds (VOCs)	Water	EPA 8260 C	Glass	3x40 mL VOA	HCL to pH <2: Store cool at <6º C > 0º C	14 days
	Soil/Sediment	EPA 8260 C	Glass	4 oz.	Store cool at <6º C > 0º C	14 days
Polycyclic Aromatic Hydrocarbons (PAHs)	Water	EPA 8270C SIM	Glass (Amber)	1,000 mL	Store cool at <6º C > 0º C	14 days
	Soil/Sediment	EPA 8270C SIM	Glass	8 oz.	Store cool at <6º C > 0º C	14 days
Polychlorinated Biphenyls (PCBs)	Water	EPA 8082A	Glass (Amber)	1,000 mL	Store cool at <6º C > 0º C	14 days
	Soil/Sediment	EPA 8082A	Glass	8 oz.	Store cool at <6º C > 0º C	14 days
PCB Congeners	Sediment	EPA 1668C	Glass	8 oz	Store cool at <6º C > 0º C	14 days
Dioxins/Furans	Soil	EPA 1613B	Glass	8 oz	Store cool at <6º C > 0º C	14 days
Gasoline-Range Hydrocarbons	Water	NWTPH-Gx	Glass	3x40 mL VOA	HCL to pH <2: Store cool at <6º C > 0º C	14 days
	Soil/Sediment	NWTPH-Gx	Glass	4 oz.	Store cool at <6º C > 0º C	14 days
Diesel and Oil Range Hydrocarbons	Water	NWTPH-Dx	Glass (Amber)	500 mL	Store cool at <6º C > 0º C	14 days
	Soil/Sediment	NWTPH-Dx	Glass	4 oz.	Store cool at <6º C > 0º C	14 days

Table 6-4
Sample Container, Preservative, and Holding Times
(Page 2 of 2)

Chemical	Sample Matrix	Analytical Method[a]	Container	Recommended Volume	Preservative[b]	Holding Time
Major Ions and Conventional Parameters						
Total Alkalinity	Water	SM 2320C / EPA 310.1	Plastic (HDPE)	250 mL	Store cool at <6º C > 0º C	14 days
Total Dissolved Solids	Water	SM 2540C / EPA 160.1	Plastic (HDPE)	250 mL	Store cool at <6º C > 0º C	7 days
Hardness	Water	SM 2340C/ EPA 130.2	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
Total Organic Carbon	Soil/Sediment	SW 9060	Glass	4 oz.	Store cool at <6º C > 0º C	28 days
Grain Size	Soil/Sediment	ASTM D422	Plastic	150 gr.	None	None
Iron	Water	EPA 200.7	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
Chloride	Water	SM 4500-CL/EPA 300.0	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	28 days
Sodium	Water	EPA 200.7	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Potassium	Water	EPA 200.7	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
Calcium	Water	EPA 200.7	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Magnesium	Water	EPA 200.7	Plastic (HDPE)	500 mL	HNO_3 to pH < 2: Store cool at <6º C > 0º C	180 days
	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Lithium	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Phosphorus	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Silica	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Manganese	Soil	SW6010C/3050B	1 gram	4 oz jar	None	180 days
Total Carbon	Soil	9060M	1 gram	<6º C > 0º C	None	28 days

a The methods listed are for typical Standard Methods (SM), U.S. Environmental Protection Agency (EPA) Methods, SW846 Methods (SW), or American Society for Testing and Materials (ASTM) Methods.

b Note that analysis for sediment samples include additional provision(s) for freezing samples to extend recommended holding times up to 360 days.

Notes:

NaOH Sodium Hydroxide
HCL Hydrogen Chloride
HNO_3 Nitric Acid
HDPE High-Density Polyethylene

For samples requiring matrix spike/matrix spike duplicate (MS/MSD), collect triple the recommended volume.

6.4 SAMPLE CUSTODY AND DATA MANAGEMENT PROCEDURES

This section summarizes field operations and laboratory sample identification data, sample packaging/shipping, sample handling and custody pertaining to field activities and laboratory operations.

6.4.1 Field Operations

Section 5.3 provides descriptions of field sample handling and management procedures.

6.4.1.1 Sample Identification

Section 5.3.14 contains detailed descriptions of sample identification procedures.

6.4.1.2 Sample Packaging and Shipping

Section 5.3.9 provides detailed instructions for sample packaging and shipping.

6.4.1.3 Sample Handling and Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Documentation of the custody and condition of the samples is maintained in field and laboratory records. The CoC procedures described in Section 5.3.10 will be followed to guarantee documented sample custody.

6.4.2 Laboratory Operations

The following subsections summarize laboratory sample identification data, sample packaging and shipping, sample handling, and custody pertaining to laboratory operations.

All initial sample receipt, log-in, and storage are the responsibility of the laboratory Sample Custodian. The Sample Custodian is responsible for retaining documents, and for verifying data entered into the sample custody records. The Sample Custodian is also responsible for ensuring that the sample storage is secure and maintained at the proper temperature.

The Laboratory Project Manager (LPM) provides a second review of the entire log-in procedure and is ultimately responsible for its correctness and completeness.

6.4.2.1 Sample Handling

Upon receipt of samples by the laboratory, the integrity of the shipping container will be checked and verification made that the custody seals (packing tape wrapped around cooler) are intact. The presence of ice or ice substitute (e.g., blue ice) will be noted and the temperature will be documented. All receipt information and observations will be documented on a sample receipt form and the CoC record. Any discrepancies requiring corrective action will be recorded on the laboratory corrective action form.

The ideal temperature for maintaining sample integrity is defined as <6°C and >0°C. If the temperature is below 0°C, all associated samples will be inspected to determine if any ice has formed in the containers. All temperature violations will be reported immediately by telephone with a follow-up hard copy to the Performing Contractor Data Management Coordinator. The violation and corrective actions will be described on the laboratory corrective action form. Based on the ideal temperature definition of <6°C and >0°C, a temperature violation will occur if the temperature exceeds 6°C or is below 0°C unless freezing has not occurred.

All samples will remain in the proper environment to guarantee sample integrity until analytical and validated QA/QC results have been generated. Environmental samples whose holding times have expired may have some limited usefulness. These samples will be stored for a period of time corresponding to two times the EPA recommended holding time with the exception of samples to be analyzed for metals, which will be maintained for a period of 6 months. Any discrepancy in sample handling or analysis requiring corrective action will be documented on the laboratory corrective action form.

6.4.2.2 Sample Identification and Tracking

All sample information shall be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely are summarized in Table 6-4. Subcontracted analyses shall be documented with the CoC form. Procedures ensuring internal laboratory CoC shall also be implemented and documented by the laboratory. Instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

6.4.2.3 Laboratory Information Management System

The Laboratory Information Management System (LIMS) is a set of proprietary computer software programs that compile, sort, and output data results generated by the analytical testing conducted at the laboratory. Most LIMS are relational database systems that interface directly with laboratory analytical instrumentation and user terminals that are password protected. Data flow into the LIMS is safeguarded by the LIMS manager who restricts access by granting authorization levels and password information to personnel on an individual basis. All data entry and data edits are tracked by passwords. The LIMS software documentation is a matter of proprietary code auditing performed by the software manufacturers.

Relevant information specific to samples received will be recorded in the LIMS. Information to be recorded in the LIMS includes:

- Date samples were received.
- Source of the samples.
- Specific sample identification.
- All analytical tests requested for each sample.
- Number of samples associated with each analytical or preparatory batch.

Each sample received by the laboratory will be given a discrete identification number linking the sample to the field identification given by the Performing Contractor. The laboratory sample identification number will be sequentially assigned by the LIMS. This unique numbering system will enable the laboratory to accurately track the dates and times of analysis, the QA/QC, and the final disposition of each sample.

6.4.2.4 Sample Custody Records

All samples are tracked internally through the LIMS, which can be accessed from each analytical workstation. Therefore, an analyst or LPM can obtain the complete sample test request invoice for a given set of samples at any time.

Samples are also manually tracked using a copy of the Performing Contractor CoC record. A copy of the completed original CoC will be forwarded to the Performing Contractor with the final report.

6.4.3 Environmental Information Management System (EIMS) Submittal Requirements

The Environmental Information Management System (EIM) is the Department of Ecology's main database for environmental monitoring data. The EIM contains records on physical, chemical, and biological analyses and measurements. Supplemental information about the data (metadata) is also stored, including information about environmental studies, monitoring, and data quality.

As specified in the Agreed Order (Ecology 2014), new sampling data collected in support of the RI work effort will be entered into the EIM in accordance with WAC 173-340-840(5) and Ecology's Toxic Cleanup Program Policy 840: Data Submittal Requirements. Only validated data will be entered into the EIM database.

6.5 ANALYTICAL METHODS AND PROCEDURES

This section presents the minimum criteria for laboratory selection and discusses analytical methods to be used in support of the RI work effort.

6.5.1 Laboratory Selection

The analytical laboratory selected to perform the analysis under this Work Plan must meet the State of Washington lab accreditation requirement(s) set forth in the WAC 173-50, including accreditation through the Washington State Environmental Laboratory Accreditation Program (WA ELAP).

Prior to selecting a laboratory for sample analysis, the laboratory must provide their internal Laboratory Quality Assurance Plan (LQAP) and Statement of Qualifications (SOQ) to the Performing Contractor's Data Management Coordinator. The LQAP should comprehensively address laboratory QA policies and procedures. The SOQ should include historical information about the laboratory, company, qualifications of key laboratory personnel, a floor plan of the laboratory, descriptions of analytical instruments, services offered, and certifications held.

The LQAP and SOQ will be reviewed by the Data Management Coordinator prior to selection. The Data Management Coordinator will ensure the LQAP for the selected laboratory is appropriate for meeting the established DQOs. It is the responsibility of the Data Management Coordinator to communicate DQOs, parameters for analysis, and methods of analysis to the laboratory, as well as to communicate sampling and analysis schedules to the laboratory with sufficient lead time to meet contractual agreements with the laboratory.

6.5.2 Analytical Program Summary

Target analytes for laboratory sample analysis in support of the RI work effort are presented in Table 6-5. Table 6-5 includes identification of chemical-specific laboratory techniques, as well as associated laboratory analytical preparation methods and analysis for specific environmental sample media (i.e., soils, freshwater sediments, groundwater and surface water). The list of target analytes has been established based on previous data collected from the Site, as well as understanding of past facility operations, activities, and/or known or suspected spills and releases as summarized in the Phase 1 Work Plan. The analytical methods for the RI work effort were selected based on the project DQOs. Chemical-specific DQOs are discussed in Section 6.2, and are summarized in Tables 6-1 and 6-2 based on aqueous and non-aqueous sample matrix.

6.5.3 Field Screening Methods

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, less calibration, and/or fewer QC requirements than are necessary to produce definitive data. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Physical test methods (e.g., dissolved oxygen, temperature, pH, specific-conductance, turbidity, oxidation reduction potential) and others carried out in the field have been designated by definition as screening methods. Field measurement activities are described in Section 5.3.

Table 6-5
Laboratory Analytical Program Summary
Columbia Gorge Aluminum Smelter Site, Goldendale, Washington

Chemical	Laboratory Analytical Technique	Laboratory Analytical Method[a]		
		Soil	Freshwater Sediment	Groundwater and Fresh Surface Water
Cyanide				
Total Cyanide	Colorimetric	EPA 9012B	EPA 9012B	EPA 335.4
Free Cyanide	Colorimetric	NA	NA	ASTM D4282-02 or EPA 9213
WAD Cyanide	Colorimetric	SM 4500-CN-I	NA	SM 4500-CN-I
Amenable Cyanide (waste profiling only)	Colorimetric	EPA 9012B	NA	NA
Fluoride				
Total Fluoride	IC	SM 4500-F or EPA 300.0	SM 4500-F C or EPA 300.0	SM 4500-F C or EPA 300.0
Sulfate				
Total Sulfate	IC	SM 4500-S or EPA 300.0	SM 4500-S or EPA 300.0	SM 4500-S or EPA 300.0
Metals (Total and Dissolved)				
Aluminum	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Arsenic	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Cadmium	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Chromium	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Copper	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Lead	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Mercury	CVAA	SW 7471B	SW 7471B	EPA 245.1/7470A
Selenium	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Zinc	ICP/ICP-MS	SW 6010C	SW 6020A	EPA 200.7/200.8
Volatile Organic Compounds (VOCs)				
VOCs	GC/MS	EPA 8260C	NA	EPA 8260C
Polycyclic Aromatic Hydrocarbons (PAHs)				
cPAH/HPAH/LPAH	GC/MS	EPA 8270D SIM	EPA 8270D SIM	EPA 8270D SIM
Polychlorinated Biphenyls (PCBs)				
PCBs -Aroclors	GC/ECD	EPA 8082A	EPA 8082A	EPA 8082A
PCB Congeners	HRGC/HRMS	NA	EPA 1668C	NA
Dioxin/Furans	**HRGC/HRMS**	**EPA 1613B**	**NA**	**NA**
Total Petroleum Hydrocarbons (TPH)				
Gasoline Range	GC/FID,PID	NWTPH-Gx	NWTPH-Gx	NWTPH-Gx
Diesel/Oil Range	GC/FID,PID	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx
Major Ions and Conventional Parameters				
Calcium	ICP	SW6010C	NA	EPA 200.7
Chloride	IC	NA	NA	SM 4500-CI E
Iron	ICP	NA	NA	EPA 200.7
Magnesium	ICP	SW6010C	NA	EPA 200.7
Sodium	ICP	SW6010C	NA	EPA 200.7
Potassium	ICP	NA	NA	EPA 200.7
Lithium	ICP	SW6010C	NA	NA
Phosphorus	ICP	SW6010C	NA	NA
Silica	ICP	SW6010C	NA	NA
Manganese	ICP	SW6010C	NA	NA
Total Carbon	ICP	SW6010C	NA	NA
Hardness	Titration	NA	NA	SM 2340B/EPA 130.2
Total Alkalinity	Titration	NA	NA	SM 2320B/EPA 310.1
Total Dissolved Solids	Gravimetric	NA	NA	SM 2540C/EPA 160.1
Total Organic Carbon	IR	EPA 9060A	EPA 9060A	NA
Grain Size	Sieve/Hydrometer	NA	ASTM D-422	NA

a The methods listed are for typical Standard Methods (SM), U.S. Environmental Protection Agency (EPA) Methods, SW846 Methods (SW), or American Society for Testing and Materials (ASTM) Methods. For metals in soil and sediments a strong acid digestion will be performed using EPA 3050B.

ASTM American Society for Testing and Materials
CVAA Cold Vapor Atomic Absorption
ECD Electron Capture Detector
FID Flame Ionization Detector
GC Gas Chromatography
HR High Resolution
IC Ion Chromatography
ICP Inductively Coupled Plasma
IR Infrared Spectrophotometry
ISE Ion Selective Electrode
LPAH Low Molecular Weight Polycyclic Aromatic Hydrocarbons
MS Mass Spectrometry
NA Not applicable
PAHs Polycyclic Aromatic Hydrocarbons
PID Photoionization Detector
TOC Total Organic Carbon
WAD Weak-acid dissociable

6.5.4 Laboratory Method Detection and Quantitative Reporting Limits

The following sections discuss laboratory method detection and quantitative reporting limits.

6.5.4.1 Method Detection Limits

Method detection limits (MDLs) are required for all methods of quantitative analysis to evaluate each method's performance. MDLs for any analytical procedures depend on the matrix of the sample being tested. The laboratory performs MDL studies for each instrument, method, analyte, and matrix on an annual basis.

MDLs may need to be updated more often than annually if, for example, new instrumentation is used, new extraction technique or solvents are used, different sample volumes are received, new matrices are analyzed, or new detectors are used. Each MDL study is performed as specified in 40 CFR Part 136, Appendix B.

6.5.4.2 Quantitative Reporting Limits

Factors that influence the quantitative reporting limits of analytical methods include the analytical method itself, sample matrix, interference, and high concentration of the target analyte. Actual reporting limits may vary from sample to sample in accordance with standard laboratory practices (e.g., dilution due to high analyte concentration).

Laboratories contracted to perform sample analyses using the specified analytical methods will be required to submit current MDL studies (see above). Ultimately, the best achievable detection limits will be reported on a discreet sample basis given considerations for matrix effects, chemical interferences, data quality assurance specifications, and instrument measurement reliability.

Any concentrations reported at or above the laboratory reporting limit are considered quantified data of known precision and accuracy, in contrast to concentrations reported below the laboratory reporting limit, which are considered estimated values. For those results falling between the MDL and the laboratory reporting limit, a "J" flag shall be applied to the results by the laboratory, indicating the variability associated with the result. No results shall be reported below the MDL.

6.6 INTERNAL QUALITY CONTROL CHECKS

This section describes internal quality control checks to be used for this RI work effort.

6.6.1 Field Activities Quality Control

QC procedures associated with sample collection are an integral part of each sampling methodology. These procedures are designed to ensure the collection of representative samples that are free of external contamination. The RI field QC program is discussed in Section 5.3.11. The following field QA/QC procedures will be used during sample collection:

- Equipment Blanks (EBs) will be collected every day that reusable sampling equipment is used. EBs are prepared by pouring deionized water into the sampling equipment, and then transferring the water into sample containers. EBs are analyzed for the same analytes as the associated environmental samples.

- Duplicate water samples will be collected at a frequency of one for every 10 environmental samples. Duplicate water samples are two samples collected at one sampling location during the same sampling event.

- Sampling apparatus will be thoroughly cleaned between each sampling event to prevent cross-contamination of the samples. Details of the decontamination procedures of sampling apparatus are provided in Section 5.3.

- Trip blanks consist of a series of cleaned sample containers filled with analyte-free water and pre-certified by analysis at the laboratory as clean. Trip blanks will be analyzed for VOCs and therefore will only accompany routine samples to be analyzed for VOCs. There will be no holding time limitations for trip blanks in the field. However, it is a general guideline that sample coolers with trip blanks and unfilled sample containers should not be stored at a particular site longer than five working days. Once the trip blank samples are submitted for analysis, they are subject to the same holding times as environmental samples

6.6.2 Laboratory Analysis Quality Control

The control limits for QC analytes in the LcS are those considered free from matrix effects. The LcS control limits will be applied to the MS/MSDs for acceptance.

6.6.2.1 Analytical Batch

The batch is the basic unit of frequency for the analysis of the QC samples, which control the related environmental sample results. The QC samples must be unambiguously linked and permanently attached to the batch. The QC samples must also be unique to the batch and cannot be used or transferred to any other batch. Two types of analytical batches can be identified: the preparation batch and instrument batch.

An analytical batch is a number of samples (20 or less) that are similar in composition and are extracted or digested at the same time and with the same lot of reagents. For methods that do not have a separate extraction (e.g., volatile analyses by purge and trap), the analytical batch is a number of samples (20 or less) that are similar in composition and analyzed sequentially within a calibration period.

Analytical methods that have a separate preparation batch, where the samples are uniquely associated with the preparation batch, may be analyzed across several instrument batches to obtain valid results. EPA Method SW8270 is an example of a method where this type of batch is used. Since the QC resides in the preparation batch, the instrument batch does not affect the method QC sample associations. After the samples (environmental and QC) are extracted, 40 days are allowed for analysis of the batch.

For analytical methods that do not have a separate preparation batch, where the method itself has inseparably linked the preparation and instrument analysis, the instrument batch becomes the defining batch.

6.6.2.2 Laboratory or Method Blank

The laboratory will use a method blank to monitor the batch for interferences and contamination from glassware, reagents, and other potential laboratory-generated contaminants. The laboratory blank is taken through the entire sample preparation process, and is included with each batch of extractions/digestion preparation.

6.6.2.3 Laboratory Control Sample

Laboratory control samples are defined as blank reagent water spiked with a known amount of analyte. The spiking solution contains all the analytes of interest. The LcS is used to evaluate laboratory precision and accuracy. The LcS is analyte-free water for aqueous analyses with all analytes listed for the method in Tables 6-1 and 6-2. Each analyte in the LcS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. (The midpoint is defined as the median point in the curve, not the middle of the range.) The LcS shall be carried through the complete sample preparation and analysis procedure.

The LcS is used to evaluate each analytical batch and to determine if the method is in control. The LcS cannot be used as a calibration verification sample.

One LcS shall be included in every analytical batch. If more than one LcS is analyzed in an analytical batch, results from all LcS analyzed shall be reported. A QC failure of an analyte in any of the LcS shall require appropriate corrective action including qualification of the failed analyte in all of the samples as required.

The performance of the LcS is evaluated against the QC acceptance limits (refer to Tables 6-1 and 6-2). Whenever an analyte in a LcS is outside the acceptance limit, corrective action shall be taken. After the system problems have been resolved and system control has been re-established, all samples in the analytical batch shall be re-analyzed for the out-of-control analyte(s). When an analyte in an LcS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

6.6.2.4 Matrix Spike/Matrix Spike Duplicate Samples

The MS/MSD Field QC samples are specified by the sampling personnel and noted on the CoC record. The MS/MSD will be analyzed at a frequency of 5 percent for each type of sample matrix. The matrix spiking solutions for organic compounds are prepared from the same source as the calibration standards. Inorganic matrix spikes are prepared with analytes of interest at an appropriate concentration. The MS/MSD analytes for organic and inorganic QC samples are the complete target list. The LcS control limits will also apply to MS/MSD samples.

The MS/MSDs are prepared as aliquots of sample spiked with known concentrations of all analytes listed for the method in Tables 6-1 and 6-2. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. The MS/MSD shall be designated on the CoC record.

The MS/MSD is used to document the bias of a method due to sample matrix. The sampling team should select the samples for MS/MSDs. The sample replicates will be generated in the field and will be used by the laboratory to prepare the appropriate MS/MSDs. The MS/MSD results and flags must be associated with or related to samples that are collected from the same site and matrix from which the MS/MSD set were collected. The sampling team should document the unique sample set that an individual MS/MSD pair is associated with.

A minimum of one MS and one MSD shall be designated by the project manager and analyzed with every batch of samples in a batch of up to 20 field samples (i.e., collect up to 20 field samples followed by two additional samples designated as MS and MSD). More than one MS/MSD pair may be submitted as part of the sample group of environmental samples, however, project managers must coordinate with the laboratory providing analytical services for most cost-effective sampling.

The performance of the MS and MSD is evaluated against the QC acceptance limits for the method provided in Tables 6-1 and 6-2. If either the MS or the MSD is outside the QC acceptance limits, the analytes in all related samples shall be qualified in accordance with data flagging criteria.

6.6.2.5 Surrogate Compounds

Surrogates are used to evaluate laboratory accuracy, method performance, and extraction efficiency. Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples. Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

For GC and GC/MS analyses, the analytical process includes the addition, subsequent detection, and recovery calculations of surrogate spiking compounds. Surrogate compounds are added to every sample at the beginning of the sample preparation, and the surrogate recovery is used to monitor sample preparation and the possibility of matrix interference. Method-specific surrogates are used in both matrix and laboratory control samples. Surrogate failure thought to be due to matrix interference must be confirmed by re-analysis. Suitable surrogates will have the following qualities:

- Consist of compounds not requested for analysis.
- Consist of compounds that do not interfere with the determination of the analytes of interest.
- Consist of compounds chemically similar to the analytes of interest.
- Exhibit similar responses to the analytes of interest.

Whenever a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, re-prepare and re-analyze the sample. If corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

6.6.2.6 Internal Standards

Internal standards (IS) are used to accurately quantify data analyte concentrations, to verify extraction efficiency, and verify overall system performance.

Internal standards are measured amounts of certain compounds added after preparation or extraction of a sample.

Internal standards are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects.

Internal standards shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed while the system was malfunctioning shall be re-analyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

6.6.2.7 Performance Evaluation Samples

Periodically, during any sampling round, EPA or commercially available performance testing evaluation (PE) samples may be forwarded to the laboratory as part of the selected contractor's performance evaluation program. The samples will be blind sample to the laboratory and will cover all methods used for project samples.

Analysis of PE samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced. PE samples are sample spiked with known amounts of target analytes, and are analyzed like normal environmental samples to verify the accuracy of the preparation and analytical procedures.

There are three general types of PE samples: 1) PE samples ordered by the selected contractor and submitted to the subcontractor laboratory disguised as regular project samples; 2) PE samples ordered by the subcontractor laboratory from an outside vendor; and 3) PE samples prepared by the QC department of the subcontractor laboratory.

6.6.2.8 Retention Time Windows

Retention time windows are used in GC and High Performance Liquid Chromatography (HPLC) analyses for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 method 8000B.

When the retention time is outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, re-analyze all samples analyzed since the last acceptable retention time check. If corrective actions are not performed, the appropriate validation flag shall be applied to the sample results.

For GC and HPLC methods, the daily retention times of each analyte in the method are checked from the calibration verification standards for that day or the analytical batch. If the daily retention time of an analyte falls within the established absolute retention time window, the daily window is calculated based on that day's retention time and using the +/- 3 Standard Deviation (SD) used in establishing the absolute retention time window.

6.6.2.9 Interference Check Sample

The Internal Check Sample (ICS), used only in ICP analyses, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and inter-element correction factors.

The ICS is analyzed at the beginning of an analytical batch for SW6010, and at the beginning of an analytical batch or once every 12-hour period, whichever is more frequent for SW6020.

When the interference check sample results are outside of the acceptance limits stated in the method, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, re-analyze the ICS. If the ICS result is acceptable, re-analyze all affected samples. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

6.6.2.10 Method Blank

The method blank is used to document contamination resulting from the analytical processes.

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure. A method blank shall be included in every analytical batch.

The presence of analytes in a method blank at concentrations equal to or greater than the reporting limit indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples containing the analyte(s) found in the method blank above the reporting limit shall be re-prepared and re-analyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples, and corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

6.6.2.11 Establishment of Control Limits

The laboratory will monitor the percent spike recovery in LcS, MS/MSDs, and the surrogate recoveries in all samples where surrogates are appropriate. The RPD between MS and MSD or sample and duplicate recoveries, depending on the method, will also be monitored. From these results, in-house control limits will be calculated.

Control limits are automatically monitored through the LIMS system, using an Access-based control charting program and, at a minimum are updated annually. When control limits are updated, hardcopy forms will be distributed to the project manager(s).

As discussed in Section 6.2, Tables 6-1 and 6-2 includes a set of default QC limits for individual analytical methods anticipated for use on this project.

6.7 QUALITY CONTROL PROCEDURES

The following sections discuss analytical holding time compliance, use of control charts, instrument calibration requirements, and laboratory supplies and consumables.

6.7.1 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. The holding time for a sample begins at the time of sample collection. The preparation holding time is calculated from the time the sample is collected to the time the sample preparation process is completed, as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction procedures. If no separate preparation (e.g., extraction) is required, the analysis holding time is calculated from the time the sample is collected to the time all analytical runs are completed, including dilutions, second column confirmations, and any required re-analysis. In methods requiring separate sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required re-analysis.

If holding times are exceeded and the analyses are performed, the results shall be qualified in accordance with data flagging criteria.

6.7.2 Analyte Confirmation

Quantitative confirmation of results at or above the MDL for samples analyzed by GC or HPLC shall be required, and shall be completed within the method-required holding times. For GC methods, a second column is used for confirmation. For HPLC methods, a second column or a different detector will be used. The result from the primary column/detector is the result that shall be reported. If holding times are exceeded and the analyses are performed, the results shall be qualified in accordance with data flagging criteria.

The confirmation column or detector must be calibrated and quality controlled like the primary column or detector. If one result is significantly higher (e.g., >40 percent), the chromatograms should be evaluated to see if an obviously overlapping peak is causing an erroneously high result. If no overlapping peaks are noted, the baseline parameters established by the instrument data system (or operator) during peak integration should be evaluated. If no anomalies are noted, review the chromatographic conditions. If there is no evidence of chromatographic problems, report the higher result. This approach is conservative relative to protection of the environment. The data user should be advised of the disparity between the results on the two columns. The case narrative must explain the actions taken and the rationale for selecting a result.

6.7.3 Control Charts

Control charts are used to track the performance of laboratory control sample recoveries over time. All analytes spiked into the LcS should be tracked via control charts. These charts are useful in identifying trends and problems in an analytical method. Updating these charts annually and reviewing them for possible trends that could compromise data quality is recommended. These charts can also be used to benchmark a laboratory's performance against regulatory requirements to determine possible areas for improvement.

Standard materials, including second source materials, used in calibration and to prepare samples shall be traceable to National Institute of Standards and Technology (NIST), EPA, American Association of Laboratory Accreditation (A2LA), or from another equivalent approved source, if available. If an NIST, EPA, or A2LA standard material is not available, the standard material proposed for use shall be included in an addendum to the QAPP and approved before use. The standard materials shall be current, and managed according to the following expiration policy.

Re-validation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory shall label standard and QC materials with expiration dates.

A second source standard is used to independently confirm initial calibration. A second source standard is a standard purchased from a vendor other than the vendor supplying the material used in the initial calibration standards. The second source material can be used for the calibration verification standard or for the LcS (but shall be used for one of the two). Two different lot numbers from the same vendor do not constitute a second source.

6.7.4 Instrument Calibration Requirements

Analytical instruments shall be calibrated in accordance with the analytical methods. All analytes reported shall be present in the initial and calibration verification standards, and these calibrations shall meet acceptance criteria. Results outside the calibration range are unsuitable for quantitative work and will only give an estimate of the true concentration. For methods SW6010, results shall be within the working range determined by linear range studies. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

The initial calibration must include a minimum number of standard concentrations required by the method including a standard at or below the corresponding reporting limit. If a standard at or below the reporting limits could not be included as part of the initial calibration curve, then a reporting limit verification must be done after the initial calibration.

The initial calibration shall be checked at the frequency specified by in the method using materials prepared independently of the calibration standards. Multipoint calibrations shall contain the minimum number of calibration points specified in the method with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed shall be included in the initial calibration.

If the highest concentration for an analyte exceeds the linearity for that analyte, the laboratory may delete the highest concentration point and recalculate the acceptance with all the remaining points. All results for field samples shall be reported only within the calibration linearity range. No middle data point in the calibration curve shall be excluded in the calculation of the acceptance of the linearity of the curve.

6.7.5 Supplies and Consumables

The laboratory shall inspect supplies and consumables prior to their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored by analysis of LcS. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

6.8 PERFORMANCE AND SYSTEM AUDITS

Technical systems and performance audits may be conducted by the Performing Contractor as independent assessments of sample collection and analysis procedures. Audit results can be used to evaluate the ability of an analytical subcontractor to: 1) produce data that fulfill the objectives established for the program, 2) comply with the QC criteria, and 3) identify any areas requiring corrective action. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of a measurement system. Data validation is also a quantitative check of the analytical process, where all documentation and calculations are evaluated and verified (refer to Section 6.12).

6.9 PREVENTIVE MAINTENANCE

The following sections discuss laboratory maintenance responsibilities, maintenance schedules, and maintenance record keeping.

6.9.1 Maintenance Responsibilities

The subcontracted laboratory must ensure that all instruments and equipment receive routine preventive maintenance, and be recorded in instrument-specific maintenance logbooks. Routine maintenance ensures that the equipment is operating under optimum conditions, reducing the possibility of instrument malfunction.

6.9.2 Maintenance Schedules

Preventive maintenance procedures including lubrication, source cleaning, and detector cleaning (and the frequency of such maintenance) must be performed according to the procedures recommended in the manufacturer’s instrument user manual.

Precision and accuracy data shall be examined for trends and to determine evidence of instrument malfunction. Maintenance must be performed when the instrument begins to degrade as evidenced by the degradation of peak resolution, decreased sensitivity, or failure to meet one or more of the quality control criteria. Instrument logbooks containing maintenance and repair records must be kept in the laboratories at all times.

6.9.3 Maintenance Records

Maintenance and repair of major field and laboratory equipment shall be recorded in field or laboratory logbooks. These records shall document the serial numbers of the equipment, the person performing the maintenance or repairs, the date of the repair, the procedures used during the repair, and proof of successful repair prior to the use of the equipment.

6.10 LABORATORY CORRECTIVE ACTIONS

Problems requiring corrective action in the laboratory shall be documented by the use of a corrective action report. The QA coordinator or any other laboratory member can initiate the corrective action request in the event QC results exceed acceptability limits, or upon identification of some other laboratory problem.

The type and level of corrective action for laboratory activities will depend on the degree of nonconformity. Corrective action may be initiated and carried out by nonsupervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

When errors, deficiencies, or out-of-control situations arise, the QA program systematically implements "corrective actions" to resolve the problem and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if the following are observed with respect to analytical results:

- QC data are outside the acceptable window for precision and accuracy determination.
- QC samples such as the method blank or the laboratory control sample contain contamination above previously described acceptable levels.
- Undesirable trends are detected in spike recoveries or in the RPDs between the QC sample and appropriate duplicate sample.
- Unusual changes occur in detection limits.

- Deficiencies are detected by the QA/QC Department during internal or external audits of the laboratory and/or deficiencies are detected from the results of performance evaluation samples submitted by the Performing Contractor.
- Client inquiries are received concerning the quality of laboratory-generated results.

Corrective action procedures can usually be handled by the chemist, who reviews the preparation and extraction procedures for errors and checks the instrument calibration, instrument sensitivity, and ancillary equipment associated with the instrument. If the problem persists, or cannot be identified after all possible sources of errors are investigated, the matter is then referred to the supervisor and the QA Manager in the form of a corrective action report. The corrective action report is utilized for documenting the suggested corrective need and the return to control. Additional documentation to support the return to control is located in the associated instrument analysis logbook and the instrument-specific maintenance logbook. Once resolved, the corrective action report is completed describing the corrective action procedure. This report is maintained in a project file. A copy of the completed corrective action report is forwarded to the Performing Contractor's Project Manager and the Data Management Coordinator.

Recommended holding times for samples are monitored closely. If a sample is analyzed outside a holding time, the corrective action report is used to report any holding time violations. The QA Manager and/or Program Manager will immediately notify the Performing Contractor's Data Management Coordinator of the holding time violation by phone, followed up by a hard copy of the completed corrective action report by both facsimile and first-class mail. Samples may be re-collected if holding times are exceeded prior to either extraction or analysis of the environmental sample at no additional cost to the client.

6.11 AUDITS AND REPORTS

Effective management of field sampling and analytical effort requires timely assessment and review of field and laboratory activities. Such assessment and review will require effective interaction and feedback between the Performing Contractor's field sampling team, the Project Manager, the Data Management Coordinator, and the QA Manager of the laboratory. Specific QA report procedures and contents are summarized below.

Sampling and analysis field operations will be reviewed by staff members responsible for the activity to determine if the sampling QC requirements are being fulfilled. The laboratory QA Manager is responsible for keeping the Performing Contractor's Project Manager and the Data Management Coordinator up to date regarding the status of their respective tasks. This procedure ensures that solutions are developed and implemented as quickly as possible.

The QA Manager will include the following elements in a report detailing the status of the system's data quality:

- Activities and general program status.
- Calibration and QC problems.
- Unscheduled maintenance activities.
- Corrective actions.
- Status of any unresolved problems.
- Assessment and summary of data completeness.
- Significant QA/QC problems and recommended and/or implemented solutions.

The QA auditor will prepare audit reports following each performance and system audit. These reports will address the audit results and provide a qualitative assessment of overall system performance. They will be submitted to the QA Manager and the Laboratory Director, and to the Performing Contractor's Project Manager and Data Management Coordinator.

6.12 DATA REDUCTION, VALIDATION, AND REPORTING

The data reduction, review, reporting, and validation procedures described in this section will ensure that 1) complete documentation is maintained, 2) transcription and data reduction errors are minimized, 3) the data are reviewed and documented, and 4) the reported results are qualified if necessary. Laboratory data reduction and verification procedures are required to ensure the overall objectives of analysis and reporting meet method and project specifications.

Data verification and validation involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements, and calculations. To help ensure the project DQOs are achieved, the Performing Contractor will monitor all aspects of data gathering as part of the comprehensive groundwater investigation work effort. The laboratory is required to submit an electronic data deliverable (EDD) containing each Sample Delivery Group (SDG) as a separate computer data file. Each SDG should have data for all environmental results and field QC, as well as all associated lab QC data (e.g., Matrix Spikes, Laboratory Control Samples, Method Blanks) for QA/QC review. The laboratory must submit the EDD according to general guidelines established by the Performing Contractor. This data shall be placed in the master project database for subsequent analysis and tabulation.

Data storage and documentation will be maintained using logbooks, data sheets, and computer files that will be kept at the laboratory. All computer-generated raw data are stored on magnetic tape, or other media, and will be maintained along with all paper copies for not less than 5 years.

6.12.1 Data Reduction

This section discusses field and laboratory data reduction.

6.12.1.1 Field Data Reduction

Field measurements and observations will be made and documented during the sampling project. Field data will be recorded on standard forms and in a field notebook to provide a permanent record of field activities.

The Performing Contractor Project Manager and Data Management Coordinator will ensure that all field data forms are evaluated for the factors listed below:

- A check for completeness of field records will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and procedures specified in this QAPP and the companion FSP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

- Identification of valid samples involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. The lithologic and geophysical logs may be consulted to determine stratigraphic variations within the subsurface. Records should note sample properties (e.g., clarity, color, and odor).

- The results of field tests obtained from similar areas will be correlated and the findings documented.
- Anomalous field data will be identified and explained to the extent possible. The significance of anomalous data will be discussed in the technical report.

Data quality checks will be performed during the processing of field data. The purpose of these checks is to identify anomalous data (i.e., data that do not conform to the pattern established by other observations). The principal method of this data assessment will be the performance of routine checks to ensure that data are correctly transcribed and that identification codes and sampling information matches the corresponding information in the associated field documentation.

6.12.1.2 Laboratory Data Reduction

Data reduction calculations are part of laboratory SOPs. The first step in laboratory data reduction is data processing. In general, an analyst processes data through:

- Manual calculations of instrument calibration and sample results (typically performed on method-specific bench sheets).
- Manual input of raw data for subsequent computer processing.
- Direct acquisition and processing of raw data by a computer.

Raw data are to be entered in bound laboratory notebooks. The raw data entered will be sufficient to document all factors used to arrive at the reported value for each sample. Regardless of how data processing is done at the laboratory, sufficient documentation is to be presented to allow another analyst to review and check the data.

Laboratory personnel are to conduct a review of both sample and laboratory data. At a minimum, this review will focus on:

- CoC forms.
- Holding times.
- Method calibration limits.
- Method blanks.
- Laboratory-established detection limits.

- Analytical batch control records, including MS/MSD results.
- Corrective actions.
- Formulas used for analyte quantitation.
- Calculations supporting analyte quantitation.
- Completeness of data.

The check of laboratory data completeness will ensure that: 1) all required samples and analyses have been processed, 2) complete records exist for each analysis and the associated QC samples, and 3) procedures specified in this QAPP have been implemented.

6.12.2 Data Quality Assessment

The following sections describe laboratory and Performing Contractor data quality review and verification requirements, as well as data validation and reporting.

6.12.2.1 Laboratory

All sample analyses are reported through the LIMS system. The analyst is responsible for the first level of data review. Notes are maintained by the analyst and submitted with each data package.

Control charts are generated automatically through an Access program designed to receive data collected in the LIMS for all methods and analytes. The analyst initiates a discrepancy report, if warranted.

The laboratory supervisor oversees the daily analytical activities of their respective assigned areas. Narrative notes and QC information provided by the analyst are reviewed by the supervisor or peer chemist. The final results are reported through the LIMS and/or a full data package that includes raw data and forms. All final results are reviewed by a laboratory supervisor.

Initial and continuing calibration curves and any discrepancies are reviewed by the supervisor. The supervisor is responsible for ensuring contractual and technical compliance for samples collected at the Site.

The supervisor reviews and approves the case narrative. The supervisor may be asked to confer with the Performing Contractor's Data Management Coordinator regarding technical issues.

All discrepancies in the initial and calibration verification control criteria are to be reviewed by the Laboratory Quality Assurance Manager (LQAM). The LQAM is responsible for ensuring contractual and technical compliance for samples received. The LQAM reviews and approves the case narrative, conducts contractual compliance review of at least 10 percent of the data packages, reviews items in the data package such as calculations, determines if both QC and method criteria have been met, and checks that the proper forms have been used and the control criteria have been adequately described. The LQAM may be asked to confer with the Performing Contractor's Data Management Coordinator regarding technical issues.

The LPM has final data review and validation responsibilities. The LPM ensures that the final data deliverable is prepared and that permanent data packages are properly maintained. The LPM also reviews the data package for completeness and quality and reviews the narrative for accuracy. The LPM also serves as a liaison between the laboratory and the Performing Contractor. Final data packages, complete with cover letter, will be sent to the Performing Contractor by the LPM.

If, at any point during data review, a condition adverse to quality is identified, a discrepancy report may be initiated to return the data to a satisfactory status. The situation is analyzed for both incidental conditions as well as chronic trends that have affected the quality of the data being generated. The impact of the condition is evaluated and, if deemed to have no adverse effect on the quality of the data, the investigation is closed with written narrative to support the decision. If the condition is deemed to cause adverse effects to the quality of the data, the relevant manager is notified and the following steps are taken:

- The cause of the adverse effect is determined.
- Any impacts to the data are evaluated.
- Corrective actions are taken to preclude a recurrence of the adverse effect.
- The adverse condition as well as the steps taken to alleviate this condition are documented and reported to the appropriate manager.
- The implementation of the corrective action is verified.

Once the corrective action has been determined to be effective, the case is closed out with written narrative documenting all steps taken. If the corrective action is determined to not be effective, a re-evaluation of the corrective action process must occur. The re-evaluation of the corrective action process should include at a minimum the supervisor, the LQAM, and the LPM. The corrective action process may be repeated and/or an alternate corrective action may be implemented. This process will continue until the system is demonstrated to be back in control.

6.12.2.2 Performing Contractor

The Performing Contractor shall review the entire definitive data report package, and with the field records, apply the final data qualifiers for the definitive data. The laboratory shall apply data qualifying flags to each environmental field QC sample (i.e., ambient blanks, EBs, MS samples, and MSD samples). The Performing Contractor shall review the field QC samples and field logs, and shall then appropriately flag any of the associated samples identified with the field QC sample. Each MS sample shall only be qualified by the laboratory, while the Performing Contractor shall apply the final qualifier for a matrix effect to all samples collected from the same site as the parent sample or all samples showing the same lithologic characteristics as the MS/MSD.

The Performing Contractor shall: 1) determine if the DQOs have been met, and 2) calculate the data completeness for the project. These results shall be included in the data package deliverable. Contractual requirements for payment of laboratory services are beyond the scope of this document and may be different than the data validation requirements. In addition to the validation described above, it may be necessary to also validate the data by other appropriate guidelines.

6.12.2.3 Third-Party Data Validation

Data validation will be conducted by a qualified third-party data validation subcontractor familiar with the analytes and analytical methods specified for this program. The National Functional Guidelines shall be used as the primary guidance documents for validation purposes. Validation activities will be performed according to the following documents:

- EPA (2014a) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.
- EPA (2014b) Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.

Third-party data validation will include 100 percent of the environmental samples collected for laboratory analysis using the National Functional Guidelines and Stage 2B data validation protocol

[Appendix B of the Guidance for Labeling Externally Validated Laboratory Data for Superfund Use (EPA 540-R-08-005)]. EPA Stage 2B data validation will be performed on the summary (i.e., no raw data) packages for analyses of groundwater samples analyzed by EPA and non-EPA methods. The validation of non-Contract Laboratory Program (CLP) analyses must be performed using the requirements and criteria from the analytical method(s) referenced and this QAPP. The third-party data reviewer will request any missing information from the laboratory and facsimile a copy of this request to the client's project manager when missing information is requested. The data reviewer will validate all components of the data package even when an individual QC element has rejected the data. All data will continue through the validation process and be qualified and re-qualified as many times as they fail to meet established criteria. An overall final qualification of results will encompass the impact of individual findings and will be determined using the professional judgment of a senior data reviewer.

Data summary packages provided by the contract laboratory should consist of sample results and QA/QC summaries (equivalent to CLP Forms 1 through XIV for inorganic analyses), and all raw data associated with the sample results and QA/QC summaries.

All data validation procedures will be in accordance with EPA Functional Guidelines requirements (as indicated above) and industry standards. Table 6-6 includes a summary of EPA Level 3 data validation elements for inorganic analysis, including QC review elements, data qualifiers, and data qualifier descriptors.

6.12.3 Data Reporting

Project data reporting, including hardcopy and electronic data submittals, format conformance, and delivery of final analytical data is discussed in the following sections.

6.12.3.1 Hardcopy Data Submittals

Hardcopy data reporting package requirements are outlined below. The data reporting requirements and formats may be modified based on project DQOs. Modifications to reporting requirements shall be specified in the project specific QAPP addenda, as required. All hard copy submittals will be signed by the Laboratory Director certifying that the data provided therein is correct and is suitable for its intended use. Each data package must stand alone analytically and must not rely on other data packages for QC completeness.

Table 6-6
Data Validation Elements and Qualification

QC Review Elements EPA Stage 2B Validation for Inorganics and Organics	Data Validation Qualifiers	Data Qualifier Descriptors
• Holding times • Initial calibration • Continuing calibration • Blanks (Laboratory and Field) • Surrogate recovery • Matrix spike and matrix spike duplicate recovery • Duplicate sample RPD • Laboratory control sample recovery • Internal standard performance • ICP interference check • MSA and serial dilution checks • Field duplicate sample analysis RPD • Reporting limits • Overall assessment of data in the SDG	B: The sample result is less than 5 times (10 times for common organic laboratory contaminants) the blank contamination. The result is considered not to have originated from the environmental sample, because cross-contamination is suspected. J: The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value. R: The sample result is rejected and not usable for any purpose. The presence or absence of the analyte cannot be verified. U: The analyte was not detected above the MDL. UJ: The analyte was not detected above the MDL; however, the MDL is uncertain and may be elevated above normal levels. Y: Confirmation column results indicate a non-detect for the target analyte.	a: The analyte was found in the method blank. b: The surrogate spike recovery was outside quality control criteria. c: The MS and/or MSD recoveries were outside control limits. d: The laboratory control sample recovery was outside control limits. e: A holding time violation occurred. f: The duplicate/replicate sample's relative percent difference (RPD) was outside the control limit. g: The data met prescribed criteria as detailed in the QAPP. h: The method requires a confirmation result, but none was performed. k: The analyte was found in a field blank. l: The second column confirmation result indicates the analyte was not confirmed. n: The laboratory case narrative indicated a QC problem. p: Professional judgment determined the data should be qualified. q: The analyte detection was below the PQL. r: The result is above the instrument's calibration range. t: The temperature was outside acceptance criteria.

Final hard copy reports from the laboratory will include at least the following elements:

- A copy of the signed CoC form showing the date and time the sample was received.
- A cross-reference of field sample number to laboratory sample number.
- A cross-reference to identify applicable laboratory QC samples with the field samples.
- A cross-reference to identify each batch to the QC samples.
- A glossary to define the symbols and terms used in the laboratory report.

- Sample collection, extraction, and analysis dates.
- Sample receiving temperature.
- A list of detection limits.
- A list of practical quantitation limits.
- Instrument identification number for the tests performed.
- Instrument calibration summary data to verify that initial and continuing calibration criteria are in control.
- Environmental sample results reported with at least two significant figures.
- The analytical results for all detected and non-detected QAPP target analytes.

Depending on the DQOs for a project, the definitive data package will include a QA/QC summary report, providing data on method blanks, LcS, MS/MSDs, and any other QA/QC samples relevant to all initial, diluted, or re-analyzed samples. The QA/QC report will also contain a narrative that details all elements relevant to the sample results for both inorganic and organic analyses. The narrative will discuss each element; whether the element was acceptable or not and why; if outside acceptance criteria, the value and the criteria will be noted; corrective action taken; and the effect any problems had on the quality of the data.

Results of all initial, diluted, and re-analyzed sample analyses for all methods as explained below:

1. The initial results are the undiluted or least diluted and most QC compliant sample analysis.
2. The diluted results are those results related to the initial sample analysis which, by virtue of a calibration range exceedance, caused the diluted analysis to be performed. All analytes reported in the initial results will be reported in the diluted results. All dilutions should be analyzed within holding times.
3. The re-analyzed sample results are those results usually related to corrective action procedures. The most common situations are surrogate recovery and IS area failures. If surrogate results or IS areas are outside control limits (high or low) the analysis is considered out of analytical control. The corrective action is to re-prepare and re-analyze the sample. Upon re-analysis, if the results are inside control limits, the laboratory reports only the in control results. However, if results are outside control limits in the re-analysis, then both sample results must be reported to document the corrective action attempt.

At the direction of the Performing Contractor, the laboratory will provide hardcopy data packages equal to a full raw data deliverable data package.

6.12.3.2 Electronic Data Submittals

Laboratory services providers will report all data in electronic and hard copy format. The electronic data will be reported as EDDs in a format specified by the Performing Contractor. Hard copy data will be reported in the Data Package format and using summary forms. If the laboratory cannot generate summary forms, the following elements which comprise a minimum data package, will be delivered:

- A copy of the signed CoC record showing the date and time the sample was received.
- A cross-reference of field sample number to laboratory sample number.
- A cross-reference to identify applicable laboratory QC samples with the field samples.
- A cross-reference to identify each batch to the QC samples.
- A glossary to define the symbols and terms used in the laboratory report.
- Sample collection, extraction, and analysis dates.
- Sample receiving temperature.
- A list of detection limits.
- A list of practical quantitation limits.
- Instrument identification number for the tests performed.
- Environmental sample results reported with at least two significant figures.
- The analytical results for all detected and non-detected QAPP target analytes.

A QA/QC summary report, providing data on method blanks, LcS, MS/MSDs, and any other QA/QC samples relevant to all initial, diluted, or re-analyzed samples will be provided. The QA/QC report will also contain a narrative that details all elements relevant to the sample results for both inorganic and organic analyses. The narrative will discuss each element; whether the element was acceptable or not and why; if outside acceptance criteria, the value and the criteria will be noted; corrective action taken; and the effect any problems had on the quality of the data.

The results of all initial, diluted, and re-analyzed sample analyses for will follow the guidelines presented above for the EDDs.

6.12.3.3 Format Conformance with Agencies

In determining EDD format, the Performing Contractor must be aware that EDDs should conform to the formatting requirements of other agencies. The EDD format and content must be sufficient to meet the data delivery requirements to Ecology and the EIM system (refer to Section 6.4.3). The Performing Contractor's Statement of Work will specify the project electronic formatting requirements. Project-specific QAPP addenda will further identify electronic requirements to support regulatory agency databases, as required.

6.12.3.4 Formatting Conformance with Performing Contractor

Data generated during sampling activities will be incorporated into an electronic database. A geographic information system (GIS) may be utilized as a tool to aid in the graphical presentation and interpretation of physical and analytical data collected during sampling activities. The Performing Contractor shall provide the laboratory with an SOP for data generation that includes instructions regarding data review for consistency and status, and maintenance of magnetically stored data to ensure integrity. Electronic laboratory data are delivered to the Performing Contractor in EDDs and formats for use with GIS data (as applicable).

Hard copy data reports will be provided to the client in various formats depending on contract and end user requirements.

6.12.3.5 Delivery of Final Analytical Data to Ecology

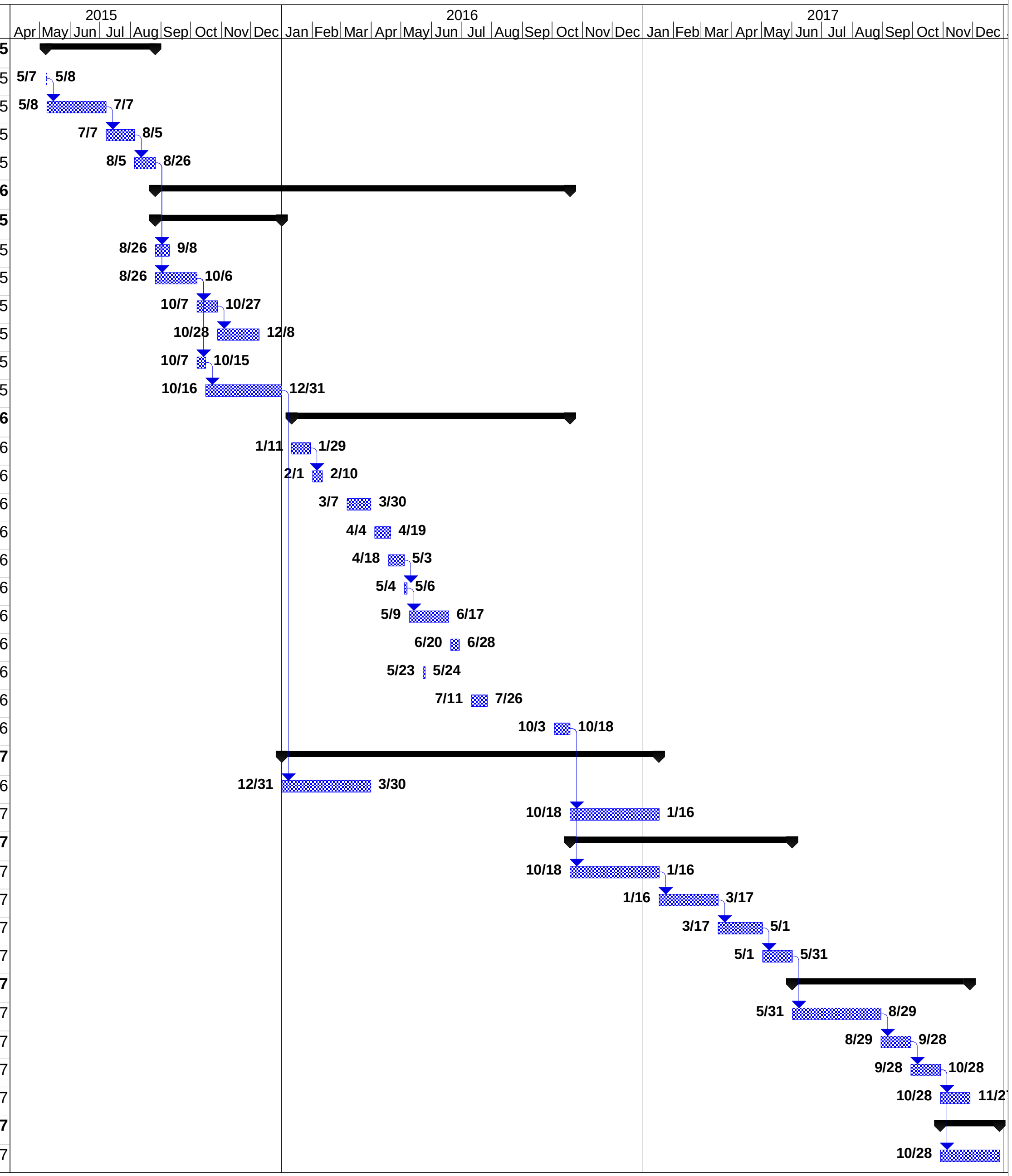
Within ninety (90) days following receipt of the final data reports from the laboratories, all verified field data, validated analytical results, QA/QC sample results and associated sample location and project descriptive information shall be submitted to Ecology. The submission process will consist of uploading the date to Ecologies EIM system (refer to Section 6.4.3). The data submitters are responsible for the correctness and completeness of the data submitted to EIM. The data submitted to EIM will be identified with a status of "Final"; and will be fully qualified according to the QAPP. Date will be submitted in accordance with specifications referenced in Ecology's Toxic Cleanup Program Policy 840: Data Submittal Requirements.

Section 7
Project Schedule

The project schedule is presented in Figure 7-1. The schedule begins with submission of the Draft Phase 2 Work Plan scheduled for May 8, 2015 and extends through submission of the Draft Cleanup Action Plan scheduled for December 27, 2017. The schedule incorporates the work plan and report deliverables and deliverable preparation schedule included in the Agreed Order. Agency review and comment periods have been included and estimated based on past experience. The project schedule utilizes calendar days for project deliverables and working days for completion of field-related activities.

Figure 7-1. Remedial Investigation / Feasibility Study Schedule
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

ID	Task Name	Duration	Start	Finish
1	**RI Work Plan**	**79 days**	**Thu 5/7/15**	**Wed 8/26/15**
2	Draft RI Work Plan Submittal	1 eday	Thu 5/7/15	Fri 5/8/15
3	Ecology Review and Comment	60 edays	Fri 5/8/15	Tue 7/7/15
4	Prepare Final RI Work Plan	29 edays	Tue 7/7/15	Wed 8/5/15
5	Ecology Approval of Final RI Work Plan	21 edays	Wed 8/5/15	Wed 8/26/15
6	**Field Investigation**	**300 days**	**Wed 8/26/15**	**Tue 10/18/16**
7	**Investigation 2015**	**92 days**	**Wed 8/26/15**	**Thu 12/31/15**
8	-Well Inventory	10 days	Wed 8/26/15	Tue 9/8/15
9	-Utility Location//Permits/Mobilization	30 days	Wed 8/26/15	Tue 10/6/15
10	-Coring & Packer Testing	15 days	Wed 10/7/15	Tue 10/27/15
11	-Well Construction/Development	30 days	Wed 10/28/15	Tue 12/8/15
12	-Columbia River Sediments (AOC)	7 days	Wed 10/7/15	Thu 10/15/15
13	-Plant Area AOC (and associated SWMUs)	55 days	Fri 10/16/15	Thu 12/31/15
14	**Investigation 2016**	**202 days**	**Mon 1/11/16**	**Tue 10/18/16**
15	-1st QTR GW Sample Event	15 days	Mon 1/11/16	Fri 1/29/16
16	--Slug Tests and Water Level Study	8 days	Mon 2/1/16	Wed 2/10/16
17	-Aquifer Testing (Constant Rate & Production Wells)	18 days	Mon 3/7/16	Wed 3/30/16
18	-2nd QTR GW Sample Event	12 days	Mon 4/4/16	Tue 4/19/16
19	-Rectifier Yard AOC	12 days	Mon 4/18/16	Tue 5/3/16
20	-Wetlands AOC	3 days	Wed 5/4/16	Fri 5/6/16
21	-All Remaining SWMUs (NESI after June)	30 days	Mon 5/9/16	Fri 6/17/16
22	--NESI Trenching / Test Pits (Dry Season Permit)	7 days	Mon 6/20/16	Tue 6/28/16
23	-Stormwater Pond Drawdown Study	2 days	Mon 5/23/16	Tue 5/24/16
24	-3rd QTR GW Sampling Event	12 days	Mon 7/11/16	Tue 7/26/16
25	-4th QTR GW Sampling Event	12 days	Mon 10/3/16	Tue 10/18/16
26	**EIM Data Submittal**	**272 days**	**Thu 12/31/15**	**Mon 1/16/17**
27	2015 EIM Data Submittal	90 edays	Thu 12/31/15	Wed 3/30/16
28	2016 EIM Data Submittal	90 edays	Tue 10/18/16	Mon 1/16/17
29	**RI Report**	**161 days**	**Tue 10/18/16**	**Wed 5/31/17**
30	Draft RI Report Submittal	90 edays	Tue 10/18/16	Mon 1/16/17
31	Ecology Review and Comment	60 edays	Mon 1/16/17	Fri 3/17/17
32	Prepare Final RI Report	45 edays	Fri 3/17/17	Mon 5/1/17
33	Ecology Approval of Final RI Report	30 edays	Mon 5/1/17	Wed 5/31/17
34	**FS Report**	**128 days**	**Wed 5/31/17**	**Mon 11/27/17**
35	Draft FS Report Submittal	90 edays	Wed 5/31/17	Tue 8/29/17
36	Ecology Review and Comment	30 edays	Tue 8/29/17	Thu 9/28/17
37	Prepare Final FS Work Plan	30 edays	Thu 9/28/17	Sat 10/28/17
38	Ecology Approval of Final FS Work Plan	30 edays	Sat 10/28/17	Mon 11/27/17
39	**Draft Cleanup Action Plan**	**43 days**	**Sat 10/28/17**	**Wed 12/27/17**
40	Draft Cleanup Action Plan Submittal	60 edays	Sat 10/28/17	Wed 12/27/17



Project: Goldendale
Date: 05/01/15

Task | Milestone | Summary | External Milestone

Section 8
References

1. Aiken, C.M. 1993. Archaeology of Oregon. U.S. Department of the Interior, Bureau of Land Management. Oregon State Office. 333 pp.

2. Aleris. 2010. Letter and attached data regarding groundwater monitoring at the Closed Spent Pot Liner Landfill-Goldendale, Washington. Prepared by Pauline Moorman of Aleris International, Inc. to Paul Skyllingstad of Washington Department of Ecology. March 8th.

3. ARCADIS. 2008a. NPDES Ponds Site Investigation Report and Closure Alternatives Analysis, Lockheed Martin Corporation, Goldendale, Washington. Prepared by ARCADIS U.S., Inc. for Lockheed Martin Corporation. January.

4. ARCADIS. 2008b. Supplemental Sampling Results, NPDES Ponds. October.

5. ARCADIS. 2011a. Site Closure Report, NPDES Ponds, Columbia Gorge Aluminum, Goldendale, Washington. Prepared by ARCADIS U.S., Inc. for Lockheed Martin Corporation. January.

6. ARCADIS. 2011b. 2010 Groundwater Monitoring Report, East Surface Impoundment, Goldendale, Washington. Prepared by ARCADIS U.S., Inc. for Washington State Department of Ecology.

7. ASTM. 2000. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure, D2488-00. American Society of Testing and Materials.

8. Bakemeier. 2009. Groundwater Monitoring Data (through 2008) at the Closed Spent Pot Liner Landfill – Goldendale, Washington. Prepared by Bakemeier, P.C., and sent to Washington Department of Ecology. March 12th.

9. Century. 1986. Commonwealth Aluminum, East Surface Impoundment, Groundwater Quality Assessment Program, 1985 Plan, First Report. Prepared by Century Environmental Sciences for Commonwealth Aluminum. June 4th.

10. CH2MHill. 1996. Goldendale Aluminum Slope Repairs Proposal and Grading Plan. Prepared by CH2MHill for Commonwealth Aluminum and Goldendale Aluminum. September 5th.

11. CH2MHill. 1997. Revised Cost Breakdown for Repair of Damaged Ditch and Liner. Prepared by CH2MHill for Columbia Aluminum Corporation. May 2nd.

12. CH2MHill. 2009. Letter Report regarding Updated North SPL Building Closure Certification, Columbia Gorge Aluminum, Goldendale, Washington. Prepared by CH2MHill for Columbia Gorge Aluminum. May 21st.

13. Columbia Gorge Aluminum. 2011. Industrial Storm Water Pollution Prevention Plan. For Columbia Gorge Aluminum Company. Revised May 10th.

14. Compton, Robert R. 1985. Geology in the Field. Published by John Wiley & Sons, Inc., New York, New York,.

15. DAHP 2010. Washington State Standards for Cultural Resources Reporting, Survey & Inventory Standards. Washington State Department of Archaeology & Historic Preservation. January.

16. Damkaer and Dey. 1986. Industrially-Polluted Sediments of the Columbia River near Wenatchee, Washington. Preliminary report to the U.S. Environmental Protection Agency. Prepared by D.M. Damkaer and D.B. Dey for the U.S. Environmental Protection Agency and National Marine Fisheries Service, National Oceanic and Atmospheric Administration. October.

17. Ecology. 1990a. Central Operations Memorandum, RCRA Dangerous Waste Compliance Inspection at Columbia Aluminum on May 9-10, 1990. Washington Department of Ecology. September 28th.

18. Ecology. 1990b. Central Operations Memorandum, Recommendation for Enforcement – Caustic Spill at Columbia Aluminum. Prepared by Wayne Wooster, Washington State Department of Ecology. October 23rd.

19. Ecology. 1990c. Central Operations Memorandum, Revised Recommendation for Enforcement – Caustic Spill at Columbia Aluminum (follow-up to original October 23, 1990 memorandum. Prepared by Wayne Wooster, Washington State Department of Ecology. November 7th.

20. Ecology. 1994. Natural Background Soil Metals Concentrations in Washington State Washington Department of Ecology Toxics Cleanup Program, Publication #94-115. October.

21. Ecology. 1995a. Guidance on Sampling and Data Analysis Methods. Washington State Department of Ecology. Publication No. 94-49. January.

22. Ecology. 1995b. Transmittal of Dangerous Waste Inspection Report (and attached report). Letter prepared by Don Reif, Washington Department of Ecology, sent to Wayne Wooster Columbia Aluminum Corporation. December 14th.

23. Ecology. 1997. Conditional Approval letter for Request to Convert Two Existing Enclosed Waste Piles into Pot Liner Containment Buildings. Prepared by Paul Skyllingstad, Washington Department of Ecology to Wayne Wooster, Goldendale Aluminum Company. January 2nd.

24. Ecology. 2003. Guidance for Site Checks and Site Assessments for Underground Storage Tanks. Washington State Department of Ecology. Publication No. 90-52. Revised April.

25. Ecology. 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Publication No. 04-03-030. July.

26. Ecology. 2008. Sediment Sampling and Analysis Plan Appendix (Obsolete). Ecology Publication No. 03-049-043. Revised February. This document has been replaced by SCUM II.

27. Ecology. 2009. Letter regarding Certification of Clean Closure for the Spent Pot Liner Containment Building (the North Building). Letter prepared by Robert King, Washington Department of Ecology to Galen May, Columbia Gorge Aluminum. July 16th.

28. Ecology. 2013. Sediment Management Standards - Chapter 173-204 WAC, Final Rule. Washington State Department of Ecology. February 22nd. <https://fortress.wa.gov/ecy/publications/SummaryPages/1309055.html>

29. Ecology. 2014. Agreed Order No. DE 10483 in the Matter of Remedial Action for the former Columbia Gorge Aluminum Smelter signed by Lockheed Martin Corporation and NSC Smelter, LLC. May 1st.

30. Ecology. 2015a. Industrial Stormwater General Permit. Washington Department of Ecology. A National Pollution Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated with Industrial Activities. Effective January 2, 2015.

31. Ecology 2015b. Ecology Review of Draft Remedial Investigation Phase 1 Work Plan, Columbia Gorge Aluminum Smelter, FSID 95415874. Washington State Department of Ecology. Also contains comments from the Yakama Nation Fisheries Program. January 29th.

32. Ecology. 2015c. Final Sediment Cleanup User's Manual II. Accessed April 20th online at: https://fortress.wa.gov/ecy/publications/SummaryPages/1209057.html. Revised March.

33. Ecology 2015d. Ecology Review of Draft Remedial Investigation Phase 2 Work Plan, Columbia Gorge Aluminum Smelter, FSID 95415874. Washington State Department of Ecology. Also contains comments from the Yakama Nation Fisheries Program. June 29th.

34. ENSR. 1991. RCRA Part B Permit Application, Columbia Aluminum Corporation, Goldendale, Washington Prepared by ENSR Consulting and Engineering for Columbia Aluminum Corporation and submitted to Washington State Department of Ecology. April.

35. ENSR. 1994. Baseline Sediment Characterization, Columbia Aluminum Company. Prepared by ENSR Consulting and Engineering for Columbia Aluminum Company. May.

36. EPA. 1992. Specifications and Guidance for Contaminant-Free Sample Containers. EPA/540/R-93/051, PB93-963316.

37. EPA. 1996. Low Flow (Minimal Drawdown) Groundwater Sampling Procedures. By Puls, R.W., and M.J. Barcelona. EPA/540/S-95. April.

38. EPA 2001. Method for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823-B-01-002. October. http://water.epa.gov/polwaste/sediments/cs/collection.cfm

39. EPA. 2002a. Groundwater Sampling Guidelines for Superfund and RCRA Project Managers, EPA 542-S-02-001. May

40. EPA. 2002b. Guidance for Quality Assurance Plans (EPA QA/G-5), EPA/240/R-02/009, Office of Environmental Information. December.

41. EPA. 2014a. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review. OSWER 9355.0-131. USEPA-540/R-13-001. August.

42. EPA. 2014b. USEPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Data Review. OSWER 9355.0-132. USEPA-540/R-14-002. August.

43. Fujitani Hilts & Associates 2001. Draft Geotechnical Report, Cliffs Project. Prepared by Fujitani Hilts & Associates, Inc. for Goldendale Aluminum Company. May 31st.

44. GeoPro. 2014. 2014 Annual Groundwater Monitoring Report, West Surface Impoundment, Columbia Gorge Aluminum Smelter Site, Prepared GeoPro LLC in cooperation with Blue Mountain Environmental Consulting, Inc. on behalf of NSC Smelter LLC and Lockheed Martin Corporation. June 2nd.

45. Goldendale Aluminum Company. 1996. Underground Storm & Sanitary Sewer Piping w/ Chm'l & OilStr'g Areas, Drawing Number A1/1752, Revision 4. November 8th.

46. Goldendale Aluminum Company. 1997. Revised Part B Dangerous Waste Permit Application. Prepared by Goldendale Aluminum Company and submitted to Washington Department of Ecology. October 1st.

47. Golder. 1988. Draft Groundwater Monitoring Program Evaluation, Columbia Aluminum Corporation, Goldendale, Washington. Prepared by Golder Associates Inc. for Columbia Aluminum Corporation. May.

48. Golder. 1995. Closure Plan and Contingent Post-Closure Plan for SPL Containment and Storage Buildings. Prepared by Golder Associates, Inc. for Columbia Aluminum Corporation. October 25th.

49. Golder. 1996a. Certification of Closure, South and South Annex Spent Pot Liner Containment Building. Prepared by Golder Associates Inc. for Columbia Aluminum Corporation. January 17th.

50. Golder. 1996b. Final Recommendations for Certification of CRRUD Room and North SPL Building as Containment Buildings. Prepared by Golder Associates for Columbia Aluminum Corporation. February 22nd.

51. Golder. 1996c. Certification of the Cathode Demolition and North SPL Containment Buildings. Prepared by Golder Associates for Goldendale Aluminum Company. December 16th.

52. Harvey Aluminum. 1971a. Groundwater Drain Plan, Drawing Number W103-99-410, As-Built Revision 3, 11/30/71. Prepared by Harvey Aluminum, Inc., Torrance, California.

53. Harvey Aluminum. 1971b. Paving and Roads for the Aluminum Storage Area, Drawing A01099, Revision 3. Prepared by Harvey Aluminum, Inc., Torrance, California. November 11th.

54. In-Situ. 2011. Technical note, Pneumatic Slug Testing Using the Level Troll™ 700. In-Situ, Inc. October.

55. ITRC 2011. Incorporating Bioavailability into the Evaluation of Contaminated Sediment Sites. CS-1. Interstate Technology Regulatory Council. February.

56. JUB Engineers. 1985. Sediment and Water Quality Surveys near the Commonwealth Aluminum Plant. Prepared by JUB Engineers, Inc. for Commonwealth Aluminum. Winter.

57. KPUD 2014. JD Pool Pumped Storage Hydroelectric Project, Pre-Application Document, Federal Energy Regulatory Commission Project No. 1333, Klickitat County, Washington for Public Utility District No. 1 of Klickitat County, Washington. October.

58. Landau. 1995. Final Air Operating Permit Application, WAC 173-401. Prepared by Landau Associates, Inc., for Columbia Aluminum Corporation, Goldendale, Washington. June 2nd.

59. Lockwood Greene et al. 1999. Grading Plan, Pond Expansion South Shipping Building Work, Drawing Number A1/4025. Prepared by Lockwood Greene and Moffet Nichol & Bonney, Inc. for Goldendale Aluminum Company. January.

60. Martin Marietta. 1980. Goldendale Plant Cell Addition Site Plan, Site Utilities Plan, Sheets 1, 2, and 3, Drawing Numbers 2009-0103A, B, and C. Approved for construction in May and June. Stamped As-Built.

61. Parametrix. 2004a. Part B Dangerous Waste Permit Application, Goldendale Aluminum Company. Prepared by Parametrix for Goldendale Aluminum Company. August.

62. Parametrix. 2004b. Groundwater Sampling Data Analysis and Evaluation Plan for Goldendale Aluminum West Surface Impoundment Facility. Prepared by Parametrix for Goldendale Aluminum Company.

63. Parametrix. 2004c. West Surface Impoundment Closure and Post Closure Plan. Prepared by Parametrix for Goldendale Aluminum Company. November.

64. Parametrix. 2004d. Construction Quality Assurance Report, West Surface Impoundment. Prepared by Parametrix for Goldendale Aluminum Company. November.

65. Parametrix. 2007. Two-Year Post-Closure Groundwater Evaluation, Goldendale Aluminum, West Surface Impoundment Facility. Prepared by Parametrix for Northwest Aluminum. September.

66. PGG. 2010. Preliminary Site Investigation Report, Plant Area – Former Goldendale Aluminum Company Smelter. Prepared by Plateau Geoscience Group LLC in contract with Blue Mountain Environmental Consulting, Inc. for Golden Northwest Aluminum Holding LLC. October 7th.

67. PGG. 2011. Certificate of Closure for Cathode Dismantling and Recovery Building. Prepared by Plateau Geoscience Group LLC in collaboration with Blue Mountain Environmental Consulting, Inc. for Columbia Gorge Aluminum Company.

68. PGG. 2012a. Photographs of SWMU 22 Wood Pallet Storage Area taken by Plateau Geosciences Group. March.

69. PGG. 2012b. Rectifier Yard, Stormwater Catch Basin, and Interior Transformer Soil Sampling Data Report. Prepared by Plateau Geoscience Group for NSC Smelter LLC under contract to Blue Mountain Environmental and Consulting Inc., June 30th.

70. PGG. 2012c. Crushed Concrete Sample Data Report, Former Columbia Gorge Aluminum Smelter, 85 John Day Dam Road, Goldendale, Washington. Prepared by Plateau Geoscience Group LLC for NSC Smelter LLC under contract to Blue Mountain Environmental and Consulting, Inc. August.

71. PGG. 2013a. Septic System, Wetlands, Upper Fluoride Area, and Soil Background Investigation Report, Former Columbia Gorge Aluminum Smelter. Prepared by Plateau Geoscience Group LLC under contract to Blue Mountain Environmental and Consulting Company for NSC Smelter LLC. March 15th.

72. PGG. 2013b. Geophysical Soil and Groundwater Investigation of Wetland D, Former Goldendale Aluminum Smelter, 85 John Day Dam Road, Goldendale, Washington. Prepared by Plateau Geoscience Group LLC for Columbia Gorge Aluminum Corporation. October 31st.

73. PGG, personal communication, November 2014. E-mail correspondence regarding Plant Area AOC Features and Data. Prepared by Dr. Mavis Kent, Plateau Geosciences Group and sent to Ben Farrell, Tetra Tech. November.

74. PGG. 2014. Coke Silos Concrete Sample Data Report, Columbia Gorge Aluminum Smelter Site. Prepared by Plateau Geoscience Group LLC for NSC Smelter LLC under contract to Blue Mountain Environmental and Consulting, Inc. July.

75. PSEP. 1997a. Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Puget Sound Estuary Protocols Prepared by U.S. Environmental Protection Agency and the Puget Sound Water Quality Action Team. April.

76. PSEP. 1997b. Recommended Quality Assurance and Quality Control Guidelines for the Collection of Environmental Data in Puget Sound. Puget Sound Estuary Protocols Prepared by U.S. Environmental Protection Agency and the Puget Sound Water Quality Action Team. April.

77. Technico Environmental Services. 1990. Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Wastewater Pond Sediments Relative to Washington State Dangerous Waste Regulations, WAC 173-303. Prepared by John Zillich of Technico & Environ Services Company.

78. Technico Environmental Services. 1991a. Letter regarding East End Landfill Investigation. Prepared by Technico Environmental Services for Columbia Aluminum. March 8th.

79. Technico Environmental Services. 1991b. Letter regarding Polycyclic Aromatic Hydrocarbon Concentrations in the Stormwater Retention Basin Columbia Aluminum Plant, Goldendale, Washington. Prepared by John Zillich, Technico Environmental Services for Columbia Aluminum and submitted to Washington State Department of Ecology. October 30th.

80. Technico Environmental Services. 1991c. Letter regarding Columbia Aluminum Order No. DE90-1050 (regarding Paste Plant). Prepared by Technico Environmental Services for Columbia Aluminum and submitted to Washington State Department of Ecology. October 30th.

81. Tetra Tech. 2010. Draft Cleanup Action Plan West End Landfill Capping Project, Goldendale, Washington. Prepared by Tetra Tech for Lockheed Martin Corporation. December.

82. Tetra Tech. 2011a. Final East End Landfill Supplemental Investigation Work Plan, Three Sites Investigation, Goldendale, Washington. Prepared by Tetra Tech for Lockheed Martin Corporation. April. 20th.

83. Tetra Tech. 2011b. Final Area North of the East Surface Impoundment Work Plan, Three Sites Investigation, Goldendale, Washington. Prepared by Tetra Tech for Lockheed Martin Corporation. April.

84. Tetra Tech. 2011c. Final Area Smelter Sign Area Work Plan, Three Sites Investigation, Goldendale, Washington. Prepared by Tetra Tech for Lockheed Martin Corporation. April.

85. Tetra Tech. 2012. 100 Percent Design Package, West End Landfill Capping Project, Goldendale Washington. Prepared by Tetra Tech for Lockheed Martin Corporation. March.

86. Tetra Tech. Personal communication, August 13, 2014. Teleconference regarding Dredging in the vicinity of John Day Dam between Ben Farrell, Tetra Tech, and Kathleen Whitman, U.S. Army Corps of Engineers, Portland District.

87. Tetra Tech et al. 2014. Draft Remedial Investigation Phase 1 Work Plan, Columbia Gorge Aluminum Smelter Site. Prepared by Tetra Tech, Inc., Blue Mountain Environmental Consulting, Inc., and Plateau Geoscience Group LLC for Lockheed Martin Corporation and NSC Smelter LLC. November 25th.

88. Tetra Tech et al. 2015. Draft Remedial Investigation Phase 2 Work Plan, Columbia Gorge Aluminum Smelter Site. Prepared by Tetra Tech, Inc., Blue Mountain Environmental Consulting, Inc., and Plateau Geoscience Group LLC for Lockheed Martin Corporation and NSC Smelter LLC. May 8th.

89. Travis, Russell B. 1955. "Classification of Rocks." Volume 50, Number 1, Quarterly of the Colorado School of Mines, Golden Colorado. January.

90. Tschope, K. et al. 2009. Autopsies of Spent Pot Linings – A Revised View. Light Metals 2009. Published by TMS The Minerals, Metals & Materials Society. http://www.material.ntnu.no/ceramics/Autopsies_revised_view.pdf

91. URS. 2008a. Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation/Feasibility Study, East End Landfill. Prepared by URS Corporation for Lockheed Martin Corporation. January 26th.

92. URS. 2008b. Cleanup Action Report, Goldendale Aluminum Smelter, East Surface Deposit Area, 85 John Day Dam Road, Goldendale Washington. Prepared by URS Corporation for Lockheed Martin Corporation. April 18st.

93. URS. 2008c. Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation and Feasibility Study, East Spent Pot Liner Storage Area. Prepared by URS Corporation for Lockheed Martin Corporation. September 30th.

94. URS. 2008d. Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation, Drum Storage Area. Prepared by URS Corporation for Lockheed Martin Corporation. November 12th.

95. URS. 2008e. Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation and Feasibility Study, North and South Pot Liner Soaking Stations. Prepared by URS Corporation for Lockheed Martin Corporation. November 13th.

96. URS. 2008f. Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation and Feasibility Study, West End Landfill. Prepared by URS Corporation for Lockheed Martin Corporation. December 3rd.

97. URS. 2009. Technical Memorandum, Results of Task 1 Well Inventory for the Site-Wide Groundwater Investigation at the Columbia Aluminum Site, Goldendale, Washington. Prepared by URS Corporation for Lockheed Martin Corporation. March 27th.

98. URS. 2010. Final Draft Report, Goldendale Aluminum Company Smelter Remedial Investigation, West End Landfill. Prepared for Lockheed Martin Corporation by URS Corporation. June 15th.

99. URS. 2011. Site-Wide Groundwater Investigation Report, Columbia Gorge Aluminum Smelter, Goldendale, Klickitat County, Washington. Prepared by URS Corporation for Lockheed Martin Corporation.

100. USACE. 1994. Site Inspection Report, John Day Lock and Dam, Oregon-Washington, FSID 16820. Prepared by U.S. Army Corp of Engineers, Portland District. March.

101. USACE. 2014. Dredge Material Management Program User Manual, Section 9. December.

102. Wayne Wooster, e-mail communication, May 5, 1997. Internal Columbia Aluminum Corporation E-mail communication from Wayne Wooster regarding Commonwealth Aluminum SPL Pile Ditch Repair.

103. Westinghouse. 1990. Underground Storage Tank Removals at Goldendale Washington. Prepare by Westinghouse Environmental and Geotechnical Services, Inc., for Columbia Aluminum Corporation. June 22nd.

104. WSDH et al. 2005. Survey of Potential Hanford Site Contaminants in the Upper Sediment for the Reservoirs at McNary, John Day, The Dalles, and Bonneville Dams. Prepared by Washington State Department of Health (WSDH), U.S. Department of Energy, Ecology, and Oregon Department of Energy. February.

APPENDIX A— HEALTH AND SAFETY PLAN

DRAFT
HEALTH AND SAFETY PLAN

COLUMBIA GORGE ALUMINUM SMELTER SITE
REMEDIAL INVESTIGATION
GOLDENDALE, WASHINGTON

Prepared for

LOCKHEED MARTIN

Lockheed Martin Corporation
Energy, Environment, Safety & Health
2950 N. Hollywood Way, Ste. 125
Burbank, CA 91505

May 2015

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1.0 INTRODUCTION

This Draft Health and Safety Plan (HASP) addresses the health and safety practices and controls that will be implemented by all Performing Contractor employees, subcontractors, and all other site workers participating in the Remedial Investigation at the Goldendale site. This draft plan will be revised and updated by the selected Performing Contractor(s) upon award of the RI field investigation to ensure compliance and consistency with applicable rules and the Performing Contractor's health and safety program.

Activities performed under this HASP must comply with applicable sections of 29 CFR 910.120 and the Performing Contractor's Corporation Health and Safety Program. Modifications to the HASP (if required) will be reviewed and approved by Performing Contractor's Program Health and Safety Manager (PHSM) using the Field Change Request (FCR) form.

Performing Contractor and its subcontractors, and Performing Contractor's client, do not guarantee the health or safety of any person entering this site. Owing to the nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site.

This draft HASP has been prepared to addresses environmental and basic physical hazards associated with the Columbia Gorge Aluminum Smelter RI. All Performing Contractor field participants and observers must read this plan and sign the certification in Attachment A stating that they agree to comply with all of the plan conditions to help ensure safety compliance. A copy of the HASP will be maintained at the site during the course of all field activities.

Plan Prepared by: ________________________________ **Date:** ___________________

Plan Approved by: ________________________________ **Date:** ___________________

2.0 ORGANIZATION STRUCTURE AND RESPONSIBILITIES

All employees and personnel working on this project are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. To provide an organizational structure that supports this objective, the following individuals are assigned specific responsibilities and lines of communication for the duration of this project.

KEY PERSONNEL AND RESPONSIBILITIES	
Project Manager	_________ is the designated Project Manager (PM) for this project. He is responsible for overall administration of the project. His duties include project planning, budgeting, communications, and coordination. He is also responsible for ensuring that adequate personnel and equipment resources are available to complete the project safely. The PM reports to Performing Contractor's Program Manager.
Site Health and Safety Officer	_________, Field Lead, is the Site Health and Safety Officer (SHSO) for the Project. He or a designated representative is responsible for ensuring that all work is performed in accordance with the contract requirements in a safe and compliant manner. , or his designee, is responsible for conducting routine safety inspections, daily safety briefings, and incident investigations.
Boat Operator	_________, The Boat Operator/Captain, is responsible for boat operations including compliance with U.S. Coast Guard safety (and other requirements) and this plan. The Lead Driller reports directly to the PM and Site Health and Safety Officer
Excavation Site Superintendent	_________, The excavation Site Superintendent for the project is responsible for ensuring that all excavation and trenching work is performed in accordance with the contract requirements. The Site Superintendent is also the competent person for determination of excavation safety. The Site Superintendent reports directly to the PM and Site Health and Safety Officer.
Lead Driller	_________ , The selected drilling contractor will provide a Washington-licensed well driller for the project. He is responsible for ensuring that all drilling and well installation is performed in accordance with contract requirements and Washington State requirements. He is also responsible for ensuring that the health and safety requirements for drilling operations are met. The Lead Driller reports directly to the PM and Site Health and Safety Officer.
All Site Workers	All site workers, including subcontractors have the responsibility to report any unsafe or potentially hazardous situations to the SHSO. Site workers will maintain knowledge of the information, instructions, and emergency response actions contained in the HASP. All site workers will comply with the rules, regulations, and procedures as set forth in the HASP.
Plan to be updated by:	Performing Contractor Date:

3.0 SITE BACKGROUND AND WORK ELEMENTS

This section provides a summary of site background and brief discussion regarding planned project activities and associated work elements.

3.1 SITE BACKGROUND

The former Columbia Gorge Aluminum Smelter (site) is located at 85 John Day Dam Road, Goldendale, Washington. It incorporates an area of approximately 350 acres associated with the former plant operations within a 7,000 acre parcel of land currently under the same ownership. The site is located adjacent to the Columbia River approximately 9 miles southeast of the City of Goldendale in Klickitat County (Figure 1). The site includes portions of Sections 20 and 21 in T3N, R17E, Willamette Meridian.

The facility was operated nearly continuously as a primary aluminum smelter from its completion of construction in the early 1970s until 2003 when aluminum smelter operations were permanently suspended. The current owner (NSC) plans to redevelop the site for commercial and industrial purposes. Figure 2 shows the main features of the former smelter and surrounding area. Figure 3 shows the former aluminum reduction facility and the 32 SWMUs planned for investigation in support of this work effort.

When the aluminum reduction facility was in operation, there were a total of 525 electrolytic reduction cells in which aluminum metal was produced. At full capacity, the smelter produced a nominal 176,000 tons of aluminum and aluminum alloys per year and required a work force of 650 employees. During peak operation, the smelter facilities included a carbon plant, four reduction cell lines, a cast house, rectifier building and electrical substations, a laboratory, administrative offices, storm water and groundwater collection systems, and a sewage treatment plant. In April 2003, the plant was shut down. Demolition of all buildings directly associated with the smelter operations, including the reduction cell lines, began in 2011 and was completed in spring 2013.

The main COPC associated with the aluminum production process include PAHs, fluoride, and cyanide salts. Other chemicals present or suspected in some areas, include PCBs, petroleum hydrocarbons, VOCs, and metals.

The environmental setting is described in detail in the Phase I work plan (Tetra Tech et al. 2014). The site is located in the semi-arid eastern portion of the Columbia River Gorge The former smelter is located on a topographic bench about 450 to 540 feet in elevation about 0.5 miles from the Columbia River (see Figure 1). South of the site, the bench generally terminates in a line of cliffs above the Columbia River. North of the site, the Columbia Hills form a steep ridge with about 2,500 feet of relief with a talus slope extending down slope onto the site. Three natural seasonal drainages are present to the south of the former smelter and north of the Columbia River. One of these drainages was modified during initial plant construction into a series of settling ponds called the National Pollutant Discharge Elimination System (NPDES) Ponds A through D (Figure 2).

The site is located on the Columbia River Plateau where the bedrock is composed of the Miocene Columbia River Basalt Group. The bench area represents an erosional feature formed by scour during the Pleistocene Missoula Floods. Unconsolidated deposits in the site vicinity consist of glacial fluvial sediments, alluvium, colluvium shed from the ridge to the north, potential localized eolian deposits, and man-made fill associated with highway construction, dam construction, and smelter construction and operations. These unconsolidated deposits are present as either a discrete stratigraphic unit ranging from a few feet to over 60 feet thick or localized areas within flood-scoured depressions on the basalt bench surface. Conceptually, the aquifer system can be seen as an unconsolidated alluvial/colluvial aquifer underlain by a series of basalt bedrock aquifer zones that represent the more permeable zones within the basalts.

The 2014 Agreed Order (Ecology 2014a) specifies preparation of a RI work plan for 32 SWMUs and 5 AOC to be completed in two phases, including a Phase 1 RI Work Plan that summarizes existing data and identifies data gaps and data needs, and a Phase 2 RI Work Plan summarizing the scope of work and procedures for completing the RI field work effort. The Draft Phase 1 RI Work Plan was submitted on November 25, 2014 (Tetra Tech et al. 2014). As stated in the Agreed Order, the scope of the Phase 2 RI work plan (Tetra Tech et al 2015) includes preparation of a SAP, a QAPP, and HASP that collectively meet the requirements of WAC 173-

340-810 through 840. Consistent with the Agreed Order, the Phase 2 RI Work Plan also includes cultural resource protocols for the sampling that comply with federal, state, and local laws and regulations. A completed JARPA is also included as an Appendix to the Phase 2 RI Work Plan as appropriate for proposed test pit and trenching activities in some wetland areas.

3.2 WORK OBJECTIVES AND ELEMENTS

The scope of work for the Agreed Order includes preparation of an RI Work Plan, performance a Remedial Investigation (RI) and Feasibility Study (FS) at 32 SWMUs and 5 AOC, as well as preparation of a draft Cleanup Action Plan that summarizes the proposed remedial actions necessary to address contamination at each of the SWMUs and AOC, The objective of the Remedial Investigation/Feasibility Study (RI/FS) under the Washington State Model Toxics Control Act (MTCA) is to collect, develop, and evaluate sufficient information and data to select remedial actions consistent with MTCA requirements. The scope of the field investigations includes the following major work elements:

- **Trenching and Test Pit Excavations.** Trenches and test pits will be excavated using a small excavator. Trenching activities will include the excavation of several trenches at both the SSA and the NESI sites. Each of these trenches will be a minimum of 100-feet long and approximately 4-feet wide. Up to 20 test pits will be completed in the SSA and the NESI areas; and up to 8 test pits will be completed in the EELF area. Test Pits will also be excavated during characterization activities in the Rectifier Yard AOC.

  Test pits will be from approximately 3-feet deep or until bedrock is encountered. The total depth of the test pits will be based on the reach of the backhoe and is assumed to be 12 to 15 feet below ground surface (bgs). Each test pit will be approximately 4 square feet area. Sampling activities will include the collection of both soil and waste characterization samples using a backhoe bucket to extract sample materials.

- **Drilling and Well Installation.** Drilling activities include use of a hollow-stem auger drill rig for installation of borings and temporary wells in unconsolidated deposits, rock coring using a wire-line coring rig with associated packer testing, and air-rotary drilling for installation of monitoring wells within the basalt bedrock. Grab soil and groundwater sampling will be performed during installation of the borings.

- **Boat Operations and Sediment Sampling.** Sediment samples will be collected from a boat in the Columbia River and within the stormwater detention pond.

- **Well Development and Well Sampling.** All newly constructed permanent and temporary wells will be developed using surging or pumping techniques. Selected existing wells may also be re-developed based on the results of the well verification survey. Two comprehensive site-wide rounds of groundwater sampling will be performed at existing and newly installed wells.

- **Aquifer Testing.** Two constant rate pumping tests are planned as well as two tests of plant production wells. Slug testing of newly constructed wells and selected existing wells will also be performed.

- **Hand-Auger Borings and Soil Sampling**. Hand augering will be performed during investigation of the Wetlands AOC as well as specific SWMUs. Grab and composite soil samples will be collected.

- **Stormwater and Stormwater Catchbasin Sampling.** Stormwater and industrial line water and catchbasin solids will be sampled as part of RI activities.

4.0 HAZARDS ANALYSIS

Field activities at the Site include the potential encounter of buried wastes and the collection of potentially contaminated soils, sediment, groundwater and stormwater. Exposures will be managed by the proper use of personnel protective equipment (PPE), safe work practices, and engineering controls, as appropriate designed to minimize contact with potentially contaminated material.

4.1 CHEMICAL HAZARD ASSESSMENT

A chemical hazard evaluation is provided in Table 1.

The primary chemicals of concern at the site include cyanide salts, PAHs, and fluoride resulting from historical aluminum reduction processing. Other constituents are also present in wastes generated by the facility, including sulfate and metals. Due to the unknown nature of the potential buried materials, petroleum constituents, volatile organic compounds (VOCs), and asbestos containing material may also be encountered. Landfill gasses including ammonia, hydrogen sulfide methane, and phosphine could be present in landfill areas such as the EELF or other areas with waste accumulation; however, based on previous experience at the Goldendale site the likelihood of gas generation is low.

Air monitoring including dust monitoring, PID monitoring, iBRID monitoring will be performed as appropriate for specific work activities to monitor for and help prevent potential chemical inhalation exposures (see Section 10; Table 4). Use of PPE including use of nitrile gloves and safety glasses during sampling and equipment decontamination activities will be used to mitigate potential chemical exposures.

4.2 ACTIVITY HAZARD ASSESSMENT

An activity and physical hazard evaluation is provided in Table 2. A brief hazard analysis for specific tasks is also presented in the following sections to emphasize hazard evaluation for specific aspects of the work.

Table 1. Chemical Hazard Evaluation

Potential Hazard Level:	☐ High ☒ Moderate ☐ Low ☐ Unknown		
Potentially Contaminated Media:	☒ Groundwater ☒ Surface Water and Storm Water ☒ Soil ☒ Sediment		
Known or Suspected Contaminants of Concern:	Spent Potliner (K088) waste: cyanide, fluoride, polynuclear aromatic hydrocarbons (PAHs). Also, potential for volatile organic compounds (VOCs), TPH, asbestos materials. Low potential for landfill gases.		
Exposure Routes:	☒ Inhalation ☒ Ingestion ☒ Contact ☐ Radiation		
Toxicity:		**TLV/PEL**	**IDLH**
	Hydrogen cyanide	4.7 ppm	60 ppm
	PAHs	10 ppm (50 mg/m3)	250 ppm
	Fluoride	2.5 mg/m3	250 mg/m3 (as F)
	asbestos	0.1 f/cc	Ca
	arsenic	0.010mg/m3	100 mg/m3
	petroleum distillates	500 ppm	1,100 ppm
	benzene	1 ppm	500 ppm
	toluene	200 ppm	500 ppm
	ethylbenzene	100 ppm	800 ppm
	xylenes	100 ppm	900 ppm
	1,1,1-TCA	350 ppm (1,900 mg/m3)	700 ppm
	TCE	100 ppm, 5 min peak	1,000 ppm, Ca
	PCE	100 ppm	150 ppm, Ca
	Vinyl chloride	1 ppm	Ca (ND)
	Methane	1,000 ppm (Oregon)	NE
	Hydrogen Sulfide	10ppm/11mg/m3-skin	NE
	Ammonia	50 ppm(35 mg/m3)	300 ppm
	Phosphine	0.3 ppm (0.4 mg/m3)	50 ppm
Acute Exposure Symptoms:	**Cyanide**- Skin, eye, nose, throat, and respiratory system irritation; headache, vertigo/dizziness, fatigue/drowsiness, nausea/vomiting, dermatitis. Blue or colorless, bitter almond odor. Avoid dermal contact and inhalation of dust and vapors. **Polynuclear Aromatic Hydrocarbons including benzo(a)pyrene-** Skin, eye, and respiratory irritation. Low tendency to form vapor. Avoid dermal contact, and inhalation of dust. Gray, dark brown or black appearance. Includes human carcinogens. **Benzene, ethylbenzene, toluene, and xylene (BTEX)**. Benzene is a human carcinogen. Skin, eye, nose, throat, and respiratory irritation; headache, dizziness, fatigue, nausea, High tendency to form vapor. Avoid vapor inhalation, dermal contact, and inhalation of dust. Colorless **Landfill Gases**- Skin, inhalation, eye contact: dizziness, confusion, excitation, and asphyxia. Colorless, bitter almond odor for cyanide. **Chlorinated Solvent Constituents**: TCE, PCE, and vinyl chloride are human carcinogens. Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury. TCE is a colorless liquid with a chloroform-like odor.		

Table 2. Activity Hazard Analysis
(Page 1 of 3)

Site/Activity Name: Columbia Gorge Aluminum Smelter Site Remedial Investigation, Goldendale, Washington

Job Site Location: Goldendale, WA	**Boat Operator Contact: TBD**
Project Manager: TBD	**Drilling Subcontractor Contact: TBD**
Safety Representative: TBD	**Excavation Subcontractor Contact: TBD**

APPROVALS:

Position: Project Manager **Signature:**	**Date**	**Position: Safety Representative** **Signature:**	**Date**

TASKS/SITE DESCRIPTION: Site investigation to include site reconnaissance, test pit and trench excavation, drilling and well installation, well development and sampling, slug testing and aquifer testing, boat operations and sediment sampling, hand auger operations and soil sampling.

ACTIVITY HAZARD ANALYSIS: Check below all hazards applicable to job or task(s) or activities being carried out

	Yes	No		Yes	No		Yes	No
Electrical		X	Noise	X		Respiratory Hazards	X	
Material Handling	X		Dust	X		Lock & Tag		X
Heavy Equipment	X		Temperature Extremes	X		Pressure Systems		X
Manual Lifting	X		Illumination	X		Explosives		X
Elevated Work		X	Chemicals	X		Grinding/Sawing		X
Pinch Points	X		Biological Hazards (rattlesnake, black widow, poison oak, ticks)	X		Compressed Air	X	
Power Tools	X		Radiological Hazards		X	LPG		X
Compressed Gas			Asbestos	X		Portable Heaters		X
Welding & Cutting		X	Scaffolding		X	Egress Means		X
Ergonomics	X		Aerial Lifts		X	Sharp Objects	X	
Hot Surfaces		X	Subsidence/excavation failure	X		Cryogenics		X
Ladders		X	Confined Spaces		X	Ventilation		X
Walking/Working Surfaces	X		Water Hazards	X		Flying Objects	X	
Excavation	X		Fire Hazards	X		Powered Ind. Trucks	X	
Vehicle Traffic	X		Remote Work Area		X	Guarding		X
Overhead Hazards	X		Cranes/Rigging		X	Hand Tools	X	
Falling Objects	X		Drilling	X		Man Baskets		X
Sanitation		X	Spill Containment	X		Emergency Controls	X	
Hazard Communication	X		Sign/Site control	X		Airborne Pathogens	X	
Lasers		X	Off-Road Vehicle Use		X	Training/Qualifications	X	
First Aid	X		Falls	X		Competent Persons	X	

NOTE: **If additional hazards are discovered during the conduct of these activities, work shall stop until such hazards are controlled. Approval (written or verbal) of the S&H Professional is necessary before work can resume.**

Table 2. Activity Hazard Analysis (Page 2 of 3)		
Activity/Item	**Potential Safety/Health Hazards**	**Recommended Controls**
Site Reconnaissance and all field activities	• Heat and/or cold stress depending on season • Slip, trip, and falls • Biologic hazards (rattlesnakes, black widow spiders, poison oak in some areas)	• Wear Modified Level D PPE • Recognize potential areas/habitats for biologic hazards. Wear long sleeve shirts and pants. Proceed with caution.
Hand Tools	• Use of power tools	• Wear eye protection, hearing protection, and chaps. Train site workers in appropriate use of equipment
Excavations and Trenching	• Being struck or run over by heavy equipment • Contact with contaminated soil • Inhalation of hazardous atmosphere or contaminated dust	• Wear PPE • Follow Excavation and Trenching Procedure s • Mark exclusion zone, erect temporary fencing as needed. • Perform dust and air monitoring as appropriate. Use dust suppression through water application as appropriate • Communicate and make eye contact with equipment operators. Wear safety vests.
Entry into excavations	• Contact with contaminated soil • Inhalation of hazardous atmosphere or contaminated dust • Noise exposure • Being struck by heavy equipment and pinch points • Slip, trip, and falls • Confined space/shoring considerations	• Decontaminate equipment and wear PPE. • Ensure safe access through sloping or use trench box to protect entrant from cave-in. • Wear hearing protection during operations • Wear chemical protective clothing according to requirements in this plan. • Establish control zones around work area, mark pinch point hazard areas. • Route traffic away from work area. • Ensure that vehicles have back-up alarms. • Clear work area of trip hazards (good housekeeping). • Perform air monitoring in accordance with this plan
Drilling and Well Installation	• Contact with contaminated soil • Inhalation of hazardous atmosphere • Noise exposure • Being struck or pinched by heavy equipment and hand tool use • Slip, trip, and falls • Grout mixing	• Decontaminate Equipment and Wear PPE. • Follow Drilling and Well Installation Procedures • Wear hearing protection during operations • Wear chemical protective clothing according to plan requirements. • Establish control zones around work area, mark pinch point hazard areas. • Route traffic away from work area. • Ensure that vehicles have back-up alarms. • Clear work area of trip hazards (good housekeeping). • Wear eye protection during grouting and other operations
Well Development and Sampling	• Contact with contaminated water • Inhalation of hazardous atmosphere • Being struck by vehicles, heavy equipment, and hand tool use • Slip, trip, and falls	• Wear PPE and perform air monitoring in accordance with plan. • Wear traffic vests when working near roadways • Inspect work area prior to beginning work.
Hand-Auger Operation and Soil Sampling	• Contact with contaminated soil • Inhalation of hazardous atmosphere • Hand tool use • Slip, trip, and falls • Biological hazards in some areas	• Wear PPE and perform air monitoring in accordance with plan. • Recognize potential areas/habitats for biologic hazards. Wear long sleeve shirts and pants. Proceed with caution.
Aquifer Testing	• Contact with contaminated water • Inhalation of hazardous substances • Use of hand tools and pressurized cylinder(for pneumatic slug test • Potential noise exposure • Slip, trip, and, falls, • Water tank management • Night operations	• Wear PPE and perform air monitoring in accordance with plan • Operate hand tools and equipment in accordance with instructions • Provide adequate lighting for night operations.

Table 2. Activity Hazard Analysis
(Page 3 of 3)

Activity/Item	Potential Safety/Health Hazards	Recommended Controls
Boat Operations and Sediment Sampling	• Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas, and encountering severe weather, to name a few	• To address these concerns, all work conducted from small vessels will comply with Boating Safety Procedures (to be provided by Performing Contactor upon award) and applicable Coast Guard regulations. Vessels will be operated by experience s crewmembers and all equipment will be inspected prior to use to ensure that it is in proper working order. This inspection will be conducted by the SHSO for each vessel used on a daily basis. • Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing an on-board emergency (i.e., fire, mechanical failure, man overboard situation, etc.).
Stormwater and Catch Basin Sampling	• Contact with contaminated soil or water • Inhalation of hazardous atmosphere • Hand tool use • Slip, trip, and falls	• Wear PPE and perform air monitoring in accordance with plan.
Biological Hazards	• Rattlesnakes and spiders	• Be cognizant of the potential for snakes and spiders. • Use care in working around rock piles, stacked materials, and other sheltered areas. • Do not step or put your hands where you cannot see. • Do not turn over rocks or boards with bare hands. Use a tool. • Carry a long walking stick or shovel for rustling brush.
Adverse weather	• Employees exposed to adverse weather hazards	• Use caution when working in adverse weather such as strong wind and shut down work activities if conditions warrant. • Follow the National Lightning Safety Institute requirements in thunderstorms. • During hot summer weather, drink fluids regularly, take frequent breaks, monitor for signs of heat exhaustion • During cold weather, wear appropriate clothing and monitor for signs of hypothermia. Be especially careful of slip and fall and vehicular dangers in the event of snow or freezing conditions. Shut down trucking activities if conditions warrant.
Training	• High potential for injury to untrained personnel	**Training will consist of:** • Pre-job briefing covering the SSHP and applicable Tt EHS requirements. • Also a daily tailgate briefing will be conducted to address activities, hazards, etc. • Trained and familiarization with equipment and tools. • Trained in emergency plans and actions. • Aware of emergency controls to be used if needed.
Fueling equipment/generator	• Fires or explosions	• Turn off all engines and electrical equipment; allow generator or equipment to cool down prior to fueling. • Never smoke or strike a match while fueling. • **When filling a tank or gas can, follow these guidelines:** ➢ Never fill a tank to the brim. Leave room for gas to expand. After fueling, put the fill cap on tightly to prevent vapors from escaping. Immediately wipe up any spilled gas. Air out the rag after using it. ➢ Store gas in a safety-approved fuel can in an area of good ventilation. ➢ Refill portable gas cans on ground, not in truck bed.
Spill Containment	• Employee exposure and environmental concerns	• Follow SSHP requirements. An environmental protection plan including spill prevention controls will be implemented at the work site. • Hazcom training.

4.2.1 Trenching and Test Pit Operations

The field investigation will include trenching and test pit excavation as a primary means for site characterization in the Smelter Sign Area, NESI, EELF, and Rectifier Yard AOC. The crew and field staff (all qualifying as competent person under 29 CFR 1926.32f) will inspect each location and utility markings to help ensure that each location has been appropriately cleared. In no circumstances, will trenching activities commence, unless the 48-hour utility notification and private location has been verified. The excavator operator will review the location of the emergency “off “switch with all site personnel.

Field (on-foot) personnel will not enter the swing radius of the excavator or the working zone except as necessary for conductance of the work (such as health and safety monitoring, sampling, or to give direction). Active work zones will be visually delineated. In all cases, field personnel will make clear communication with the equipment operator before entering or moving within active work zones.

Field personnel will not physically enter excavations deeper than 4-feet unless a competent person performs necessary evaluations and makes a determination regarding sidewall sloping requirements, the potential need for shoring, and/or confined space entry. Personnel will not enter the excavations at the site unless the excavations are appropriately shored or sloped. The excavations will be marked clearly with caution tape when unattended.

If visible dust is observed during excavation and stockpiling, watering will be performed consistent with the work plan. To the extent practical, personnel will be situated on the upwind side of the excavations. This approach will reduce potential exposure by the direct contact and inhalation pathways. Soil stockpiles will be covered if not in use to minimize the potential for the spread of contamination and the potential for air-borne dust.

The work station for lithologic logging and soil sampling will be established outside of, but in close proximity to the working area of the excavation crew. Sampling personnel will wear chemical resistant nitrile gloves and safety glasses during sampling and equipment decontamination activities.

Potential exposure to contaminants will be addressed through use of PPE and air monitoring Personal Protective Equipment will consist of hard hat, safety toed boots, safety glasses with side shields, standard work uniform (long pants, full length sleeve shirt), and high visibility safety vest. Hearing protection will be worn as required. Work gloves worn when indicated.

Best management practices regarding the management of soils and wastes during excavation will be employed to reduce and eliminate the potential for the spreading of contamination. These include the use of lined temporary stockpile pads, covering of soil/waste stockpiles, and the use of silt fencing, straw bales and wattles as appropriate.

4.2.2 Drilling and Well Installation

Multiple drilling methods will be employed including use of hollow-stem augers, rock coring rigs, and air-rotary drill rigs.

To address hazards associated with underground and above ground utilities, the crew and field staff will inspect each location and utility markings to help ensure that each location has been appropriately cleared. In no circumstances, will drilling activities commence, unless the 48-hour utility notification and private location has been verified. The driller will review the location of the emergency “off “switch with all site personnel.

Field (on-foot) personnel will not enter the working zone except as necessary for conductance of the work (such as health and safety monitoring, sampling, or to give direction). Active work zones will be visually delineated. In all cases, field personnel will make clear communication with the drill rig operator before entering or moving within active work zones.

There is significant risk workers being struck or pinched by heavy equipment during drilling operations. Workers will wear high-visibility vests and exclusion zones will be established and standard procedures for drilling operations will be followed. Drilling equipment used on the job will be inspected prior to use to ensure that it is in an adequate state of repair.

Slip, trip, and falls represent a hazard associated with drilling operations Open holes and excavations will be covered when not in use. The work area will be inspected and cleared of tripping hazards prior to beginning drilling operations.

Long periods of heavy manual labor may result in strains and other injuries. A steady work pace will be maintained and rest periods will be taken, particularly during periods of hot weather. Proper lifting techniques and correct tools will be used for the job.

Potential exposure to contaminants will be addressed through use of PPE and air monitoring Personal Protective Equipment will consist of hard hat, safety toed boots, safety glasses with side shields, standard work uniform (long pants, full length sleeve shirt), and high visibility safety vest. Hearing protection will be used as required. Work gloves will be worn when indicated. Splash goggles and face shield must be worn if splash hazards exist during drilling operations such as grouting.

4.2.3 Boating Operations and Sediment Sampling

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas, and encountering severe weather, to name a few. The risk of a boating accident can be reduced by ensuring the boat operators are experienced, and when applicable, licensed; operating the vessel in compliance with Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on-board (i.e., life vests, life rings, safety skiffs, fire extinguishers, communication equipment, etc.).

To address these concerns, all work conducted from small vessels will comply with Boating Safety Procedures (to be provided by Performing Contactor upon award) and applicable Coast Guard regulations. Vessels will be operated by experience crewmembers and all equipment will be inspected prior to use to ensure that it is in proper working order. This inspection will be conducted by the SHSO for each vessel used on a daily basis. Ultimately, the boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment.

Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing an on-board emergency (i.e., fire, mechanical failure, man overboard situation, etc.). The maximum number of passengers and weight that can safely be transported shall be posted. The number of passengers shall not exceed the number of personal floatation devices (PFDs). Boat operators and passengers will be required to wear Type III, Type V, or better USCG-approved international orange PFDs in accordance with EM385-1-1. If any work is done at night, the PFDs will be equipped with a USCG-approved automatically activated light.

Vessels will have at least one sound signaling devices and a radio to communicate with support services on-shore. Boating operations will be suspended during severe weather or rough seas.

Sediment sampling equipment may include use of a Van Veen or Ponar samplers. Working with and near this equipment poses potential physical hazards including being struck by or against the equipment or pinched or caught by the equipment. These hazards will be avoided by ensuring that operators keep their hands away from any cutting surfaces and pinch points. Gloves will be used for hand protection as appropriate.

4.2.4 Field Sampling Activities

Sampling of groundwater, soil, and stormwater are characterized by many similar hazards and are summarized together for this reason. Potential exposure to contaminants will be addressed through use of PPE and air monitoring. Personal Protective Equipment will consist of hard hat (where overhead hazards are present), safety toed boots, safety glasses with side shields, standard work uniform (long pants, full length sleeve shirt), and high visibility safety vest. Hearing protection will be used as required. Work gloves worn when indicated. Splash goggles and face shield must be worn if splash hazards exist.

Note that the intent of PPE is to prevent contact with soil and groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by the skin or cause irritation to the skin). Review the safety data sheets for preservatives. Wear PPE specified by the safety data sheets and consult with the site-health and safety officer.

Improper handling of sampling of equipment could cause strain or injury to a worker and slip, trip, and fall hazards are often present. Use care when walking and carrying equipment so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers, if needed. For loads greater than 50 pounds, use two people to carry. Use proper lifting techniques. Maintain good housekeeping in the work area. Mark, or remove, all identified trip, slip, and fall hazards from the sampling area. Maintain proper illumination in the work area.

Be aware of potential pinch points with hand tools or structures being opened. For example, leather gloves should be used when opening well lids, and appropriate tools (picker or crowbar) should be used when opening catch basin lids.

Potential chemical exposures can occur during sampling activities both from site contaminants and sample preservatives. Wear required PPE and monitor air space with iBRID or PID as appropriated depending on the area being investigated. Decontaminate exteriors of sample containers, avoid spills, and ensure that spill cleanup supplies are available.

Improper handling of samples can cause leakage, cuts, or abrasions. All glassware should be handled with care, lids should be securely tightened, and containers should be appropriately packed in the field to prevent breakage.

Make sure that all reusable sampling equipment is appropriately decontaminated and that all IDW is appropriately containerized for disposal in accordance with waste management procedures in the field sampling plan.

Personnel performing field sampling must be familiar with the work plans as well as the use, calibration, and inspection of the field equipment, health and safety equipment, and hand tools. Only qualified personnel will operate equipment. Operator's manuals for field equipment will be reviewed by the field staff to reduce the potential for accidents and non-representative data collection.

A first aid kit, fire extinguisher, and eyewash station will be present onsite during all field activities and all field workers will review the location of these supplies before starting field work.

4.3 PHYSICAL HAZARD ASSESSMENT

The following section describes potential physical hazards that are not limited to specific work elements, but general hazardous relevant to all field activities.

4.3.1 Fire and Explosion Hazard

A gasoline powered generator and/or air compressor may be used at the site to power sampling equipment and various other power tools. There is a risk of fire during refueling of the generator, particularly if fuel is spilled in the process. To prevent ignition of this fuel, the generator will be staged and operated outside, away from all ignition sources. Refueling will not be done while the generator is running. Smoking will be prohibited within 100 feet of the generator and associated fuel storage area. The gasoline will be stored in a safety can and will be bonded to the generator during transfer of fuel. Fuel will not be dispensed from the fed of plastic lined pickup trucks. The generator will be grounded to a conducting rod driven into the ground, if necessary, and if such grounding is recommended by the manufacturer. A 10-pound portable dry chemical fire extinguisher and sorbent pads will be staged at the job site in the event of fuel spillage or fire.

4.3.2 Manual Lifting

Collecting boring samples, handling coring equipment, and unloading materials will involve heavy lifting. Such activities carry the risk of back and muscle strain. To control this hazard, workers will be instructed to use proper lifting techniques when moving heavy loads, particularly when unloading cores, deploying boats, stowing gear, and moving material weighing more than 50 pounds or awkwardly shaped. When engaged in such activities, workers will maintain ergonomically safe lifting postures and have others help them if mechanical lifting devised cannot be used.

4.3.3 Hand and Power Tools

Several different tools including hand tools and power tools may be used during the project. Power tools can cause injury if their wiring is defective, guards are missing, kill switches are broken, metal fatigue or cracks are present in reciprocating cutting and drilling appliances, or if the tools are used in a manner other than what they are designed for. To control these hazards, users will be properly trained and familiar in the safe use procedures for power tools. All power tools will be inspected before and after each use. Any defects noted during these inspections will be immediately repaired or the tool will be taken out of service. Under no circumstances will power tools be sued in an inappropriate (non-specified) manner. Tool operators will be trained in the use of each type of tool they will be required to use. All electrically powered tools, as well as all electrical equipment used on site, will be connected to power sources equipped with ground fault circuit interrupters. In addition, extension cords used with the power tools will be equipped with water poof couplings to prevent electrocution wherever wet conditions may be. Portable tools will be stored in a clean, secure area after each day's use.

4.3.4 Temperature Extremes

Depending on the season, there is likelihood of both hot and cold weather conditions at the Columbia Gorge Aluminum Smelter Site. There is some risk that site workers could develop heat or cold stress. The likelihood of this occurring is dependent on environmental conditions, the level of work activity, and the personal control measures that are used to manage heat loads (work/rest regimes, use of clothing, hydration, etc.). Appropriate control measures will be taken to manage these thermal stress concerns. The SHSO will monitor ambient temperatures in the work area, track workloads, and determine the need for personal protective and administrative controls. In addition, all site workers will be instructed in the recognition and control of thermal stress symptoms and in the treatment procedures identified below.

4.3.5 Cold Weather- Signs of Hypothermia

Hypothermia can result from abnormal cooling of the core body temperature. It is caused by exposure to a cold environment, and wind-chill as well as wetness or water immersion can play a significant role. The following discusses signs and symptoms as well as treatment for hypothermia.

Typical warning signs of hypothermia include fatigue, weakness, loss of coordination, apathy, and drowsiness. A confused state is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink. Body temperatures below 90o F require immediate treatment to restore temperature to normal.

4.3.6 Cold Weather-Treatment of Hypothermia

Current medical practice recommends slow rewarming as treatment for hypothermia, followed by professional medical care. This can be accomplished by moving the person into a sheltered area and wrapping with blankets in a warm room. In emergency situations where body temperature falls below 90o F and heated shelter is not available, use a sleeping bag, blankets and/or body heat from another individual to help restore normal body temperature.

4.3.7 Heat Stress

Elevated temperatures, heavy physical labor, and the use of PPE present the possibility of heat stress to employees. Heat stress can occur at any time regardless of the season or weather. The occurrence of heat-related injuries is dependent on the amount of direct sun, wind, humidity, and degree of physical exertion. Personnel who must wear protective clothing while working in warm temperatures are subject to heat-induced physiological stress since little evaporative cooling can occur. If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur, ranging from mild reactions (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to death.

1. ACGIH defines heat stress as the net heat load to which a worker may be exposed from the combined contributions of metabolic heat, environmental factors (e.g. air temperature, humidity, air movement, and radiant heat), and clothing requirements. These factors influence the human response, which is known as heat strain, or the overall physiological response from heat stress. Heat stress can be manifested in symptoms such as heat rash, syncope (fainting), cramps, exhaustion, and heat stroke. Heat cramps, heat exhaustion, and heat stroke all result from the excessive loss of body fluids and electrolytes.

2. The following information describes the various heat stress related illnesses that may occur and the preventive measures to incorporate to mitigate these illnesses:

   - Heat Rash: skin irritation resulting from prolonged contact with wet clothing; Preventive measures: rest in a cool place; keep skin dry and clean.

   - Heat Syncope (Fainting): blood pools in legs and less blood goes to brain, caused by standing in heat for long periods of time and/or not acclimatizing to the heat.

3. Preventive measures: moving around; not standing still.

   - Heat cramps: spasms in the abdomen or limbs, caused by loss of salts when sweating; Preventive measures: drink electrolyte liquids.

   - Heat Exhaustion: pale, clammy skin, profuse perspiration, weakness, headache, and nausea; loss of fluids and salts;

4. Preventive measures: rest in place, loosen clothing, drink electrolyte solution (slowly), and elevate feet 8-12 inches from ground.

    - Heat Stroke: life threatening condition that occurs when the body's temperature regulating system no longer functions properly. Symptoms include hot, dry skin, a high fever [often 106 degrees Fahrenheit (°F) or higher], dizziness, nausea, rapid pulse, and unconsciousness. Brain damage and death may follow if the body temperature is not reduced;

5. Heat stroke will be treated as a medical emergency (call 911, control situation, and then call PHSM).

6. Heat stroke should be treated immediately by bringing the affected person(s) out of direct sunlight and applying cool water or cold packs to the neck and armpits, and following emergency procedures.

Procedures that shall be implemented to reduce the risk of heat stress illnesses include:

- Training to familiarize individuals with signs and symptoms of heat stress;

- Acclimating workers to site conditions, self-determination of heat exposure, health status monitoring, and adjustment of expectations based on acclimatization;

- Implementing work/rest cycles, as appropriate, to periodically allow employees to remove protective clothing and warm up or cool down. Cotton undergarments can aid in absorbing perspiration and will hold it close to the skin, which will provide cooling from the limited evaporation that takes place underneath chemical-resistant clothing;

- Making liquids available to replace loss of body fluids and electrolytes lost during sweating. Perspiration is composed of sodium and potassium salts. Replacement fluids should be similar in composition (e.g., diluted Gatorade [3:1 ratio], or unsweetened fruit juices). The use of salt tablets is not recommended;

- Utilizing cooling devices if necessary;

- Monitoring of employee stress levels; and

- Fluid replacement.

The importance of replenishing fluids is vital in minimizing the potential for heat-related injuries. A Heat Stress Prevention Checklist will be prepared that will be utilized during all field operations when ambient temperatures are expected to reach or exceed 85°F. The SSHO or designee will be responsible for determining when to use the checklist and how much water is required to be on-hand and available for field personnel. The SSHO shall verify that the amount of water calculated via the checklist is continually available. Copies of worksheets will be maintained with project files.

Employees shall be encouraged to take rest breaks as necessary. This approach has been found very effective because individual tolerances to heat vary considerably. Additional mandatory breaks shall be scheduled at the discretion of the SSHO or designee. For specific areas or activities, all work will be halted temporarily in extreme conditions. At a minimum, workers will break every 2 hours for 10 to 15 minute rest periods. In addition, workers are encouraged to take rests whenever they feel any adverse effects, especially those effects that may be heat-related. The frequency of breaks may need to be increased upon worker recommendation or decision of the SSHO and a supervisor.

The SSHO or designee will be responsible for monitoring symptoms of heat stress and the establishment of a work/rest regimen. The SSHO or designee may set up a physiological monitoring program that may include measurement of oral temperatures, body weight loss each day, humidity, etc. in order to assess work-rest regimens. If at any time a worker feels nauseated or dizzy, he/she will immediately stop work, cool off, rest (in a shaded area), and seek assistance if symptoms do not subside.

If determined necessary by the SSHO or designee, scheduling of activities may occur so that work is performed early in the morning or late afternoon to minimize heat stress.

4.3.8 Severe Weather

Windy conditions may increase airborne dust levels. Airborne dust in the eyes and respirable dust may pose a health hazard if nuisance dust reaches a level of 5 milligrams per cubic meter (mg/m3). Visible dust contains large particles that are easy to see. While the tiny, respirable-sized particles (those that can get into the deep lung) pose the greatest hazard and are not visible. Therefore, visible dust should not be used as an indicator of nuisance dust. Air monitoring for COPCs will be the best indicator to determine if an airborne hazard exist.

The supervisor or SSHO will stop all work when wind speeds are 59 miles per hour (mph) or higher. This wind speed condition falls into the category of severe weather watch. The supervisor and the SSHO will assess what work procedures can be safely performed when wind conditions exceed 59 mph. They will give consideration to fugitive dust and odor emissions, the safety of equipment in high winds, and protection of workers from flying debris and dust in windy conditions. No elevated work is permitted when wind speeds are at 25 mph or higher.

Thunderstorms may create electrical and other physical hazards during site activities. A lightning strike may cause significant injury or death. Whenever lightning is within visible range or thunder is within audible range, site activities will be shut down. Work vehicles such as pick-up trucks are generally the safest place for work crews to remain while thunderstorms are present, assuming that nothing grounds the vehicle. In addition, rainstorms may cause erosion of the site cover, slippery conditions, and flash floods in low lying areas.

An accumulation of snow or ice may significantly increase slip and fall hazards and hazards associated with operation of heavy equipment, trucks, and vehicles. The Field Lead and Site-Health and Safety Officer have the authority to suspend particular field operations as appropriate based on accumulated snowfall or icy conditions. Onsite engineering controls such as application of sand or salt may be used to address specific small areas.

4.3.9 Biological Hazards

Snakes and venomous arthropods, including spiders, scorpions, centipedes, millipedes, ticks, and insects, create a hazard when their habitats are disturbed. The best defense is to understand where these creatures may be found and avoid them. Spiders including hobo and black widows, and ticks can be found in this area, some of which are poisonous or may carry diseases. A sting or bite may cause persistent pain, numbness, and tingling. Personnel shall be especially careful walking in grass and underbrush. Boots and heavy pants should be worn. In the event of a bite or sting, normal treatment for this type of poisoning is an ice pack on the site, alternating every 10 minutes with the pack on, then off. Ticks can carry many diseases. When in the field, check often for ticks. Ticks are best removed by a physician. However, removing a tick with tweezers is an acceptable first aid measure.

Poisonous snakes which may be encountered at the Site include the Western Rattlesnake. The degree of toxicity (hemotoxin) resulting from a snake bite depends on the potency of the venom, the amount injected, and the weight of the victim. Poisoning may occur from injection or absorption of venom through cuts or scratches. Personnel shall be especially careful walking in grass, underbrush, and rocky areas. Boots and heavy pants should be worn. Use of a long walking stick or shovel is recommended for rustling brush. In the event of a snake-bite, the affected area will be immobilized and the victim will be transported to the hospital. Snake bite kits are not used, as current American Red Cross first aid procedures do not advocate the use. Based on this recommendation, no other treatment will be performed by on-site personnel for this sort of injury.

Poison oak occurs in the general site vicinity particularly on hillslopes and along drainages. The best prevention is recognition of the plants and avoiding contact. However, if skin contact does occur, the dermatitis may be avoided by prompt removal of the allergen. About 10 minutes are required for the cutaneous penetration of the allergen. Wash affected area of skin with running water for approximately 10 minutes, avoiding soap. Soap removes protective skin oils and may cause or hasten penetration of the allergen. Avoid nonpolar solvents, such as alcohol, which may spread the allergen over a wider area. Early application of topical steroids minimizes the severity of the dermatitis. If the face or genitalia are involved, seek professional medical assistance immediately.

The allergen may be carried by tools or clothing. No barrier creams have been found effective; protective clothing that prevents skin contact should be used when there is unavoidable contact or in areas where there is a high likelihood of contact.

5.0 WORK ZONES

Each investigation site will be divided into an exclusion zone, a contamination reduction zone, and a clean zone. The exclusion zone (EZ) is defined as the area where contamination and other site hazards are either known or are likely to be present. The contamination reduction zone is where hazardous substances are removed from site personnel and their equipment as they exit the exclusion zone. The clean zone is a non-contaminated area where support services, storage of non-hazardous materials, and administrative activities may occur. There will be no smoking, eating, or drinking within the exclusion or contaminant reduction zones. The zone locations will be based upon current knowledge of proposed site activities. It is possible that the zone configurations may be changed due to work plan revisions. Should this occur, the work zone figures will be adjusted accordingly, and documented through use of an FCR form.

6.0 COMMUNICATIONS

Communications within the work zones will be by verbal command, hand signals, air horn, cell phone, or a combination of all four. The Site Health and Safety Officer will carry a cell phone which can also be used for off-site communications. The telephone numbers for all emergency services, including the telephone numbers for the Performing Contractor project personnel, are provided in Table 5 in Section 10. These phone numbers will be posted in the site vehicles and at each regulated work area. Site personnel will be informed of the location of the closest telephone or will have direct radio communications to someone who has phone access.

Portable air horns will be staged in the Superintendents site vehicle to alert site personnel of an emergency and to initiate a site evacuation. Communication of evacuation routes and assembly points shall occur daily during the tailgate safety briefing. Hospital routes and emergency telephone numbers will be posted at the jobsite.

7.0 TRAINING REQUIREMENTS

All site personnel directly involved in the site remediation work and/or those entering the exclusion zone will have received hazardous waste operation and emergency response (HAZWOPER) training as required by 29 CFR 1910.120(e) unless they will spend less than 24 hours on site. Details of the required training will be presented in the Performing Contractor's Corporate Health and Safety Procedures Manual. The minimum required training is summarized by the following matrix:

Personnel	Training Requirements
All site employees	40-Hour HAZWOPER 8-Hour Refresher Site Specific Hazard Communication
Site Superintendent /SHSO	8-Hour Supervisory and First Aid/CPR and Bloodborne Pathogens
One worker, in addition to SHSO	First Aid/CPR and Bloodborne Pathogens
Personnel performing a DOT function	DOT Training including Security Awareness

Documentation of the above-listed training will be kept on file at the jobsite prior to personnel entering an EZ. Individuals not having evidence of 40-hour HAZWOPER training, 8-hour refresher training (when necessary), 8-hour supervisory training (when necessary), and medical clearance from a certified occupational physician shall not be allowed to enter an EZ unless they will be on site less than 24 hours or have had the required training expire only within the past 45 day period.

7.1 SAFETY INSPECTIONS

Health and safety inspections of the jobsite will be conducted daily by the SHSO. Inspection results will be recorded on the Project Weekly/Monthly Inspection Checklist found in Performing Contractor's CRL. Any deficiencies noted during these inspections will be promptly corrected. Copies of the inspection reports will be kept on file at the jobsite and sent to the Performing Contractors' program health and safety manager for review.

If the project continues for an extended period of time, the SHSO will conduct a comprehensive health and safety program audit of the jobsite on a quarterly basis. This audit will evaluate the overall effectiveness of the Site-Specific Health and Safety Plan and assess compliance with applicable OSHA regulations and Performing Contractors' Corporate Health and Safety procedures. Inspection findings will be sent to the Performing Contractor's program health and safety manager for evaluation and correction of any deficiencies.

7.2 DAILY SAFETY MEETINGS

A daily safety meeting will be conducted to discuss the day's activities and associated health and safety procedures and potential concerns. Prior to starting work at the site, each staff working at the site will provide documentation of the necessary health and safety training. A health and safety form will be signed by the field staff on a daily basis to document and certify understanding and compliance with the health and safety plan and procedures.

All personnel in the work zone will be required at a minimum to wear eye protection, hearing protection, reflective vests, gloves, steel toe boots, and a hard hat (see Section 8; Level D Protection). If action levels are exceeded, the specific active operation that is causing the action level exceedance will be temporarily suspended and workers will be temporarily moved out of affected areas until concentrations decline. Level C protection is not anticipated and is not currently included in the plan, but could be implemented following incorporation of a brief addendum (refer to Section 8).

8.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) will be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified in this plan. Due to the nature of the tasks involved and the size of the site, the SHSO will choose PPE on a daily basis depending on the operation, location, and the hazards involved in each task. The level of PPE protection will be upgraded or downgraded based on changes in site conditions. Several factors which may indicate the need to re-evaluate site conditions and PPE selection include the following:

- Encountering or handling contaminants other than those previously identified
- Commencement of a new work phase
- Change in job tasks during a work phase
- Change of season/weather
- Change in work scope that affects the degrees of contact with contaminants
- Change of ambient levels of contaminants

The type of protective equipment that will be worn in support of this work effort is listed in Table 3. Table 3 also includes personnel and equipment decontamination procedures.

One of the most important aspects of decontamination is contamination prevention. During the soil remedial activities, the following contamination avoidance procedures will be in effect:

<u>Personnel</u>

- Avoid areas of known contamination.
- Do not handle or touch contaminated materials or liquids.
- Make sure PPE is free from cuts and tears prior to use.
- Fasten all closures on outer clothing, covering with tape if necessary.
- Report and cover any skin injuries.

- Stay upwind of dust or vapors.
- Do not eat, drink, chew tobacco, or smoke in the exclusion zone.

Equipment

- Whenever necessary, cover instruments to be used near hazardous materials with plastic, leaving openings for sampling.
- Limit contamination that comes in contact with heavy equipment, especially their tires or tracks.
- Place contaminated tools on a separate plastic liner to avoid contamination of clean equipment.
- Keep contaminated materials contained and segregated from workers and clean equipment.

Table 3. Personnel Protection				
Level of Protection:	☐ A	☐ B	☐ C	☒ D
Respiratory Protection:	☐ SCBA	☐ Airline	☐ Air-Purifying	☒ None
If Air Purifying:	☐ Canister	☐ Cartridge		
Canister/Cartridge Type:	NA			
Protective Clothing:	Modified Level D, including hardhat, steel toe boots, eye protection, ear plugs, gloves, reflective vest, and hard hat. Workers must also wear nitrile gloves when conducting sampling and equipment contamination activities.			
Justification:	Nitrile gloves will protect field staff from contact with potentially impacted groundwater and soils during soil disposal and sampling activities.			
Change in Level of Protection:	No change in level of protection. Field staff will exit the area if need for a change in level protection.			
Up or Downgraded to:	☐ A	☐ B	☒ C	☐ D
Mandatory Safety Equipment – All Jobs:	☒ First Aid Kit			
DECONTAMINATION / SITE CONTROL PROCEDURES				
Sketch of Site Control Zones Attached:	☐ Yes	☒ No		
Decontamination Equipment:	Alconox™ or an equivalent detergent mixed with potable water, distilled water, buckets and brushes.			
Personnel Decontamination Procedures:	If contact with contaminated media occurs, workers must wash their hands and face immediately. In addition, workers should wash their hands and face prior to any hand-to-mouth activities (e.g., eating, drinking, chewing tobacco), and prior to leaving the site. Any non-disposable clothing and/or personal protective equipment should be washed after use each field day.			
Equipment Decontamination Procedures:	Non-disposable sampling equipment will be decontaminated prior to each use. Decontamination of each of these items will either consist of steam cleaning the item, or removing all gross contamination using a stiff brush, washing the item in a mixture of Alconox™ or an equivalent detergent and potable water, and rinsing first with potable water, then with distilled water as a final rinse.			

9.0 MEDICAL SURVEILLANCE

In accordance with the Performing Contractor Corporate Health and Safety Program, all employees who may be exposed to hazardous materials in the course of their work are required to participate in the Corporate Medical Monitoring Program. All employees have received a baseline medical examination, including analysis of blood and urine for heavy metals, audiometric testing, as well as direct examination by a physician. All employees are also certified as fit for working with a respirator. If an employee suspects exposure, additional medical monitoring well be available and the employee must complete a Performing Contractor Employee Exposure/Injury Incident Report. All employees participating in this project will be required to complete Performing Contractor Monthly Exposure/Injury Reports and to undergo routine, annual medical examinations. Medical examinations are conducted by an occupational medicine clinic in accordance with the requirements of 29 CFR 1910.120.

10.0 MONITORING

Ambient air measurements for organic vapors, hydrogen cyanide, and airborne dust will be collected in the breathing zone of site workers during all phases of excavation work. In addition, landfill gas monitoring for methane, carbon dioxide, carbon monoxide, and hydrogen sulfide will also be performed during excavation work within the East End Landfill site. The purpose of this monitoring is to ensure that vapor or dust levels do not pose a significant inhalation or explosion hazard to site personnel and to determine the appropriate level of PPE if the use of such equipment becomes necessary.

Air monitoring results will be recorded in the site logbook. These results will also be made available for review by all site personnel.

Calibration and maintenance of monitoring equipment will be in compliance with the manufacturer's specifications and typically will be performed before daily monitoring. Calibration records will be kept in the project health and safety files. Daily reports describing sampling activities will be drafted and the originals kept in the files with the other health and safety related documentation.

Table 4 provides a summary of air monitoring requirements and associated action levels in support of this work effort.

Table 4. Air Monitoring	
Dust Monitoring	Dust monitoring equipment includes real-time air monitoring using a TSI DustTrak 8520™ dust monitor or equivalent. **The action level for dust is 1.0 mg/m3 sustained in breathing zone.** Monitoring frequency shall be every 15 minutes during active operations. Monitoring locations will be determined based on activity type and wind direction. If visible dust is present, dust control measures (watering) will be implemented.
Hydrogen Cyanide Vapor Monitoring	A MX6 iBRID Multi-Gas meter will be used during initial site entry and routinely during soil coring and sampling activities to monitor for the presence of ammonia, hydrogen sulfide, hydrogen cyanide, methane, and phosphine vapors in the breathing zone. The main focus of the initial monitoring is to rapidly identify immediate hazards and determine background concentrations. Site levels shall be compared to the decision level guidelines summarized in Table 2 to determine whether it is necessary to modify the proposed levels of protection. Specific operating and calibration requirements for this equipment can be found in the instruction manual accompanying each instrument. Visual monitoring for airborne dust will be performed continuously while at the project site. The purpose of this is to ensure that dust levels do not pose a significant inhalation hazard to site personnel. If dust is identified as a potential hazard by the SHSO, sample activities will be temporarily postponed until the dust level resides to safe conditions. Based on prior work conducted at the site, it is not anticipated that cyanide gas will be encountered. **The action level for vapor is 1.0 parts per million sustained in the breathing zone.** Monitoring will be performed in each active area of operations including the zone of active excavation or removal operations as well as sample handling and equipment decontamination areas.
Volatile Organic Vapor Monitoring	Volatile organic vapor monitoring will be performed using a photoionization detector (PID) during excavation activities to monitor for the presence of total organic vapors in the breathing zone. **The action level for total organic vapors background sustained in breathing zone.** One unit above background sustained in the breathing zone for five minutes or more warrants an upgrade in the level of required protection.
Landfill Gas Monitoring	At the East End Landfill area only, landfill gas monitoring for methane, carbon dioxide, carbon monoxide, and hydrogen sulfide will also be performed at the site using either LandTec Gem™, or an equivalent monitor. Based on prior work conducted at the site, it is not anticipated that landfill gas will be encountered. The landfill gas monitoring method will be further assessed for the removal action activities based on the results of the initial field investigation. **The action level for landfill gas is 2.1% Lower Explosive Limit and 9.5% Upper Explosive Limit in the breathing zone.** Monitoring will be performed in each active area of operations including the zone of active excavation or removal operations as well as sample handling and equipment decontamination areas.
Note: Level C and Level B work is not addressed by this Health and Safety Plan. If the action level is exceeded for dust, the specific active operation causing the action level exceedance shall cease and dust control measures will be implemented. If the action level is exceeded for vapors or landfill gases, the specific activity will cease until concentrations decline and staff will be moved out of affected or directly downwind areas. Note that hydrogen cyanide and other landfill gases require the use of specialized respirators and cartridges for Level C use. If dust control measures, vapor mitigation, or landfill gas measurements prove ineffective, the specific activity will be stopped until a plan addendum for Level C work is prepared.	

11.0 EMERGENCY RESPONSE PLAN

Performing Contractor is responsible for implementation of this Emergency Response Plan, and the establishment of control procedures to facilitate accountabilities measures. The Performing Contractor's SHSO will be designated as the Site Emergency Coordinator (SEC). The SEC will be responsible for ensuring the evacuation, emergency treatment, emergency transport of site personnel as necessary, and notification of emergency response units and the appropriate Performing Contractor management staff.

The SEC shall conduct an inspection of emergency response equipment, including fire extinguishers, first aid kits, and spill control equipment. As part of the daily site walkthrough, he/she shall pay close attention to potential fire hazards, spill potentials, and individual work practices.

An air horn will be used to alert site personnel in the event an emergency occurs. One air horn will be located in the Performing Contractor site vehicle. The SHSO will test the effectiveness of the air horn during initial site activities to ensure that all site personnel can clearly perceive the alarm above operational noise levels. If operational noise levels prevent site personnel from detecting the air horn alarm, other means of notification will be implemented.

In the event of an emergency, such as a fire or explosion, the SEC shall immediately:

- Establish the safety of all personnel.
- Direct the administration of first aid as appropriate.
- Shut down all non-essential equipment near the incident.
- Notify the local Emergency Response Team and give the exact location of the evacuated area.
- Prohibit outside personnel from entering the evacuated area.
- Provide emergency equipment as appropriate.
- Notify the Program Manager and PHSM, if not already notified.

- Complete Performing Contractor’s Incident Report and Investigation Form.

One long blast on the air horn will be the signal to evacuate the site immediately. The initial assembly point for all personnel will be the site construction truck entrance, where a head count will be conducted. Once everyone is accounted for, personnel will evacuate further to a safe location designated during the daily tailgate safety briefing. The SEC will assess the situation and outline the actions to be taken. Two short blasts will be the “all clear” signal, indicating that personnel can once again re-enter the site.

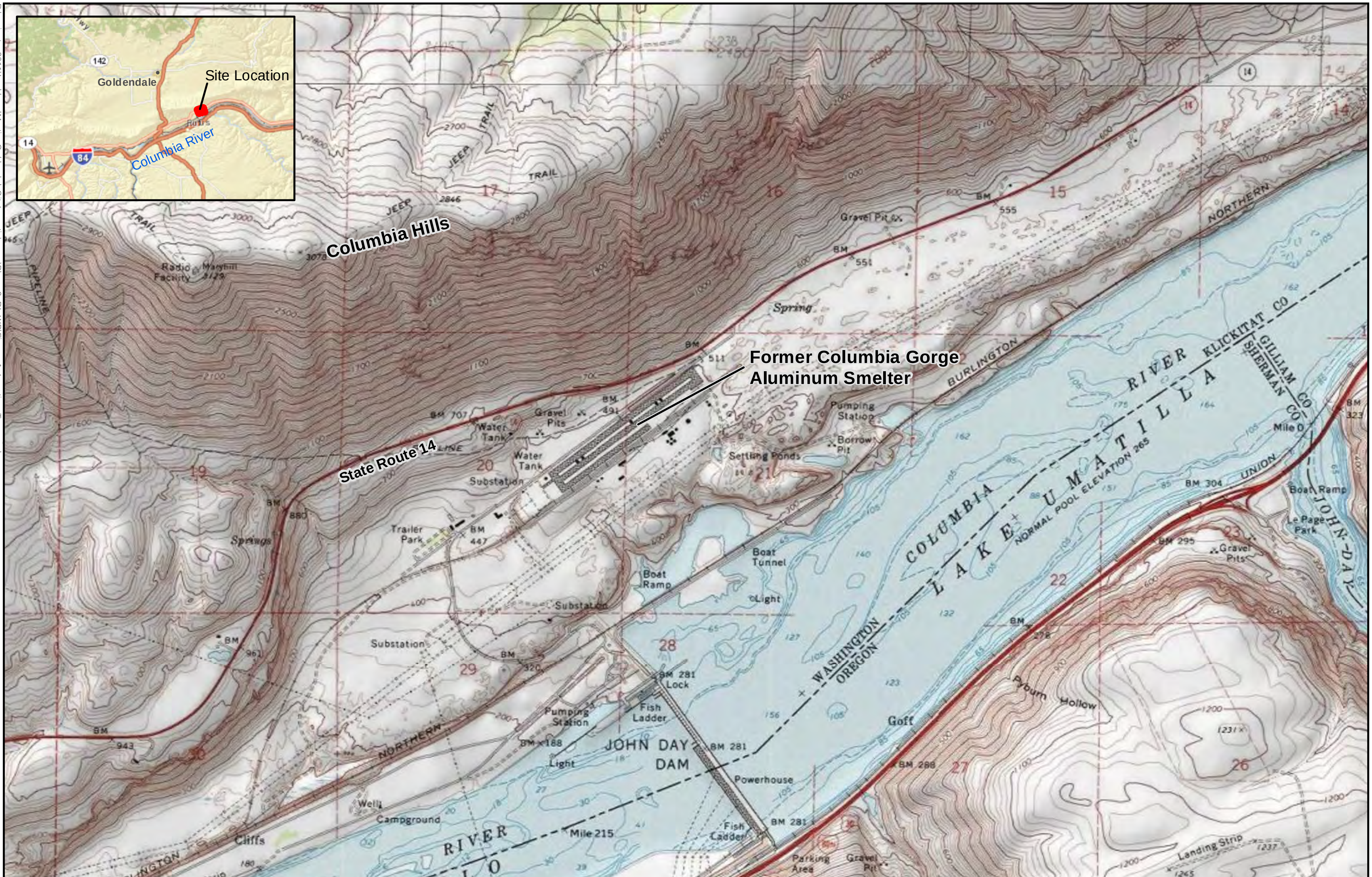
Communication regarding evacuation routes and assembly points shall occur initially, and daily as necessary, during the tailgate safety briefing. Communication of hospital routes and emergency telephone numbers will be through the posting of this information in the site vehicles. Emergency contact information in support of this project is provided in Table 5. The map to the nearest hospital is included as Figure 4.

The emergency response plan should be rehearsed regularly as part of the overall training program for site operations. The site emergency response plan should be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

Table 5. Emergency Information	
Local/Site Resources:	Name / Phone / Notified Fire ....911 ☐ Yes ☐ No Police......................................911 ☐ Yes ☐ No Ambulance..............................911 ☐ Yes ☐ No Hospital ....911 ☐ Yes ☐ No Poison Info. ....911 ☐ Yes ☐ No Site Health and Safety Officer (xxx) xxx-xxxx (cellular phone) ☐ Yes ☐ No
Nearest Hospital:	Klickitat Valley Hospital 310 S. Roosevelt Avenue Goldendale, Washington 98620 Phone: (509) 773-4022
Directions to Hospital:	Start out going northeast on John Day Dam Road toward WA-14 (0.8 miles); turn left onto WA-14, (7.4 miles). Then slight right onto US-97 (10.4 miles); turn left onto E. Broadway St./WA-142 (0.5 miles); turn left onto N. Roosevelt Avenue (0.2 miles). The hospital is on the left.
Map to Hospital Attached:	☒ Yes ☐ No
CORPORATE RESOURCES:	
Program Manager:	TBD ....(xxx) xxx-xxxx
Project Manager:	TBD. ....(xxx) xxx-xxxx
Director Health and Safety:	TBD ....(xxx) xxx-xxxx
Site Health and Safety Officer	TBD .... (xxx)xxx-xxxx (cell)
OTHER RESOURCES:	
Lockheed Martin Contact:	Bill Bath....................................... (303) 229-7063(cell)
NSC Contact:	Peter Tarbusiner,........................... (509) 521-6531(cell)
CDM Smith Contact	Scott Adamek.............................. (206) 473-7726 (cell)
Site Access Contact	Dave Rooney .... (541) 993-4940 (cell)
State Agency:	Guy Barrett, Ecology ....(360) 407-6999
Excavation Superintendent	TBD (xxx)xxx-xxxx (cell)
Boat Operator	TBD (xxx)xxx-xxxx (cell)
Drilling Contractor	TBD (xxx)xxx-xxxx (cell)
Centers for Disease Control and Prevention:	(888) 232-4636 (24 hours/every day)
National Response Center:	(800) 424-8802

FIGURE 1

PROJECT LOCATION TOPOGRAPHIC MAP



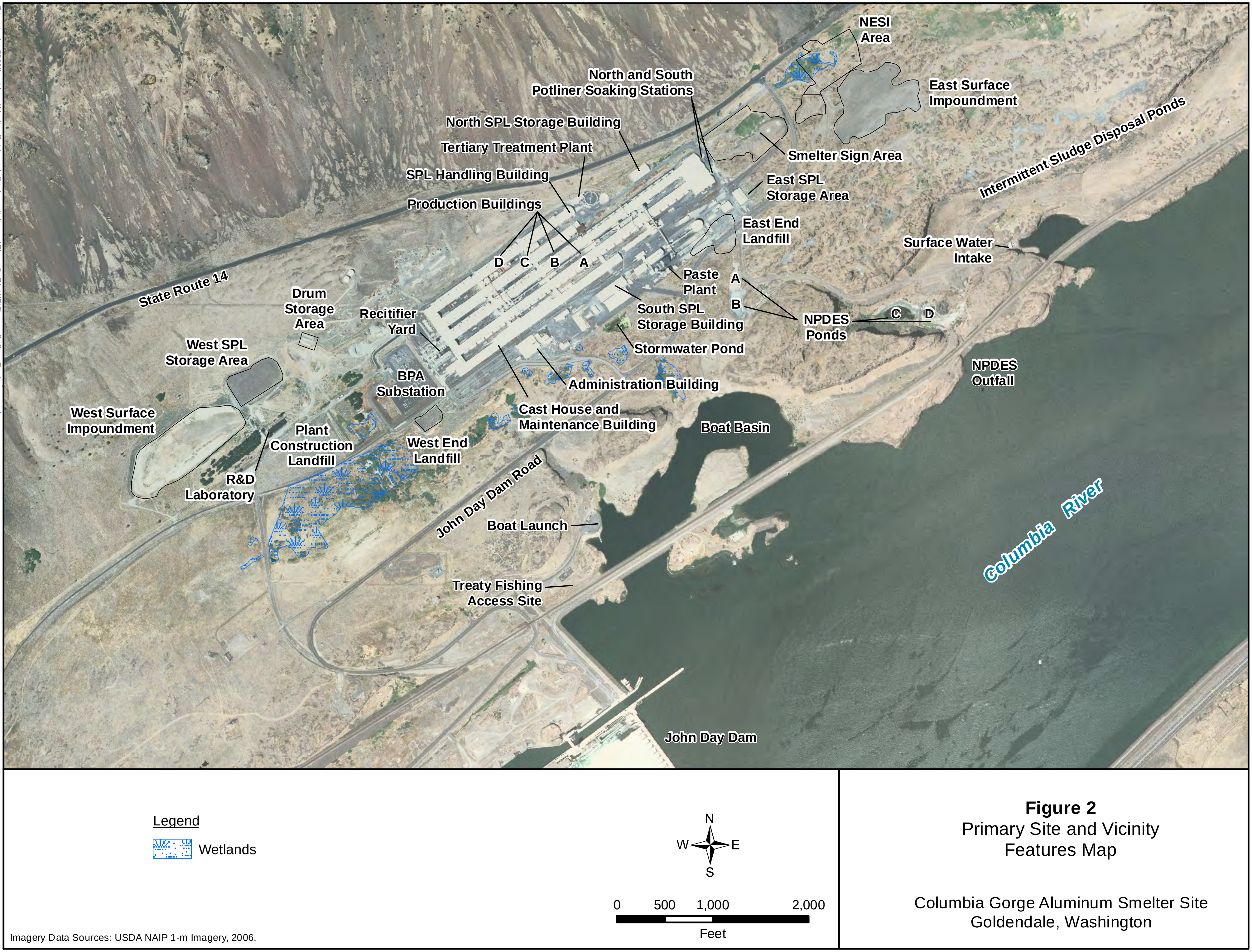
Topographic Map Data Source: USGS 24k Topographic Quadrangles, 1973.

Figure 1
Project Location Topographic Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

FIGURE 2

PRIMARY SITE AND VICINITY FEATURES MAP



Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 2
Primary Site and Vicinity Features Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\Site\Investig\maps\Phase2_RI_WP\Figure_2_Site_Features.mxd

FIGURE 3

SOLID WASTE MANAGEMENT UNITS AND INVESTIGATION AREAS

Legend

SWMU Investigation Areas

Wetlands

1 Solid Waste Management Unit

N W E S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 3

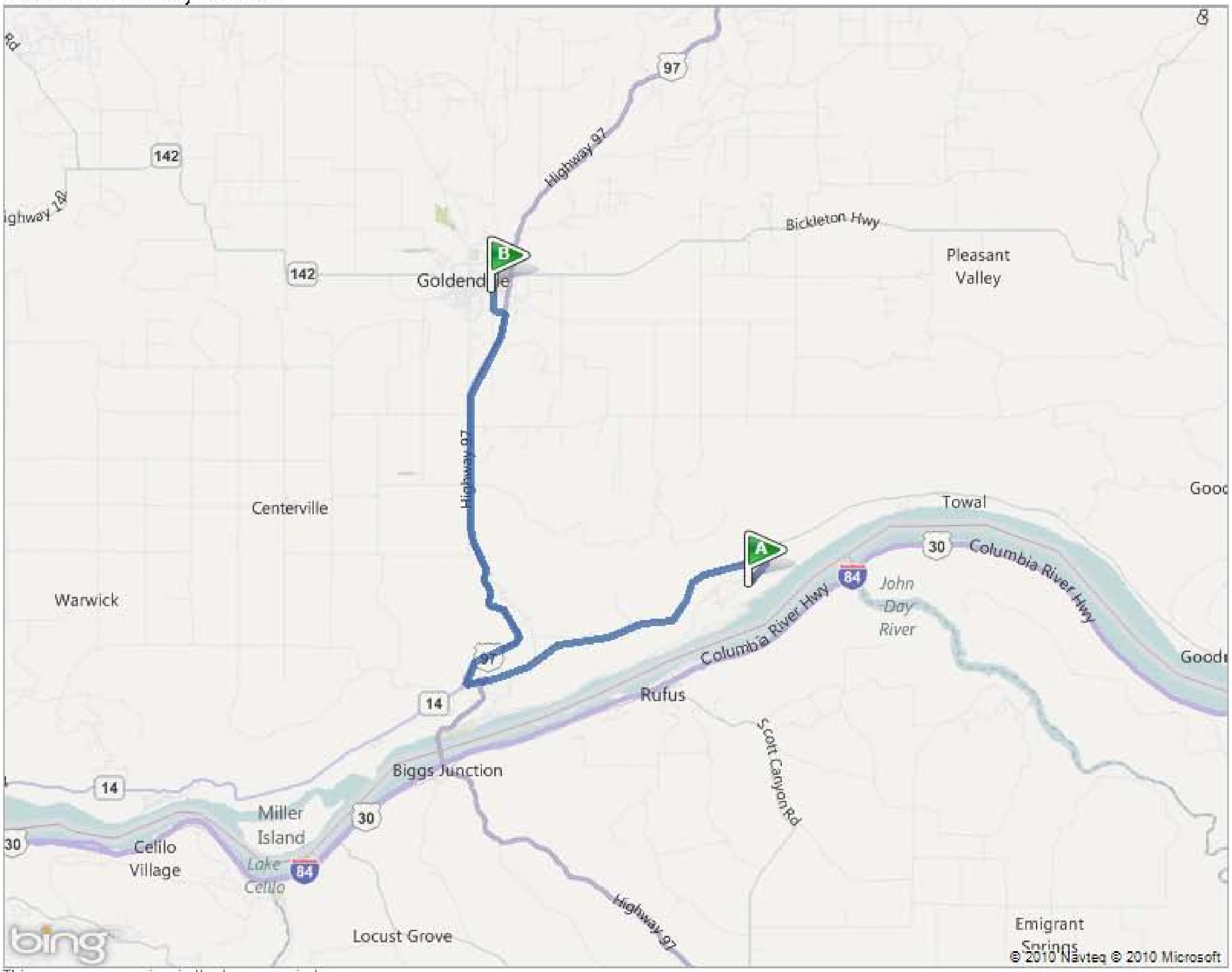
Solid Waste Management Units and Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

FIGURE 4

EMERGENCY HOSPITAL ROUTE MAP

Route: **18.2 mi, 23 min**



This was your map view in the browser window.

Source: BING MAPS Goldendale, Washington. 2011.

FIGURE 4

KLICKITAT VALLEY HOSPITAL CHARACTERIZATION INVESTIGATION GOLDENDALE, WASHINGTON

TETRA TECH, INC.

ATTACHMENT A

HEALTH AND SAFETY PLAN CONSENT AGREEMENT

PERFORMING CONTRACTOR.
HEALTH AND SAFETY PLAN
CONSENT AGREEMENT

I have reviewed the Performing Contractor Site Health and Safety Plan for the site activities to be performed at the three areas of investigation at the Goldendale, Washington site. I understand its purpose and consent to adhere to its policies, procedures, and guidelines.

Signature	Date:
Signature	Date:
Signature	Date:
Signature	Date:
Signature	Date:
Signature	Date:

Copies of this page, with signatures of all field personnel will be submitted to the Performing Contractor Health and Safety Officer and the Project Manager for inclusion in the project file.

APPENDIX B— CULTURAL RESOURCES MONITORING PROTOCOL

APPENDIX B

CULTURAL RESOURCES MONITORING PROTOCOL

COLUMBIA GORGE ALUMINUM SMELTER SITE
REMEDIAL INVESTIGATION
GOLDENDALE, WASHINGTON

August 2015

Table of Contents

Figures

Attachments

1.0 CULTURAL RESOURCES MONITORING PROTOCOL

This section describes the Cultural Resources Monitoring Protocol (CRMP) developed for use in completing the RI field activities. This protocol will be used to help locate, identify, document, and report potential cultural resource artifacts at the site, if encountered during the course of the planned field investigation activities. This protocol is a requirement of the Agreed Order. The CRMP has been prepared and will be implemented consistent with Washington State Department of Archaeology and Historic Preservation guidance (DAHP 2010). The following sections summarize cultural resources background information, cultural resource monitoring activities, documentation and notification procedures, and cultural resource staff qualifications.

1.1 CULTURAL RESOURCES BACKGROUND INFORMATION

For approximately 11,500 years (Aikens 1993), this general area was heavily used by pre-contact Native Americans for a wide variety of activities and was a center of settlement and trade in the Columbia Plateau region. In particular, pre-contact Native Americans were drawn to the Columbia River to harvest salmon. Because people were drawn annually over a broad geographic area to fish the seasonal salmon runs, trade flourished near the best fishing locations. The area was also used for gathering of vegetable foods and hunting.

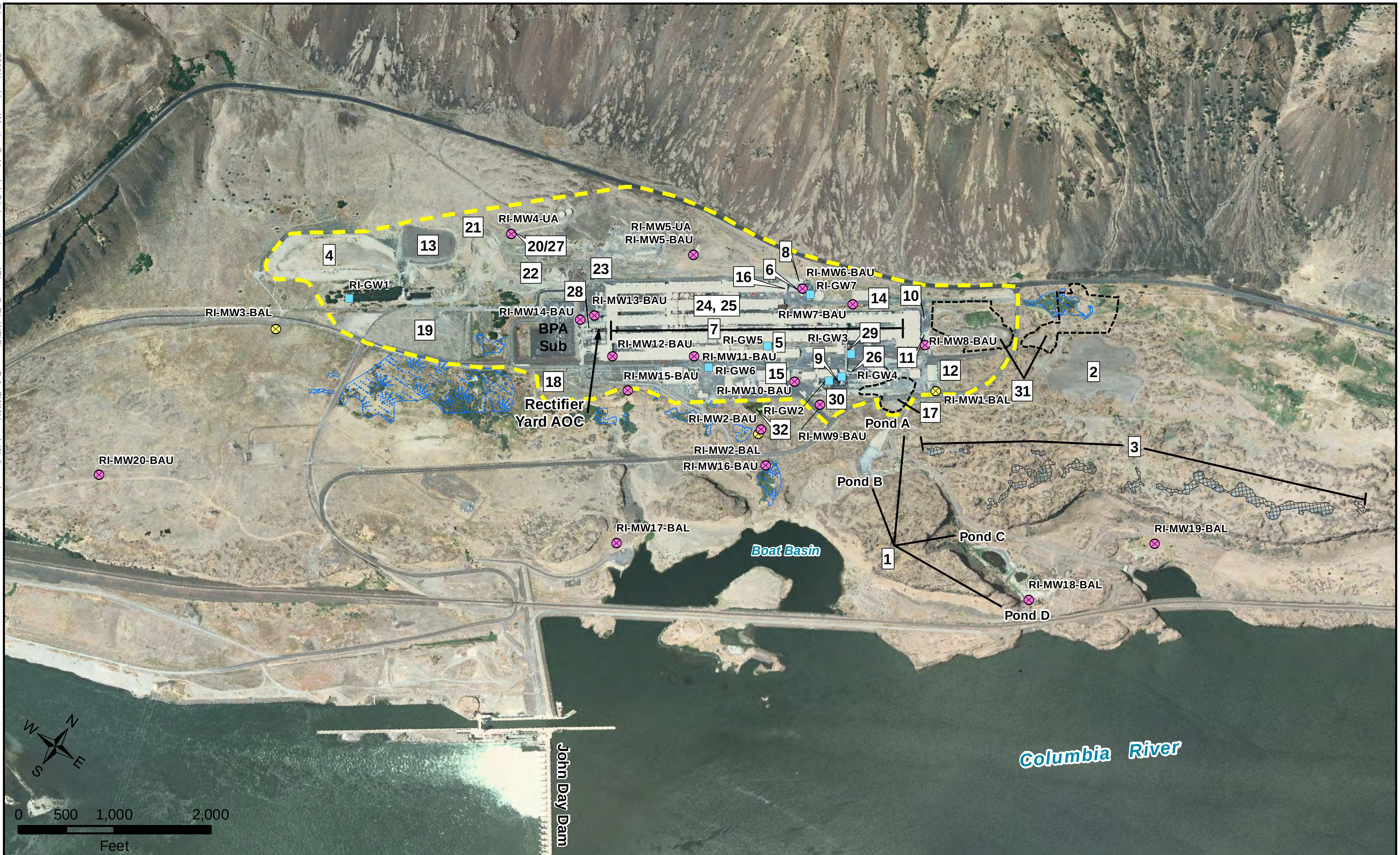
The Wildcat Canyon Site near the mouth of John Day River and near the present day location of the John Day Dam shows evidence of long-term Native American settlement with artifacts related to fishing, hunting, and trade. Cultural materials are sometimes found in the general site vicinity primarily on lands with limited exposure to industry and Euro-American settlement. The documented historical use of the non-developed portion of the project site is limited to cattle grazing and waste disposal related to historical aluminum plant operations. Most of the investigation area has been physically disturbed by these activities.

The Washington Information System for Architectural and Archaeological Records Data (WISAARD) database has been reviewed for known artifacts/site locations within or near the Columbia Gorge Aluminum Smelter Site project area. In summary, no artifacts, features or archaeological sites have been recorded within the project boundary limits. The closest known archaeological site is found 0.5-miles south of the project area towards the Columbia River. This site is a cave wall that has been decorated with rock art and has been looted by pot hunters. No other sites, features or artifacts have been identified within one mile of the project area. In the surrounding region, lithic scatters and historic debris scatters have been identified to the southwest along the Columbia River at approximately the same altitude as the project area. Northwest of the project area are several lithic scatter sites located on the upland mountainsides above the project area. Southeast of the project area in the areas where the Columbia River has inundated the valley, house pits, petroglyphs and lithic scatter have been identified. Based on this information, lithic scatters, rock art, or other cultural artifacts could be found in the project area due to the project areas similar geographic position to the locations where artifacts have been found. However, the relatively high degree of physical disturbance at the site lowers the likelihood of finding cultural resource artifacts.

The remedial investigation study area includes 32 SWMUs and 5 AOCs that occur in areas with varying degrees of physical disturbance. Many of the SWMUs and AOCs occur within the former plant footprint, with some RI investigation sites in less disturbed wetland, open, and shoreline areas (Figure B-1). The degree of physical disturbance in the RI study area is summarized as follows:

- **Former Plant Footprint –** The vast majority of the intrusive work (e.g., drilling and excavation) will be performed within the footprint of the former smelter plant (refer to Figure B-1). Much of this area was blasted and graded during the initial construction of the smelter around 1970 and the area is characterized by ground disturbance down to bedrock. This factor coupled with the 30-year history of industrial operation and subsequent plant demolition activities makes the likelihood of encountering cultural resource artifacts in this area remote.

- **Wetlands –** Fourteen wetlands have been delineated within the RI investigation area outside of the former plant footprint (refer to Figure B-1), with 10 wetlands being investigated by non-intrusive surface soil grab samples as part of the Wetlands AOC (refer to Section 5.2.3). One of the wetlands is part of SWMU 31 (the NESI Area), and is being investigated through test pit and trench excavations (refer to Section 5.1.30.5). The investigation of the NESI Area will include a pre-excavation cultural resources surface reconnaissance and monitoring during all excavation activities by a qualified archaeologist, as discussed below.



Legend

SWMU Investigation Areas

Wetlands

1 Solid Waste Management Unit

Proposed Wells

Deep Well with Coring

Shallow Well (UA or BAU as

Temporary Shallow Well (to be Installed if Shallow Groundwater is Encountered during Drilling)

Plant Area Footprint

A pre-excavation cultural resources surface reconnaisance will not be performed in the plant area footprint due to site developement and prior ground disturbance in this area.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure B-1

Plant Area Footprint, Solid Waste Management Units and Proposed Groundwater Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- **Open and Shoreline Areas –** The RI field investigation includes drilling of 7 monitoring wells in open and shoreline areas outside of the former plant footprint (refer to Figure B-1). A pre-drilling cultural resources surface reconnaissance will be performed at each drilling and associated access location by a qualified archaeologist, as described below.

1.2 CULTURAL RESOURCES MONITORING OBJECTIVES AND ACTIVITIES

Based on the background information at the site, the main focus of the cultural resources monitoring is the identification and documentation of potential Native American artifacts (e.g. fire modified rock, animal bone, lithic debitage, flaked or ground stone tools). The likelihood of finding archaeological materials appears to be relatively low given the relatively high degree of historical disturbance of the site. Notification and coordination with the Yakama Nation will be provided in advance of planned cultural resources surface reconnaissance activities and intrusive work (i.e., monitoring well drilling and excavation activities) in wetland, open, and shoreline areas as defined above.

1.2.1 Cultural Resources Surface Reconnaissance

Cultural resources surface reconnaissance will be performed by a qualified archaeologist for the NESI Area trenching and test pitting locations and newly proposed monitoring well locations in open and shoreline areas. Prior to any intrusive field activities, the project archaeologist will walk and inspect the project area (and associated access routes and areas) and document the site reconnaissance in the field logbook. All areas with exposed native surface soils will be walked and inspected at 15 meter intervals by the archaeologist to determine if any archaeological surface materials are present. Archaeological surface materials will be temporarily flagged so that they can be re-visited and documented using the forms as described in Attachment B-2, and also to help protect the artifacts from heavy equipment operations during the investigation. Field activities will commence after the surface reconnaissance has been completed by the archaeologist.

If archaeological surface materials are found at a proposed work site, the drilling or excavation location will be altered to avoid disturbance of the materials, while still meeting the project environmental characterization objectives.

1.2.2 Cultural Resources Excavation Monitoring

This monitoring activity is specifically planned for the NESI Area (part of SWMU 31) test pit and trench excavation work. Further details regarding the NESI Area are provided in Section 6.5.4 of the Phase 1 Work Plan and Section 5.30.1 of the Phase 2 Work Plan. Archaeological monitoring will involve the close inspection of excavations and other activities within NESI investigation area. The field team supervisor shall inform all construction personnel of the monitor's role. The archaeologist will monitor the excavation activities paying particular attention to the native soil horizon buried under waste and fill material. The archaeologist will comply with the requirements of the project health and safety plan and make all reasonable efforts at accommodating construction activities and schedule. The archaeologist will have authority to stop work until any cultural resources encountered during sampling are properly documented. All excavation locations, staging areas, access points, and other areas of heavy equipment operation will be examined prior to any ground cover removal and the cleared surface will also be examined prior to the excavation being conducted.

If archaeological deposits or features are encountered the following procedures will be followed:

- All work will stop within 50 feet of the discovery, the find will be clearly flagged and secured, and the monitor will immediately notify the environment project field supervisor of the discovery.

- Following notification, the monitor will make a preliminary assessment of the find to determine whether the find is an isolated artifact (e.g., lithic flake, food tin, and glass fragment), archeological site (an assemblage of two or more artifacts greater than 50 years of age) or recent deposit (e.g., contemporary debris such as aluminum cans and recently made glass bottles). If the find is determined to be recent; construction will be allowed to resume. If the find represents an isolated artifact or collection of artifacts that necessitate the completion of a site form (refer to Attachment B-2), then those documents will be completed prior to resuming excavation activities.

1.2.3 Cultural Resources Routine Monitoring

Routine inspection will include monitoring and identification of any signs of human remains, cultural features, or other archaeological resources that will be performed routinely by all field staff during all field-related activities. If any artifacts are discovered during RI field activities, work activities will cease within the immediate vicinity of the find and the project archaeologist, the property owner and Lockheed Martin, Ecology, the Department of Archaeology and Historic

Preservation (DAHP), and the Yakama Nation's Cultural Resource Program will be notified on the same day by close of business.

1.3 DOCUMENTATION AND NOTIFICATION

Recording of artifacts and handling of human remains will include strict adherence to federal and state laws, regulations, and guidelines, as well as established Yakama Nation treaty rights, as appropriate. If archaeological resources or human remains are discovered at the Facility, a treatment plan shall be developed by a professional archaeologist in consultation with the above listed parties consistent with RCW 27.44 and RCW 27.53 and implemented according to WAC 25-48.

In the event that artifacts are found, the find will be documented and properly recorded on Washington Archaeological Site Inventory Form and Washington Archaeological Isolate Form as appropriate (refer to Attachment B-2), and the artifact will be returned to the excavation from which it was recovered.

Since all artifacts encountered are the property of the landowner from which the artifact is recovered, the landowner and Lockheed Martin will be notified of the discovery of the artifacts as soon as practical. The DAHP will be notified of the archeological find through preparation and submittal of the Cultural Resources Monitoring Report that will be submitted within 14 days of completion of the field investigation activity.

In the unlikely event that human remains are encountered, work will be immediately stopped in the discovery area, the remains will be covered and secured against further disturbance, and the Goldendale Police Department and Klickitat County Medical Examiner will be immediately contacted, along with Ecology, the DAHP, and authorized Yakama tribal representative(s). Lockheed Martin and the landowner also will be notified as soon as practical. The DAHP Physical Anthropologist will also be notified as soon as practical should it be determined that the remains are of likely Native American origin. In this circumstance, documentation (photographs) of human remains will not be collected until approval is granted by the DAHP, as well as the Yakama Nation.

A list of contacts for the cultural resources monitoring aspect of the project is provided in Attachment B-1.

1.4 QUALIFICATIONS

The project archaeologist is a registered professional archaeologist who is proposed to perform the cultural resources monitoring for this study (refer to Attachment B-3 for Staff Qualifications). Because the project represents a hazardous waste site cleanup and project field personnel are required to meeting the training and other requirements of the project health and safety plan, 40-hour HAZWOPPER training is required for the archaeologist performing the cultural resources monitoring. It is anticipated that a Yakama Nation Cultural Specialist who meets all the qualifications of the Yakama Nation Tribal Council Cultural Committee may accompany the project archaeologist.

ATTACHMENT B-1

CULTURAL RESOURCES REPORTING CONTACT INFORMATION

Appendix B-1

Cultural Resources Reporting Contact Information

Organization	Point of Contact/Role	E-Mail	Phone Number
Washington Department of Ecology, Industrial Section	**Guy Barrett**, Project Manager	Guy.Barrett@ecy.wa.gov	(360) 407-6999
Washington Department of Archaeology and Historic Preservation	**Rob Whitlam**, State Archaeologist **Guy Tasa**, Physical Anthropologist	Rob.Whitlam@dahp.wa.gov Guy.Tasa@dahp.wa.gov	(360) 586-3080 (360) 586-3534
Yakama Nation	**Johnson Meninick**, Cultural Resources Program Manager **Jon Shellenberger**, Archaeologist	johnson@yakama.com jons@yakama.com	(509) 865-5121 (509) 865-5121
NSC Smelter, LLC	**Peter Trabusiner**, Project Coordinator	ptrabus1@frontier.com	(509) 521-6531
Lockheed Martin Corporation	**Bill Bath**, Project Coordinator	bill.bath@lmco.com	(720) 842-6106
Goldendale Police Department (non-emergency)			(509) 773-3780
Klickitat County Coroner:	**David Quesnel**, Coroner	davidq@klickitatcounty.org	(509) 773-5838

ATTACHMENT B-2

STATE OF WASHINGTON ARCHAEOLOGICAL ISOLATE AND SITE INVENTORY FORMS

STATE OF WASHINGTON
ARCHAEOLOGICAL ISOLATE INVENTORY FORM

Smithsonian Number:

***County:**

***Date:** *__Compiler:__

ISOLATE DESIGNATION

Isolate Name:

Field/ Temporary ID:

Site Type** *(Refer to the DAHP Survey and Inventory Guidelines Pages 19-23):**

ISOLATE LOCATION

***USGS Quad Map Name:**

***Legal Description: T R E/W: Section(s):**

Quarter Section(s):

***UTM: Zone Easting Northing**

Latitude: Longitude: Elevation (FT/M):

Other Maps: Type:

Scale: Source:

Drainage, Major: Drainage, Minor: River Mile:

Aspect: Slope:

Location Description** *(General to Specific):**

Approach *(For Relocation Purposes)***:**

****Mandatory Information for Official Smithsonian Number designation.*** *Revised 2/2010*

ISOLATE DESCRIPTION		
***Narrative Description:**		
Vegetation** *(On Site):**		
Local:	**Regional:**	
Landforms *(On Site)***:**	**Local:**	
Water Resources *(Type)***:**	**Distance:**	**Permanence:**
***Method of Collection(s):**		
Location of Artifacts** *(Temporary/Permanent):**		
ISOLATE AGE		
***Component:**	***Dates:**	***Dating Method:**
Phase:	**Basis for Phase Designation:**	

ISOLATE RECORDERS

Observed by: **Address:**

***Date Recorded:**

Recorded by** *(Professional Archaeologist):**

***Affiliation:** ***Affiliation Phone Number:**

***Affiliation Address:** ***Affiliation E-mail:**

Date Revisited: **Revisited By:**

ISOLATE HISTORY

Previous Work *(Done on Area Where Isolate was Found)***:**

LAND OWNERSHIP

***Owner:**

***Address:**

***Tax Lot/ Parcel No:**

RESEARCH REFERENCES

Items/Documents Used In Research** *(Specify):**

USGS MAP
*__Quad Name:__ ***Series:** ***Date:** ***INSERT 7.5 MIN USGS MAP** ***HIGHLIGHTING ISOLATE LOCATION***

PHOTOGRAPH(S)
***Photograph Description(s):**   ***INSERT PHOTOGRAPH(S)**

CONTINUATION/ ADDENDUM SHEET
Label all additional pages by corresponding headings. *(e.g. Isolate Description, Isolate History, Research References, etc.)*

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION
Protect the Past, Shape the Future

STATE OF WASHINGTON
ARCHAEOLOGICAL SITE INVENTORY FORM

Smithsonian Number:

***County:**

***Date:** ***Compiler:**

Location Information Restrictions *(Yes/No/Unknown)*: Yes

SITE DESIGNATION

Site Name:

Field/ Temporary ID:

***Site Type** *(Refer to the DAHP Survey and Inventory Guidelines Page 19)*:

SITE LOCATION

***USGS Quad Map Name:**

***Legal Description: T R E/W: Section(s):**

Quarter Section(s):

***UTM: Zone Easting Northing**

Latitude: Longitude: Elevation (ft/m):

Other Maps: Type:

Scale: Source:

Drainage, Major: Drainage, Minor: River Mile:

Aspect: Slope:

***Location Description** *(General to Specific)*:

Approach *(For Relocation Purposes)*:

****Mandatory Information for Official Smithsonian Number designation.***

SITE DESCRIPTION

***Narrative Description:**

Site Type** *(Refer to the DAHP Survey and Inventory Guidelines Page 19):**

***Site Dimensions**

*****Length:** *****Direction:** x *****Width:** *****Direction:**

*****Method of Horizontal Measurement:**

*****Depth:** * **Method of Vertical Measurement:**

Vegetation** *(On Site):**

Local: **Regional:**

Landforms *(On Site)***:** **Local:**

Water Resources *(Type)***:** **Distance:** **Permanence:**

CULTURAL MATERIALS AND FEATURES

***Narrative Description:**

***Method of Collection(s):**

Location of Artifacts** *(Temporary/Permanent):**

SITE AGE

***Component:** *****Dates:** ***Dating Method:**

Phase: **Basis for Phase Designation:**

SITE RECORDERS

Observed by: **Address:**

***Date Recorded:**

Recorded by** *(Professional Archaeologist):**

***Affiliation:** ***Affiliation Phone Number:**

***Affiliation Address:** ***Affiliation E-mail:**

Date Revisited: **Revisited By:**

SITE HISTORY

Previous Work *(Done on Archaeological Site)***:**

LAND OWNERSHIP

***Owner:**

***Address:**

***Tax Lot/ Parcel No:**

RESEARCH REFERENCES

Items/Documents Used In Research** *(Specify):**

USGS MAP

*__Quad Name:__

***Series:**

***Date:**

***INSERT 7.5 MIN USGS MAP**

HIGHLIGHTING SITE

LOCATION AND BOUNDARIES

SKETCH MAP

***Sketch Map Description:**

***INSERT SKETCH MAP**

***Legend:** **Known Boundary Symbology:**

Possible Boundary Symbology:

Other Symbols *(Other Than USGS)***:**

***INSERT LEGEND**

***Scale:**

North Arrow** *(Magnetic/True North):**

PHOTOGRAPH(S)
***Photograph Description(s):** ***INSERT PHOTOGRAPH(S)**

CONTINUATION/ ADDENDUM SHEET
Label all additional pages by corresponding headings. *(e.g. Site Description, Site History, Research References)*

ATTACHMENT B-3

STAFF ARCHAEOLOGIST QUALIFICATIONS

FRANK STIPE, M.A.

Archaeologist — Tetra Tech, Inc. – Bothell, Washington

EXPERIENCE SUMMARY

Mr. Stipe has 16 years of experience in cultural resource management and archaeology with a focus on Section 106 of the National Historic Preservation Act (NHPA) project work and is a qualified archaeologist who meets and exceeds The Secretary of the Interior's Standards and Guidelines for archaeology. He has successfully completed Section 106 projects for the Bureau of Land Management, U.S. Forest Service, The Nature Conservancy, and numerous third party clients such as municipalities, energy companies and private clients. He has led and/or participated in projects in Virginia, West Virginia, Delaware, Washington DC, Maryland, Iowa, Missouri, Colorado, California, Idaho, Montana, Alaska, California, Utah, Wyoming, Nevada, Pennsylvania, Oregon, and Washington.

EDUCATION

MA, University of Leicester, 2008. Dissertation was the analysis of a Landscape Archaeological approach to cultural resource management and the issue of new landscape data and existing data synthesis.

BA, Anthropology, James Madison University, 1998. Field school taken at Montpelier, VA, plantation home of James Madison, 4th President of the United States.

AA, Liberal Arts, Northern Virginia Community College, 1996

TRAINING

40 Hour Health and Safety Training for Hazardous Waste Worker OSHA Training, 2011
8-hour Update for OSHA hazardous Waste Health and Safety Training, Current
Practical Loss Control Training (2006)
PM 100 Project Management Training (2005)
First Aid/CPR (2009)
Defensive Driving (2002)
Trimble Unit training (2002)
Total Station training (1999)

CURRENT PROJECT EXPERIENCE

Archaeologist – Tetra Tech

As the Senior Archaeologist for Tetra Tech in the Seattle area, Mr. Stipe has served as the cultural resources staff for the region. Responsibilities have included:

- Project Manager for small and large scale projects which involve archaeology and cultural resources such as cell tower and transmission line projects which used 1-2 people per crew.
- Completed construction monitoring duties for soil remediation, utility installation, and UXO disposal.
- Review archaeological records for proposed project areas to determine the presence or absence of cultural resources and the possible impacts created by project work on those resources.

- Participated as a team member on large scale survey projects including pedestrian and excavation surveys which used 3 to 6 people on a crew.
- Evaluated Historic Structures for visual impacts.
- Completed budgets and proposals for large and small scale cultural resource projects.
- Completed reports designed to comply with Section 106 regulations.
- Completed numerous SHPO research projects in Washington, Oregon, and Montana.

Arlington Food Bank Survey. As Principal Investigator, Mr. Stipe conducted a cultural resource survey for a 2-acre project located in Arlington, Washington. Investigation included pedestrian survey and shovel testing. This survey was undertaken to help an agency client fulfill their obligations to complete Section 106 requirements. All project components were completed within budget and on time.

Construction Monitoring at Stevens Pass. As Principal Investigator, Mr. Stipe was the archaeological monitor for soil remediation projects at Stevens Pass, WA which involved mechanical excavation of test units to determine contamination levels. Identified all cultural resources present within excavation test pits meant to identify the extent of gas leakage from underground storage tanks.

Survey for Cellular Tower Facilities to Satisfy Section 106 of the NHPA. As Principal Investigator, Mr. Stipe has performed approximately 400 cultural resource projects that have been completed in Washington, Oregon, Idaho, Montana, and Wyoming. Projects entail a physical survey of the project area which may include a pedestrian survey and shovel test probes. Research completed at relevant SHPO offices identifies National Register of Historic Places (NRHP) Eligible/Listed historic structures for visual impact assessment which may be caused by the proposed cellular tower.

Jefferson County Culvert Surveys. Jefferson County, Washington. As Principal Investigator, Mr. Stipe completed an archaeological investigation of three proposed culvert replacement projects located along the Hoh River. Investigation included pedestrian survey and shovel testing. This survey was undertaken to help Jefferson County fulfill their obligations to complete Section 106 requirements. All project components were completed within budget and on time.

PREVIOUS PROJECT EXPERIENCE

Bureau of Land Management – Multiple Cultural Resource Investigations, Uncompaghre Field Office, Montrose, Colorado. Managed archaeological surveys for this field office, including such activities as research, field survey, test excavation, project reporting, and analysis of archaeological materials. Large projects of note include several linear surveys done for the Recreation Department, which involved surveying several hundreds of miles of roads on BLM lands. He was responsible for 25 archaeological projects, ranging from as small as an acre with 10 samples to over 1,000 acres involving nearly 100 samples. Most of these surveys also included recording and analyzing rock art and rock shelter dwellings. Recovered samples included lithic, ceramic, bone, and charcoal materials. Responsible for site testing procedures and heritage resource surveys to properly record ad analyze cultural resource properties in compliance with federal, state, and BLM regulations and guidelines, including compliance with Section 106/110 of the Federal Antiquities Act. Duties also involved managing a GIS database using ArcView and Arc/GIS software for recording project surveys, sites, features, and artifact locations. Mr. Stipe interacted with Northern Ute tribal elders on disposition of cultural remains. He also completed projects involving transportation, energy, water, fire, and cultural compliance programs.

United State Forest Service – Uncompaghre National Forest, Norwood, Colorado. As an Archaeological Technician, Mr. Stipe worked both with a crew and independently, and was responsible for field survey, project reporting, and analysis of archaeological materials. Performed 10 archaeological assessments ranging from as small as an acre to over 1,000 acres in support of transportation, fire, and wildlife projects. Mr. Stipe was responsible for site testing procedures and heritage resource surveys to properly record and analyze cultural resource properties in compliance with federal, state, and US Forest Service regulations and guidelines, which included complying with Section 106 of the National Historic Preservation Act.

United States Forest Service – Mark Twain National Forest, Winona, Missouri. As an Archaeological Technician, Mr. Stipe worked with a crew and was responsible for field surveys, project reporting, and analysis of archaeological materials and excavation of historic habitation sites. Completed heritage resource surveys in support of transportation, fire, and wildlife projects. Projects ranged in size from 100 to over 1,000 acres, with archaeological samples being taken as artifacts were discovered. Mr. Stipe was responsible for site testing procedures and to properly record and analyze cultural resource properties, in compliance with federal, state, and U.S. Forest Service regulations and guidelines, which included compliance with Section 106 of the National Historic Preservation Act.

P-III Archaeological Associates, Salt Lake City, Utah. As the Field Technician on pedestrian survey projects, Mr. Stipe performed data recovery from BLM lands subjected to natural or manmade fire. Duties included helping complete approximately 10 project surveys, ranging in size from 500 acres to over 10,000 acres. Responsible for the archaeological survey, site documentation, historic research of project survey areas, and equipment maintenance. Completed work on projects in Utah, Nevada, Colorado, and Wyoming, under Section 110 of the National Historic Preservation.

Thunderbird Archaeological Associates, Woodstock, Virginia. Served both as crew member and crew chief on cultural resource projects including shovel test surveys, a surface survey, and excavation of both prehistoric and historic features and sites. Sites and projects were completed so clients were in compliance with Section 106 of the National Historic Preservation Act. Cleaned and analyzed archaeological materials from field surveys and excavations in Virginia, West Virginia, Maryland, Delaware, and Washington, DC. Participated in approximately 20 projects ranging from excavation of a mid-woodland village complex off of the Potomac River, several plantation slave houses, including the first plantation owned by a woman in the United States and the original Anacostia Fish Market in Washington, DC.

APPENDIX C— JOINT AQUATIC RESOURCES PERMIT APPLICATION FORM

AGENCY USE ONLY

Date received:

Agency reference #: ______________

Tax Parcel #(s): ______________

____

____

WASHINGTON STATE
Joint Aquatic Resources Permit Application (JARPA) Form[1,2]

USE BLACK OR BLUE INK TO ENTER ANSWERS IN THE WHITE SPACES BELOW.

Part 1–Project Identification

1. Project Name (A name for your project that you create. Examples: Smith's Dock or Seabrook Lane Development) [help]

Part 2–Applicant

The person and/or organization responsible for the project. [help]

2a. Name (Last, First, Middle)			
2b. Organization (If applicable)			
2c. Mailing Address (Street or PO Box)			
2d. City, State, Zip			
2e. Phone (1)	**2f.** Phone (2)	**2g.** Fax	**2h.** E-mail
( )	( )	( )	

[1]Additional forms may be required for the following permits:

- If your project may qualify for Department of the Army authorization through a Regional General Permit (RGP), contact the U.S. Army Corps of Engineers for application information (206) 764-3495.
- If your project might affect species listed under the Endangered Species Act, you will need to fill out a Specific Project Information Form (SPIF) or prepare a Biological Evaluation. Forms can be found at http://www.nws.usace.army.mil/Missions/CivilWorks/Regulatory/PermitGuidebook/EndangeredSpecies.aspx.
- Not all cities and counties accept the JARPA for their local Shoreline permits. If you need a Shoreline permit, contact the appropriate city or county government to make sure they accept the JARPA.

[2]To access an online JARPA form with [help] screens, go to http://www.epermitting.wa.gov/site/alias__resourcecenter/jarpa_jarpa_form/9984/jarpa_form.aspx.

For other help, contact the Governor's Office for Regulatory Innovation and Assistance at (800) 917-0043 or help@ora.wa.gov.

Part 3–Authorized Agent or Contact

Person authorized to represent the applicant about the project. (Note: Authorized agent(s) must sign 11b of this application.) [help]

3a. Name (Last, First, Middle)			
3b. Organization (If applicable)			
3c. Mailing Address (Street or PO Box)			
3d. City, State, Zip			
3e. Phone (1)	**3f.** Phone (2)	**3g.** Fax	**3h.** E-mail
( )	( )	( )	

Part 4–Property Owner(s)

Contact information for people or organizations owning the property(ies) where the project will occur. Consider both **upland and aquatic** ownership because the upland owners may not own the adjacent aquatic land. [help]

☐ Same as applicant. (Skip to Part 5.)

☐ Repair or maintenance activities on existing rights-of-way or easements. (Skip to Part 5.)

☐ There are multiple upland property owners. Complete the section below and fill out JARPA Attachment A for each additional property owner.

☐ Your project is on Department of Natural Resources (DNR)-managed aquatic lands. If you don't know, contact the DNR at (360) 902-1100 to determine aquatic land ownership. If yes, complete JARPA Attachment E to apply for the Aquatic Use Authorization.

4a. Name (Last, First, Middle)			
4b. Organization (If applicable)			
4c. Mailing Address (Street or PO Box)			
4d. City, State, Zip			
4e. Phone (1)	**4f.** Phone (2)	**4g.** Fax	**4h.** E-mail
( )	( )	( )	

Part 5–Project Location(s)

Identifying information about the property or properties where the project will occur. [help]

☐ There are multiple project locations (e.g. linear projects). Complete the section below and use JARPA Attachment B for each additional project location.

5a. Indicate the type of ownership of the property. (Check all that apply.) [help]

☐ Private
☐ Federal
☐ Publicly owned (state, county, city, special districts like schools, ports, etc.)
☐ Tribal
☐ Department of Natural Resources (DNR) – managed aquatic lands (Complete JARPA Attachment E)

5b. Street Address (Cannot be a PO Box. If there is no address, provide other location information in 5p.) [help]

5c. City, State, Zip (If the project is not in a city or town, provide the name of the nearest city or town.) [help]

5d. County [help]

5e. Provide the section, township, and range for the project location. [help]

¼ Section	Section	Township	Range

5f. Provide the latitude and longitude of the project location. [help]

- Example: 47.03922 N lat. / -122.89142 W long. (Use decimal degrees - NAD 83)

5g. List the tax parcel number(s) for the project location. [help]

- The local county assessor's office can provide this information.

5h. Contact information for all adjoining property owners. (If you need more space, use JARPA Attachment C.) [help]

Name	Mailing Address	Tax Parcel # (if known)

5i. List all wetlands on or adjacent to the project location. [help]

5j. List all waterbodies (other than wetlands) on or adjacent to the project location. [help]

5k. Is any part of the project area within a 100-year floodplain? [help]

☐ Yes ☐ No ☐ Don't know

5l. Briefly describe the vegetation and habitat conditions on the property. [help]

5m. Describe how the property is currently used. [help]

5n. Describe how the adjacent properties are currently used. [help]

5o. Describe the structures (above and below ground) on the property, including their purpose(s) and current condition. [help]

5p. Provide driving directions from the closest highway to the project location, and attach a map. [help]

Part 6–Project Description

6a. Briefly summarize the overall project. You can provide more detail in 6b. [help]

6b. Describe the purpose of the project and why you want or need to perform it. [help]

6c. Indicate the project category. (Check all that apply) [help]

- ☐ Commercial
- ☐ Residential
- ☐ Institutional
- ☐ Transportation
- ☐ Recreational
- ☐ Maintenance
- ☐ Environmental Enhancement

6d. Indicate the major elements of your project. (Check all that apply) [help]

☐ Aquaculture	☐ Culvert	☐ Float	☐ Retaining Wall (upland)
☐ Bank Stabilization	☐ Dam / Weir	☐ Floating Home	☐ Road
☐ Boat House	☐ Dike / Levee / Jetty	☐ Geotechnical Survey	☐ Scientific Measurement Device
☐ Boat Launch	☐ Ditch	☐ Land Clearing	☐ Stairs
☐ Boat Lift	☐ Dock / Pier	☐ Marina / Moorage	☐ Stormwater facility
☐ Bridge	☐ Dredging	☐ Mining	☐ Swimming Pool
☐ Bulkhead	☐ Fence	☐ Outfall Structure	☐ Utility Line
☐ Buoy	☐ Ferry Terminal	☐ Piling/Dolphin	
☐ Channel Modification	☐ Fishway	☐ Raft	

☐ Other:

6e. Describe how you plan to construct each project element checked in 6d. Include specific construction methods and equipment to be used. [help]

- Identify where each element will occur in relation to the nearest waterbody.
- Indicate which activities are within the 100-year floodplain.

6f. What are the anticipated start and end dates for project construction? (Month/Year) [help]

- If the project will be constructed in phases or stages, use JARPA Attachment D to list the start and end dates of each phase or stage.

Start date:________________ End date:________________ ☐ See JARPA Attachment D

6g. Fair market value of the project, including materials, labor, machine rentals, etc. [help]

6h. Will any portion of the project receive federal funding? [help]

- **If yes**, list each agency providing funds.

☐ Yes ☐ No ☐ Don't know

Part 7–Wetlands: Impacts and Mitigation

☐ Check here if there are wetlands or wetland buffers on or adjacent to the project area.
(If there are none, skip to Part 8.) [help]

7a. Describe how the project has been designed to avoid and minimize adverse impacts to wetlands. [help]

☐ Not applicable

7b. Will the project impact wetlands? [help]

☐ Yes ☐ No ☐ Don't know

7c. Will the project impact wetland buffers? [help]

☐ Yes ☐ No ☐ Don't know

7d. Has a wetland delineation report been prepared? [help]

- **If Yes**, submit the report, including data sheets, with the JARPA package.

☐ Yes ☐ No

7e. Have the wetlands been rated using the Western Washington or Eastern Washington Wetland Rating System? [help]

- **If Yes**, submit the wetland rating forms and figures with the JARPA package.

☐ Yes ☐ No ☐ Don't know

7f. Have you prepared a mitigation plan to compensate for any adverse impacts to wetlands? [help]

- **If Yes**, submit the plan with the JARPA package and answer 7g.
- **If No, or Not applicable**, explain below why a mitigation plan should not be required.

☐ Yes ☐ No ☐ Not applicable

7g. Summarize what the mitigation plan is meant to accomplish, and describe how a watershed approach was used to design the plan. [help]

7h. Use the table below to list the type and rating of each wetland impacted, the extent and duration of the impact, and the type and amount of mitigation proposed. Or if you are submitting a mitigation plan with a similar table, you can state (below) where we can find this information in the plan. [help]

Activity (fill, drain, excavate, flood, etc.)	Wetland Name[1]	Wetland type and rating category[2]	Impact area (sq. ft. or Acres)	Duration of impact[3]	Proposed mitigation type[4]	Wetland mitigation area (sq. ft. or acres)

[1] If no official name for the wetland exists, create a unique name (such as "Wetland 1"). The name should be consistent with other project documents, such as a wetland delineation report.
[2] Ecology wetland category based on current Western Washington or Eastern Washington Wetland Rating System. Provide the wetland rating forms with the JARPA package.
[3] Indicate the days, months or years the wetland will be measurably impacted by the activity. Enter "permanent" if applicable.
[4] Creation (C), Re-establishment/Rehabilitation (R), Enhancement (E), Preservation (P), Mitigation Bank/In-lieu fee (B)

Page number(s) for similar information in the mitigation plan, if available: ____________________________

7i. For all filling activities identified in 7h, describe the source and nature of the fill material, the amount in cubic yards that will be used, and how and where it will be placed into the wetland. [help]

7j. For all excavating activities identified in 7h, describe the excavation method, type and amount of material in cubic yards you will remove, and where the material will be disposed. [help]

Part 8–Waterbodies (other than wetlands): Impacts and Mitigation

In Part 8, "waterbodies" refers to non-wetland waterbodies. (See Part 7 for information related to wetlands.) [help]

☐ Check here if there are waterbodies on or adjacent to the project area. (If there are none, skip to Part 9.)

8a. Describe how the project is designed to avoid and minimize adverse impacts to the aquatic environment. [help]
☐ Not applicable
8b. Will your project impact a waterbody or the area around a waterbody? [help]
☐ Yes ☐ No

8c. Have you prepared a mitigation plan to compensate for the project's adverse impacts to non-wetland waterbodies? [help]

- **If Yes**, submit the plan with the JARPA package and answer 8d.
- **If No, or Not applicable,** explain below why a mitigation plan should not be required.

☐ Yes ☐ No ☐ Not applicable

8d. Summarize what the mitigation plan is meant to accomplish. Describe how a watershed approach was used to design the plan.

- If you already completed 7g you do not need to restate your answer here. [help]

8e. Summarize impact(s) to each waterbody in the table below. [help]

Activity (clear, dredge, fill, pile drive, etc.)	Waterbody name[1]	Impact location[2]	Duration of impact[3]	Amount of material (cubic yards) to be placed in or removed from waterbody	Area (sq. ft. or linear ft.) of waterbody directly affected

[1] If no official name for the waterbody exists, create a unique name (such as "Stream 1") The name should be consistent with other documents provided.
[2] Indicate whether the impact will occur in or adjacent to the waterbody. If adjacent, provide the distance between the impact and the waterbody and indicate whether the impact will occur within the 100-year flood plain.
[3] Indicate the days, months or years the waterbody will be measurably impacted by the work. Enter "permanent" if applicable.

8f. For all activities identified in 8e, describe the source and nature of the fill material, amount (in cubic yards) you will use, and how and where it will be placed into the waterbody. [help]

8g. For all excavating or dredging activities identified in 8e, describe the method for excavating or dredging, type and amount of material you will remove, and where the material will be disposed. [help]

Part 9–Additional Information

Any additional information you can provide helps the reviewer(s) understand your project. Complete as much of this section as you can. It is ok if you cannot answer a question.

9a. If you have already worked with any government agencies on this project, list them below. [help]

Agency Name	Contact Name	Phone	Most Recent Date of Contact
		( )	
		( )	
		( )	

9b. Are any of the wetlands or waterbodies identified in Part 7 or Part 8 of this JARPA on the Washington Department of Ecology's 303(d) List? [help]

- **If Yes,** list the parameter(s) below.
- If you don't know, use Washington Department of Ecology's Water Quality Assessment tools at: http://www.ecy.wa.gov/programs/wq/303d/.

☐ Yes ☐ No

9c. What U.S. Geological Survey Hydrological Unit Code (HUC) is the project in? [help]

- Go to http://cfpub.epa.gov/surf/locate/index.cfm to help identify the HUC.

9d. What Water Resource Inventory Area Number (WRIA #) is the project in? [help]

- Go to http://www.ecy.wa.gov/services/gis/maps/wria/wria.htm to find the WRIA #.

9e. Will the in-water construction work comply with the State of Washington water quality standards for turbidity? [help]

- Go to http://www.ecy.wa.gov/programs/wq/swqs/criteria.html for the standards.

☐ Yes ☐ No ☐ Not applicable

9f. If the project is within the jurisdiction of the Shoreline Management Act, what is the local shoreline environment designation? [help]

- If you don't know, contact the local planning department.
- For more information, go to: http://www.ecy.wa.gov/programs/sea/sma/laws_rules/173-26/211_designations.html.

☐ Rural ☐ Urban ☐ Natural ☐ Aquatic ☐ Conservancy ☐ Other ________________

9g. What is the Washington Department of Natural Resources Water Type? [help]

- Go to http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesApplications/Pages/fp_watertyping.aspx for the Forest Practices Water Typing System.

☐ Shoreline ☐ Fish ☐ Non-Fish Perennial ☐ Non-Fish Seasonal

9h. Will this project be designed to meet the Washington Department of Ecology's most current stormwater manual? [help]

- **If No**, provide the name of the manual your project is designed to meet.

☐ Yes ☐ No

Name of manual:

9i. Does the project site have known contaminated sediment? [help]

- **If Yes**, please describe below.

☐ Yes ☐ No

9j. If you know what the property was used for in the past, describe below. [help]

9k. Has a cultural resource (archaeological) survey been performed on the project area? [help]

- **If Yes**, attach it to your JARPA package.

☐ Yes ☐ No

9l. Name each species listed under the federal Endangered Species Act that occurs in the vicinity of the project area or might be affected by the proposed work. [help]

9m. Name each species or habitat on the Washington Department of Fish and Wildlife's Priority Habitats and Species List that might be affected by the proposed work. [help]

Part 10–SEPA Compliance and Permits

Use the resources and checklist below to identify the permits you are applying for.

- Online Project Questionnaire at http://apps.ecy.wa.gov/opas/.
- Governor's Office for Regulatory Innovation and Assistance at (800) 917-0043 or help@ora.wa.gov.
- For a list of addresses to send your JARPA to, click on agency addresses for completed JARPA.

10a. Compliance with the State Environmental Policy Act (SEPA). (Check all that apply.) [help] • For more information about SEPA, go to www.ecy.wa.gov/programs/sea/sepa/e-review.html.
☐ A copy of the SEPA determination or letter of exemption is included with this application.
☐ A SEPA determination is pending with _______________ (lead agency). The expected decision date is ____________.
☐ I am applying for a Fish Habitat Enhancement Exemption. (Check the box below in 10b.) [help]
☐ This project is exempt (choose type of exemption below). ☐ Categorical Exemption. Under what section of the SEPA administrative code (WAC) is it exempt? ____ ☐ Other: ____
☐ SEPA is pre-empted by federal law.

10b. Indicate the permits you are applying for. (Check all that apply.) [help]

LOCAL GOVERNMENT

Local Government Shoreline permits:

☐ Substantial Development ☐ Conditional Use ☐ Variance

☐ Shoreline Exemption Type (explain): ______________________________

Other City/County permits:

☐ Floodplain Development Permit ☐ Critical Areas Ordinance

STATE GOVERNMENT

Washington Department of Fish and Wildlife:

☐ Hydraulic Project Approval (HPA) ☐ Fish Habitat Enhancement Exemption – Attach Exemption Form

http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=Home_Page

Effective July 10, 2012, you must submit a check for $150 to Washington Department of Fish and Wildlife, unless your project qualifies for an exemption or alternative payment method below. **Do not send cash.**

Check the appropriate boxes:

☐ $150 check enclosed. Check #______________________________
Attach check made payable to Washington Department of Fish and Wildlife.

☐ My project is exempt from the application fee. (Check appropriate exemption)______________________

- ☐ HPA processing is conducted by applicant-funded WDFW staff.
  Agreement #______________________
- ☐ Mineral prospecting and mining.
- ☐ Project occurs on farm and agricultural land.
  (Attach a copy of current land use classification recorded with the county auditor, or other proof of current land use.)
- ☐ Project is a modification of an existing HPA originally applied for, prior to July 10, 2012.
  HPA #______________________

Washington Department of Natural Resources:

☐ Aquatic Use Authorization

Complete JARPA Attachment E and submit a check for $25 payable to the Washington Department of Natural Resources. **Do not send cash.**

Washington Department of Ecology:

☐ Section 401 Water Quality Certification

FEDERAL GOVERNMENT

United States Department of the Army permits (U.S. Army Corps of Engineers):

☐ Section 404 (discharges into waters of the U.S.) ☐ Section 10 (work in navigable waters)

United States Coast Guard permits:

☐ Private Aids to Navigation (for non-bridge projects)

Part 11–Authorizing Signatures

Signatures are required before submitting the JARPA package. The JARPA package includes the JARPA form, project plans, photos, etc. [help]

11a. Applicant Signature (required) [help]

I certify that to the best of my knowledge and belief, the information provided in this application is true, complete, and accurate. I also certify that I have the authority to carry out the proposed activities, and I agree to start work only after I have received all necessary permits.

I hereby authorize the agent named in Part 3 of this application to act on my behalf in matters related to this application. _________ (initial)

By initialing here, I state that I have the authority to grant access to the property. I also give my consent to the permitting agencies entering the property where the project is located to inspect the project site or any work related to the project. _________ (initial)

Applicant Printed Name	Applicant Signature	Date

11b. Authorized Agent Signature [help]

I certify that to the best of my knowledge and belief, the information provided in this application is true, complete, and accurate. I also certify that I have the authority to carry out the proposed activities and I agree to start work only after all necessary permits have been issued.

Authorized Agent Printed Name	Authorized Agent Signature	Date

11c. Property Owner Signature (if not applicant) [help]
Not required if project is on existing rights-of-way or easements.

I consent to the permitting agencies entering the property where the project is located to inspect the project site or any work. These inspections shall occur at reasonable times and, if practical, with prior notice to the landowner.

Property Owner Printed Name	Property Owner Signature	Date

18 U.S.C §1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious, or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious, or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than 5 years or both.

If you require this document in another format, contact the Governor's Office for Regulatory Innovation and Assistance (ORIA) at (800) 917-0043. People with hearing loss can call 711 for Washington Relay Service. People with a speech disability can call (877) 833-6341.
ORIA publication number: ENV-019-09 rev. 08/2013

APPENDIX D— POTLINER WASTE DEFINITION AND RECOGNITION MEMORANDUM

DEFINITION AND RECOGNITION OF SPENT POTLINER
LMC - Goldendale, WA Site

Molten aluminum is produced in electrolytic reduction cells or "pots" which contain an anode and cathode (**Figure 1**). Although pot configuration varies among smelters, the illustration in **Figure 1** for Northwest Aluminum (The Dalles, OR) is consistent with what was used at Columbia Aluminum (Goldendale, WA). At full capacity, up to 500 pots, approximately 15′ x 30′ each, could have been in service at the Goldendale operation. At full operating capacity the Goldendale plant produced 185,000 short tons primary aluminum metal annually and generated between 4,000 and 10,000 tons per year of "spent potliner".[1]

Excerpt from 1992 RCRA Part B Permit Application[2]:

> "Spent Potliner (SPL) is produced during the demolition of the cathode portion of the cell. The cathode forms the bottom of the cell and consists of a steel outer shell lined with a layer of refractory brick insulation followed by a layer of carbon block. The cathode is formed in a bowl shape to contain molten bath and metal while acting as the cathode in the reduction cell. During the life of a reduction cell, typically 6.5 years, the lining is slowly eroded by the physical and chemical action of the molten metal and bath. Eventually, the lining becomes too thin to perform satisfactorily and the cathode must be removed and rebuilt. When a cathode is removed from a cell, it is cooled, the carbon and refractory liner is broken with jackhammers and removed from the steel shell with a backhoe. The broken carbon block is termed SPL and is a listed hazardous waste (K088). Although the refractory is technically not a listed hazardous waste, it is difficult to completely separate the carbon from the refractory brick, so Columbia Aluminum manages both materials as hazardous waste."

SPL can be visually recognized in the field by experienced personnel with "generator knowledge" of the specific operations. The materials shown in **Figure 2** were tentatively identified as SPL by Wayne Wooster, a former environmental staff person at Goldendale from 1993 to 2005, and a former Washington state regulator for other

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[1] Correspondence and meetings with Wayne Wooster, July-October 2010.

[2] Columbia Aluminum Corporation RCRA Part B Permit Application, prepared by ENSR and submitted to Washington Department of Ecology, April 19, 1992

aluminum sites. Additional identification of SPL was done in conjunction with Galen May, also a long term employee at the aluminum plant. After years of use at high temperature within the aluminum pot, the spent carbon is a dull black, massive material. It may or may not have small voids and/or salt deposits on exterior surfaces. SPL can be distinguished from the basalt rocks at the Goldendale site by use of a pick-hammer (**Figure 3**). When stuck with a hammer, basalt has a sharp, ringing tone, whereas carbon from SPL has a dull thud. In addition, carbon from SPL more readily breaks when struck with a hammer than basalt. SPL that is fused with refractory brick material (e.g., **Figure 4**) is relatively easy to recognize in the field. Carbon from SPL that is not fused with refractory material is more difficult to recognize in the field, and should not be confused with other carbon wastes generated by the aluminum process[3]. SPL superficially resembles basalt, a locally abundant natural material. Figures 4 through 10 show examples of SPL identified in the field.

Characteristics of SPL that are not typically found in the non-hazardous carbon wastes, that area occasionally to commonly observed in SPL include:

- Carbon material in contact with red fire brick (**Figures 3 and 5**)
- Carbon material with crystalline structures visible (**Figures 6, 8a/b, and 9**)
- Color in the blue – gray tonal range (**Figures 6 and 10**)
- Moderate to extensive white to gray-white salt efflorescence on surface, in contrast to the anode wastes, which have limited to no salts visible (**Figures 4,5,6,7 and 10**)

If visual indicators are not clear, it may be possible to distinguish SPL from other forms of carbon waste generated at Goldendale based on chemical composition. **Table 1** illustrates the reported composition of SPL at Goldendale in contrast to industry ranges. These composition ranges may also be helpful in assessing SPL residuals remaining in soil after cleanup. The most diagnostic characteristic of SPL, as opposed to other carbon containing materials is the presence of high sodium content. According to Galen May,

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[3] Carbon waste from anode production, possibly in an irregular "briquette" form, can also be observed at the site, in addition to coal tar pitch and miscellaneous carbon powders and granules. The pitch and briquette materials generally have a glossy appearance distinctly different than SPL. The anode materials are very similar to SPL carbon, but have either little or no salt deposits and do not exhibit recrystalizaiton or blue-gray colors. Carbon rod remnants, occasionally present in anote waste, is never found in SPL carbon.

the diffusion of sodium into the pot liner was one of the principal reasons for pot failure.

It is worthy to note that cyanide composition in Goldendale SPL is reportedly much lower than the industry norm. EPA's basis for hazardous waste listing of SPL is cyanide, and the risk of cyanide mobilization to groundwater. The relatively low (reported) cyanide content of SPL at Goldendale, and the relatively dry conditions (10 inches annual average rainfall[4]) may factor into the remaining remediation strategy.

[4] Long-term precipitation records at the John Day Dam on Columbia River; http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wajohn

Table 1
Spent Potliner Composition
(Compilation of Tables 3-1 and 3-2 from 1992 RCRA Permit Application)

Parameters	*Industry Reported Ranges (%)* [1]	*Columbia Aluminum* [2] *@ Goldendale*
Fluoride	7.5 - 22	24
Aluminum – Total	7- 22.2	16
Sodium	8.6 – 22	15
Carbon – Total	13 – 69	13
Alumina	9.2 – 26	NR
CN	0.04 – 0.6	0.009
SiO_2 (as Si)	0.7 – 10.9	20
Fe_2O_3 (as Fe)	0.3 – 2.8	1
Ca	0.5 – 6.4	4.5
SO_4	0.1 – 0.6	NR
S	0.1 – 0.18	NR
Mg	0.01 – 0.17	NR
Li	0.46 – 0.57	NR
P	0.005 – 0.03	NR
Mn	0.02	NR

1 - Source: Spent Potlining Workshop, the Aluminum Association, Inc., December 3 and 4, 1981; Table 3-1 in 1992 RCRA Permit Application.

2 - Source: Martin Marietta Laboratories, October 20, 1978. Table 3-2 in 1992 RCRA Permit Application

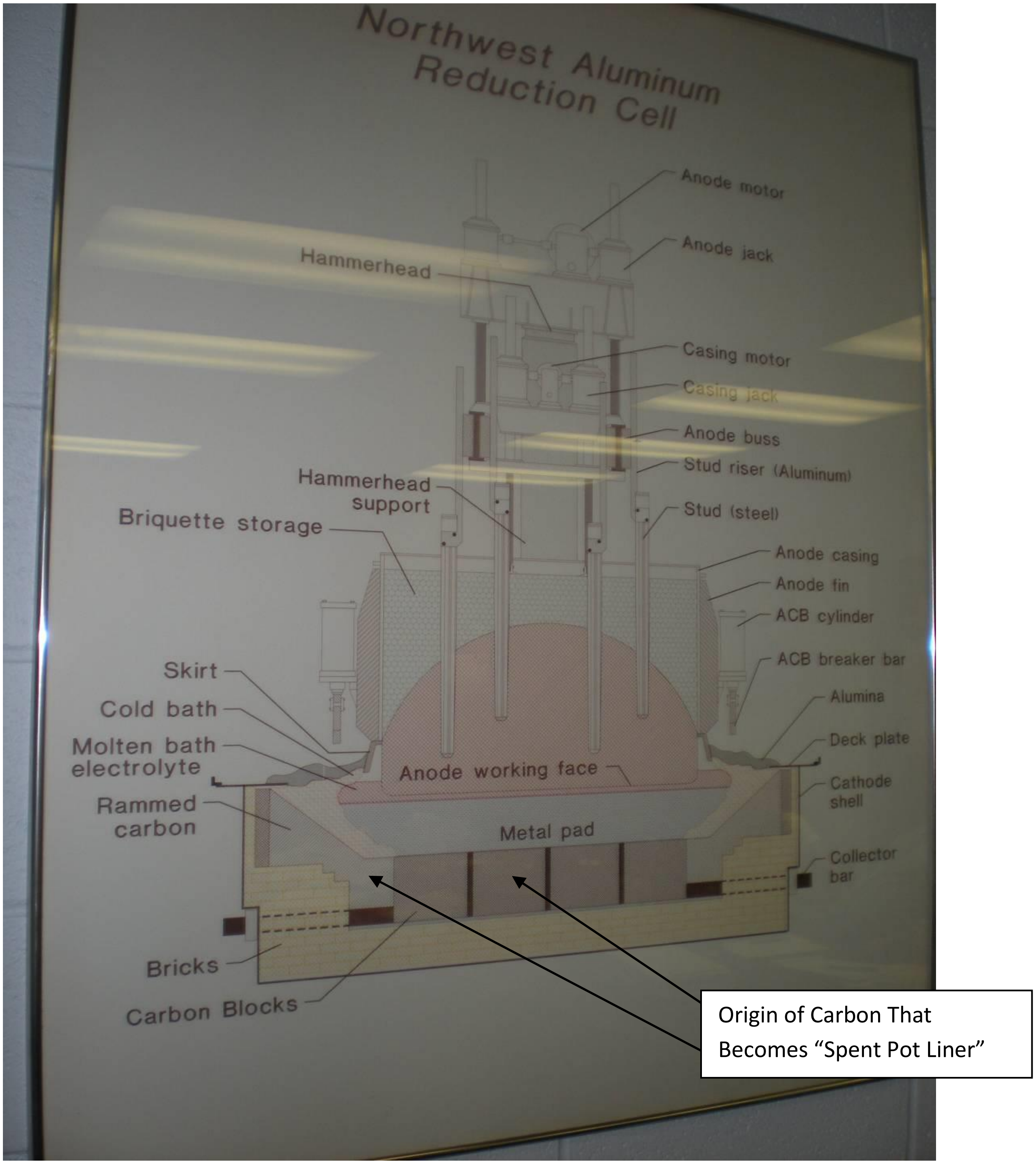

Figure 1 – Diagram of Reduction Cell Used at Northwest Aluminum (The Dalles, OR) and Columbia Aluminum (Goldendale, WA)

Figure 2 – Tentatively Identified Spent Potliner Examples Discovered at "Smelter Sign Area" – July 2010.

[material Identification confirmed by Wayne Wooster, former EHS staff at Goldendale]

Figure 3 – Bill Bath Using Hammer Test on Tentatively Identified Spent Potliner at Goldendale – July 2010.

(Note: salts impregnated into carbon potliner material; aluminum sheet to left;

Figure 4 – SPL in interstices of fire brick, shows white salt deposits

Figure 5 – SPL showing characteristic extensive white salt deposits

Figure 6 – SPL showing white salt deposits, gray-blue cast and recrystalization

Figure 7 – Large intact piece of SPL showing characteristic white salt deposits

Figure 8 a and b – Characteristic recrystalization in SPL

Figure 9 – SPL with recrystalization and vugs

Figure 10 – SPL showing blue gray color and salt deposits